MAHATMA GANDHI UNIVERSITY

INTEGRATED M.Sc PROGRAMME IN BASIC SCIENCES – PHYSICS

PROGRAMME STRUCTURE AND SYLLABUS

PROGRAMME STRUCTURE

SEMESTER	Sl. No.	CODE	TITLE	HOURS WEEK	THEORY/PRACTICAL	CREDITS	TOTAL HOURS
	1	IEN1CC01	English I-Communication Skills in English	5	T	4	90
	2	IPH1CR02	Mechanics and Properties of Matter	4	T	3	72
	3	IPH1CR03	Semiconductor Physics	4	T	3	72
	4	IPH1CR04	Thermal Physics	2	T	2	36
	5	IPH1CM05	Mathematics - I Differential Calculus, Matrices andTrigonometry	4	T	3	72
	6	IPH1CM06	Chemistry – I Basic Concepts in Chemistry	2	T	2	36
	7	IPH1CP07	Physics Practical - 1	2	P	2	36
	8	IPH1CMP08	Chemistry Practical - 1	2	P		36
			TOTAL	25		19	450
II	1	IML2CC01/1HN2CC01	SECOND LANGUAGE	5	T	4	90
	2	IPH2CR02	Physical Optics	4	T	3	72
	3	IPH2CR03	Digital Electronics and Communication	3	T	3	54
	4	IPH2CR04	Electrostatics and Magnetostatics	2	T	2	36
	5	IPH2CM05	Mathematics – II Integral Calculus and Fourier Series	4	T	3	72
	6	IPH2CM06	Chemistry – II Fundamentals of Organic Chemistry	2	T	2	36
	7	IPH2CP07	Physics Practical - II	2	P	2	36
	8	IPH2CMP08	Chemistry Practical - I	2	P	2	36
	9	IPHAUT1/2/3/4/5/6/7	AUDIT COURSE I	1	T		18
			TOTAL	25		21	450
III	1	IPH3CR01	Classical Physics - 1	3	T	3	54
	2	IPH3CR02	Quantum Mechanics - 1	4	T	3	54
	3	IPH3CR03	Astronomy & Astrophysics	3	T	2	54
	4	IPH3CM04	Mathematics – III Differential Equations and Vector Calculus	5	T	4	90

	5	IPH3CM05	Chemistry – III Fundamentals of Physical Chemistry	3	T	3	54
	6	IPH3CP06	Physics Practical - III	2	P	2	36
	7	IPH3CP07	Physics Practical -IV	2	P	2	36
	8	IPH3CMP08	Chemistry Practical - II	2	P		36
	9	IPHAUT1/2/3/4/5/6/7	AUDIT COURSE II	1	T	0	36
			TOTAL	25		19	450
IV	1	IEN4CC01	English II-English Language Skills for Academic Purposes	5	T	4	90
	2	IPH4CR02	Statistical Mechanics - 1	3	T	2	54
	3	IPH4CR03	Electrodynamics - 1	3	T	2	54
	4	IPH4CM04	Mathematics – IV Special Functions, Laplace Transforms and Complex Analysis	5	T	4	90
	5	IPH4CM05	Chemistry – IV Concepts of Physical Chemistry	3	T	3	54
	6	IPH4CP06	Physics Practical - V	2	P	2	36
	7	IPH4CP07	Physics Practical - VI	2	P	2	36
	8	IPH4CMP08	Chemistry Practical - II	2	P	2	36
			TOTAL	25		21	450
V	1	IPH5CR01	Environmental Physics & Human Rights	4	T	4	72
	2	IPH5CR02	Atomic and Molecular Physics — I	3	T	3	54
	3	IPH5CR03	Nuclear Physics - 1	4	T	3	72
	4	IPH5CR04	Solid State Physics	3	T	2	54
	5	IPH5CR05	Linear Integrated Circuits	3	T	2	54
	6	IPH5CP06	Physics Practical - VII	2	P	2	36
	7	IPH5CP07	Physics Practical - VIII	2	P	2	36
	8	IPH5CP08	Physics Practical - IX	2	P	2	36
	9	IPHAUT1/2/3/4/5/6/7	AUDIT COURSE III	2	T	0	36
			TOTAL	25		20	450
VI	1	IPH6CR01	Mathematical Physics-I	4	T	2	72
	2	IPH6CR02	Numerical Analysis	3	T	2	54
	3	IPH6CR03	Statistical Mechanics-II	3	T	2	54
	4	IPH6CR04	Particle Physics	3	T	2	54
	5	IPH6ELA1/IPH6ELA2	ELECTIVEI	4	T	4	72
	6	IPH6CP05	Physics Practical - X	2	P	2	36

	7	IPH6CP06	Physics Practical - XI	2	P	2	36
	8	IPH6CP07	Physics Practical - XII	2	P	2	36
	9	IPH6PR08	PROJECT - MINOR			2	0
	10	IPHAUT1/2/3/4/5/6/7	AUDIT COURSE IV	2	T	0	36
			TOTAL	25		20	450
VII	1	IPH7CR01	Classical Physics-II	4	T	4	72
	2	IPH7CR02	Condensed Matter Physics	3	T	3	54
	3	IPH7CR03	Atomic and MolecularPhysics-II	3	T	3	54
	4	IPH7CR04	Mathematical Physics - II	3	T	3	54
	5	IPH7CR05	Computational Physics	3	T	3	54
	6	IPH7CP06	CORE PRACTICAL XIII	4	P	2	72
	7	IPH7CP07	CORE PRACTICAL XIV	4	P	2	72
	8	IPHAUT1/2/3/4/5/6/7	AUDIT COURSE V	1	T	0	18
			TOTAL	25		20	450
VIII	1	IPH8CR01	Laser and Nonlinear Optics	3	T	3	54
	2	IPH8CR02	Quantum Mechanics-II	3	T	3	54
	3	IPH8CR03	Electrodynamics - II and Plasma Physics	3	T	3	54
	4	IPH8CR04	Nuclear Physics - II	3	T	3	54
	5	IPH8ELB1/IPH8ELB2	ELECTIVE II	4	T	4	72
	6	IPH8CP05	CORE PRACTICAL XV	4	P	2	72
	7	IPH8CP06	CORE PRACTICAL XVI	4	P	2	72
	8	IPHAUT1/2/3/4/5/6/7	AUDIT COURSE VI	1	T	0	18
			TOTAL	25		20	450
IX	1	IPH9CR01	Research Methodology in Physics	3	T	3	54
	2	IPH9CR02	Advanced Quantum Physics	3	T	3	54
	3	IPH9ELC1/IPH9ELC2	ELECTIVE III	4	T	4	54
	4	IPH9ELD1/IPH9ELD2	ELECTIVE IV	3	T	3	54
	5	IPH9ELE1/IPH9ELE2	ELECTIVE V	3	T	3	72
	6	IPH9CP03	CORE PRACTICAL XVII	4	P	2	72
	7	IPH9CP04	CORE PRACTICAL XVIII	4	P	2	72
	8	IPHAUT1/2/3/4/5/6/7	AUDIT COURSE VII	1	T	0	18
			TOTAL	25		20	450
X	1	IPHXPR01	PROJECT - MAJOR			16	

	2	IPHXVV02	COMPREHENSIVE VIVA VOCE			4	
			TOTAL			20	

ELECTIVES

SEMESTER VI

ELECTIVE I - BUNCH A

Any one of the courses in this bunch shall be selected as Elective I

Sl. No	Course Code	Course Title	Credit	Hours/week
1	IPH6ELA1	Physics of Nano Materials	4	4
2	IPH6ELA2	Nonlinear Dynamics		

SEMESTER VIII

ELECTIVE II - BUNCH B

Any one of the courses in this bunch shall be selected as Elective II

Sl. No	Course Code	Course Title	Credit	Hours/week
1	IPH8ELB1	Characterisation of Nano Materials	4	4
2	IPH8ELB2	Quantum Field Theory		

SEMESTER IX

ELECTIVE III - BUNCH C

Any one of the courses in this bunch shall be selected as Elective III

Sl. No	Course Code	Course Title	Credit	Hours/week
1	IPH9ELC1	Advanced Materials Science	4	4
2	IPH9ELC2	Advanced Quantum Field Theory		

ELECTIVE IV - BUNCH D

Any one of the courses in this bunch shall be selected as Elective IV

Sl. No	Course Code	Course Title	Credit	Hours/week
1	IPH9ELD1	Advanced Semiconductor Physics	3	3
2	IPH9ELD2	General Relativity		

ELECTIVE V - BUNCH E

Any one of the courses in this bunch shall be selected as Elective V

Sl. No	Course Code	Course Title	Credit	Hours/week
1	IPH9ELE1	Nano Optics and Nano Photonics	3	3
2	IPH9ELE2	Cosmology		

AVAILABLE AUDIT COURSES

Audit courses are evaluated internally. Any one of these courses shall be selected as Audit course. One course cannot be selected for more than one semester.

No credits are given for Audit courses.

Sl. No	Course Code	**Course Title**	Hours/week
1	IPHAUT1	Virtual Lab	1
2	IPHAUT2	Computer Aided Design	1
3	IPHAUT3	Energy Audit Course	2
4	IPHAUT4	Python Programming	2
5	IPHAUTS	Course on LaTex	1
6	IPHAUT6	MATLAB Programming	1
7	IPHAUT7	Research Paper Writing	1

SYLLABUS

SEMESTER 1

Core 1: IPH1CR02 - Mechanics and Properties of Matter

Credit 3 (72 hours)

Module I

Unit-1: Error analysis (10 hours)

Least count of instruments, 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.

Unit 2 — **Vector analysis (15 hours)**

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, cylindrical coordinates (Basic ideas with examples in physics)

Module -II

Unit 1: Rotational mechanics (12 Hours)

Angular momentum of a particle and system of particles.Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of

rotation. Motion involving both translation and rotation. Theory of flywheel.

Unit 2: Elasticity (8 hours)

Elasticity — Relation between Elastic constants, Young's modulus — uniform and non-uniform bending, cantilever. Determination of rigidity modulus - static torsion and torsion pendulum.

Module III

Hydrodynamics (12 hours)

Coefficient of Viscosity — Determination of viscosity by Poiseuille's method. Equation of continuity, energy possessed by a liquid, Bernoulli's theorem, Torricelli's theorem, Critical Velocity, Significance of reynold's number. Stoke's method of coefficient of viscosity. Surface tension, surface energy, excess pressure in a liquid drop and bubble, factors affecting surface tension, applications.

Module IV

Oscillations and Waves (15 hours)

Unit-1 (Oscillations): SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Simple and compound pendulum. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

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

Text book:

(a) Module: I

Unit - I

1. Advanced course in Practical Physics by D Chattopadhyay- Chapter-1
2. Practical Physics, G L Squires, Third edn. Cambridge University Press.

Unit — II

Introduction to Electrodynamics, David J. Griffiths, Prentice Hall India Pvt. Ltd., Chapter 1

(b) Module-II

1. Fundamentals of Physics by Halliday (Author), Resnick (Author), Walker. Wiley India Pvt Ltd; Sixth edition (20 June 2006)
2. Mechanics by D.S. Mathur

(c) Module -III

Mechanics by D.S. Mathur

(d) Module -IV

1.Mechanics by D.S. Mathur

2.Properties of Matter and Acoustics by R.Murugeshan & Kiruthiga Sivaprasath)

References

1. The theory of Errors in Physical Measurements- J C Pal- New Central Book Agency- 2010
2. Experimental Measurements: Precision, Error and Truth Hardcover by N C Barford—9 October 1985
3. Mechanics- Hans and Puri, TMH
4. Classical Mechanics by J.C. Upadhyaya, Himalaya Pub.
5. Classical Mechanics-Takwale and Puranik, TMH.
6. Classical mechanics- K.SankaraRao, PHI.
7. Properties of Matter by D.S.Mathur, S. Chand,
8. Mechanics by Somnath Datta, Pearson
9. Mechanics by H.D Young and R.A Freedman, Pearson.
10. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.

Core2:IPH1CR03 - Semiconductor Physics
Credit 3 (72hours)

Module I

Electronic Components (10 hours)

Resistors- Resistor Types — Fixed and Variable-Resistor Colour code. Inductors-Inductance of an Inductor—Mutual Inductance-Coefficient of Coupling — Energy stored — Reactance — Impedance — Q factor —Capacitors- Capacitance — Factors controlling capacitance— Energy stored-Charging of a Capacitor — Capacitor connected across AC source —Capacitive Reactance — Q factor-Transformers-Principle, Symbols — Impedance matching—Losses in transformers— Equivalent circuit—Frequency response.

Module II

Semiconducting diodes and applications (15 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 current equation, Diode parameters, Ideal diode, Zener diode and its reverse characteristics. 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, n 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.

Module III

Transistors Configurations and Feedback (25 hours)

Bipolar junction transistors, Transistor biasing, CB, CC, CE configurations and their characteristics- Active, saturation and cut-off regions. Current gain a, §, y 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-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.

Module IV

FET-Field-Effect Transistor (22 hours)

Introduction— Types of Field-Effect Transistors- Junction Field-Effect Transistor —Formation of Depletion Region in JFET — Operation of JFET — Characteristics of JFET—Drain Characteristics— Effect of Gate-to-Source Voltage on Drain Characteristics—Transfer Characteristics— JFET Parameters—Mathematical Expression for Transconductance—Comparison between Junction Field Effect Transistors and Bipolar Junction Transistor. Types of MOSFET — Depletion-Type MOSFET — Working of a Depletion-Type MOSFET — Drain Characteristics of Depletion-Type MOSFET—Transfer Characteristics for Depletion Type MOSFET Enhancement-Type MOSFET— Drain characteristics for enhancement type MOSFET - Transfer Characteristics of Enhancement-Type MOSFET.

Text Books:

Basic Electronics—Solid State, B L Theraja- S Chand (2005)

A Text Book of Applied Electronics-R S Sedha

References:

1. Principles of electronics, V K Mehta, S Chand
2. Basic Electronics(7thEdition), 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

Core 3: IPH1CR04 - Thermal Physics

Credits: 2 (36 Hours)

Module 1

Laws of Thermodynamics (4 hours)

Thermodynamic system and surrounding Thermodynamic variables, Thermal equilibrium and zeroth law. Concept of temperature, Thermodynamic system and coordinates, Thermodynamic equilibrium, Equation of state, Intensive and extensive components of common thermodynamics systems.

First Law of Thermodynamics (6 hours)

Work and its path dependence, Adiabatic work, Statement of the first law, Internal energy

function, Concept of heat, Mathematical form of first law and differential form, Heat capacity, Internal energy and specific heats, Equation of adiabatic process, Work done during isothermal and adiabatic process, The indicator diagram.

Second Law of Thermodynamics (6 hours)

Conversion of work into heat and vice-versa, Heat engine and Kelvin-Planck statement of second law, Refrigerator and Clausius' statement, Equivalence of the two statements, Reversibility and irreversibility, Conditions for reversibility, Carnot's engine and refrigerator, Carnot's theorem, Absolute zero and Carnot's efficiency, Entropy and calculation of entropy of ideal gas, TS diagram, Connection of reversibility, entropy and second law.

Module II

Entropy (6 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 and Third Law of Thermodynamics (6 hours)

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

Module III

Transfer of heat (8 hrs)

Thermal conductivity - determination by Lee's Disc method for bad conductor radial flow of heat, cylindrical flow, thermal conductivity of rubber, Weidman Franz law. Radiation of heat, Stefan's law, determination of Stefan's constant, solar constant, determination of solar temperature, Wein's displacement Law, Rayleigh Jeans Law, Planck Radiation Formula

Textbooks

1. Heat Thermodynamics and Statistical Physics - Brij Lal, Subramanyam & Hemne
2. Mark W. Zemansky, Heat and Thermodynamics, Mc Graw Hill (2017)
3. Thermal and Statistical Physics-R.B. Singh

References

1. Enrico Fermi, Thermodynamics, Dover (1936, 2007)
2. Kerson Huang, Introduction to Statistical Physics, CRC Press(2012)
3. Herbert Callen, Thermodynamics and an Introduction to Thermostatistics, Wiley(2006)
4. Daniel Schroider, An Introduction to Thermal Physics, Pearson (2014)

PRACTICAL

IPH1CP07 - Physics Practical I

Credit: 2 (36 hours)

(The student has to complete a minimum of 10 experiments)

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

2. Kater's pendulum — Determination of acceleration due to gravity (g)
3. Torsion Pendulum — Determination of rigidity modulus (n) and moment of inertia (I)
4. Uniform bending — pin & microscope OR Optic Lever — Determination of Young's modulus
5. Non-Uniform bending — pin & microscope OR Optic Lever — Determination of Young's modulus
6. Cantilever - Scale and telescope OR Pin and Microscope -Determination of Young's modulus
7. Static Torsion — Determination of rigidity modulus
8. Flywheel — Determination of moment of inertia
9. Determination of viscosity of a liquid - Constant pressure head OR Variable pressure head
10. Capillary rise method — Determination of surface tension
11. Diode characteristics- ac and dc resistance
12. Resistivity of the material of the wire- Ohm's law and verification by multimeter
13. Construction of half wave rectifier with and without filter — Ripple factor
14. Construction of full wave rectifier (Centre tap/ bridge) with and without filter — Ripple factor
15. Characteristics of Zener diode- ac and dc resistance
16. Transistor characteristics- Common Emitter Configuration
17. Voltage regulator using Zener diode- study of line and load regulations.
18. Clippers OR Clampers- - positive, negative and biased- Study of output waveforms
19. Thermistor — Resistance - Temperature characteristics and temperature co- efficient of resistance
20. Newton's law of cooling — Specific heat capacity of a liquid

SEMESTER 2

Core 4: IPH2CR02 - Physical Optics
Credit: 3 (72 Hours)

Module I

Interference (15 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-applications.

Module II

Diffraction (12 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 slit. Fraunhoffer diffraction at a single slit, double slit, N slits, theory of plane transmission grating. Dispersive power and resolving power of grating.

Polarization (12 hours)

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.

Module III

Laser (10 hours)

Absorption and emission of light-Absorption-spontaneous emission and stimulated emission, 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.

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.

Module IV

Optical Holography (14 hrs)

Basic principle, recording and reconstruction, types of holograms: transmission hologram, reflection hologram, phase holograms, rainbow hologram (qualitative analysis only). Experimental techniques, detectors and recording materials, holographic optical elements, holographic scanners, application of holography: pattern recognition, information storage

Text books

1. Optics by N.Subramanayam, Brijlal, M.N.Avadhanulu
2. Semiconductor physics and optoelectronics- V.Rajendran, J.Hemaletha and M.S.M.Gibson
3. Lasers and non-linear optics, B. B. Laud, New Age Pub (2011).
4. Hariharan, Optical Holography, Academic Press, 1983

Reference Books:

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.
15. Vest. C.M., Holographic Interferometry, John Wiley & Sons Inc., 1979
16. Graham Saxby, Practical Volume Holography, 3'd Edn, Marcal Dekker, 1994

Core 5: IPH2CR03 - DIGITAL ELECTRONICS AND COMMUNICATION

Credit-3 (54 hours)

Module I

Boolean algebra and logic gates (10 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 (14 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

Communication (24 hours)

Modulation and Demodulation: Amplitude modulation- Modulation index, Frequency spectrum, Sidebands, Power in AM wave, Amplitude modulation generation. Frequency modulation- Modulation index, Generation of FM wave, Reactance modulator, Voltage controlled oscillator.

Wave detectors : Detection of AM wave- Diode detector (qualitative) - Detection of FM waves- Slope detector, phase discriminator, Pre emphasis, De-emphasis - Comparison between AM & FM Pulse modulation-Analog & digital Pulse modulation, Basic idea of Pulse amplitude

modulation (PAM), Pulse width modulation (PWM) & Pulse position modulation (PPM) - Radio Receivers- Super heterodyne AM receiver & Super heterodyne FM receiver (Explanation with block diagram).

Text books:

1. Digital fundamentals, Thomas L. Floyd (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
5. Electronics: Fundamentals and applications- D. Chattopadhyaya , P.C.Rakshit, NewageRevised 6th edition.
6. Electronic Communication Systems- Kennedy & Davis, TMH, 4th Edition. Electronic Devices: Floyd, Pearson , 6th Edition.

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. Electronic Devices: Floyd, Pearson , 6th Edition.

Core 6:IPH2CR04 - Electrostatics and Magnetostatics

Credit: 2 (36 Hours)

Module I (12 hours)

Electrostatics - Charges and fields

Electric Charge, Conservation of Charge, Quantization of Charge, Coulomb's Law, The Electric Field, Continuous charge distribution, Calculation of Electric field, Divergence and Curl of Electrostati c fi elds, Electric field lines, Principle of super positi on of F and E, Electric dipoles, Electric Flux, Gauss's Law, Applications of Gauss's Law, Field of a Spherical Charge Distribution, Field of a uniform Line Charge, Field of an infinite plane sheet of charge, Gauss's Law in integral and differential forms.

Module II (12 hours)

The Electric Potential

Electric Potential, Electric Potential in a Uniform Field, Electric Potential of two point charges, Electric Potential due to a group of charges, Calculation of Electric Potential, Calculation of Electric Potential from Electric Field, Electric potential of a charged conducting sphere, Electric potential of an infinite line charge, Equipotential surfaces, Laplace and Poisson equations, Electrostatic boundary conditions.

Module III (12 hours)

Magnetic Forces and Fields

Motion of a charged particle in electric and magnetic fields, cyclotron motion, force and torque on a current carrying loop in a magnetic field, Biot-Savart's law, Magnetic force on a current carrying conductor, properties of B, Ampere's law, Magnetic vector potential.
Electromagnetic induction: Faraday's law, Lenz's law, Energy in a magnetic field, Inductance, Self inductance, Mutual inductance, Energy in magnetic fields, Magnetostatic boundary conditions.

Text Books:

1. Introduction to Electrodynamics, D. J. Griffiths, Pearson Education India, 4th edition (2015).
2. Electricity and Magnetism, Purcell, Berkeley Physics Course Volume 2, Tata McGraw-Hill Ltd (2008). (Chapters 1-2, Chapters 4-7).
3. University Physics, H.D Young and R.A. Freedman, 12th Edition, Pearson (2009). (Ch 21-23, 25-30)

Reference Books:

1. The Feynman lectures Volume II, Narosa (2003).
2. Fundamentals of Physics, Halliday, Resnik and Walker, John Wiley and Sons Inc, 11th Edition.
3. Electromagnetics: IV th Edition, Schaum's series, Joseph A. Edminister

PRACTICAL

IPH2CP07 - Physics Practical II

Credit: 2 (36 hours)

(The student has to complete a minimum of 10 experiments)

1. Liquid Lens — Determination of optical constants of a convex lens — water and mercury given
2. Spectrometer — Prism — Determination of refractive index of material of the prism
3. Spectrometer — Dispersive power of a Grating / Prism
4. The air wedge — Determination of diameter of thin wire
5. Newton's rings — Determination of wavelength of sodium light
6. Polarization of light and verification of Malu's law.
7. Laser — Grating — Determination of wavelength
8. Potentiometer — Measurement of resistance of wire
9. Potentiometer — Calibration of low range voltmeter

10. Potentiometer — Calibration of ammeter
11. Tangent galvanometer — Calibration of ammeter
12. Field along the axis of a circular coil — m and Bh
13. Deflection and vibration magnetometer- m and Bh
14. Gates — AND, OR, NOT- verification of truth tables
15. Verification of De Morgan's theorems — Using IC 7400
16. BCD to 7 segment decoder
17. Realization of Half adder/ Full adder using gates — Verification of truth table
18. Astable Multivibrator using IC 555
19. Monostable Multivibrator using IC 555
20. A/D converter using IC 741

COMPLEMENTARY CHEMISTRY

SEMESTER I - IPH1CM06- CHEMISTRY - I *BASIC CONCEPTS IN CHEMISTRY*

Credits-2 (36 Hrs)

Unit 1: **Atomic Structure and Chemical Bonding** (9 Hrs)

Atomic Structure: Bohr atom model and its limitations, Dual nature of matter and radiation. de Broglie equation-experimental verification, Photoelectric effect, Heisenberg's uncertainty principle-expression and significance, Concept of orbital, Quantum numbers, shapes of orbitals *(s, p,* d), Electronic configuration of atoms - Aufhau principle, Hund's rule of maximum multiplicity, Pauli's exclusion principle, Electronic configuration of atoms - half and completely filled orbitals.

Chemical Bonding: Introduction — Type of bonds. Ionic bond: Factors favouring the formation of ionic bonds - Lattice energy of ionic compounds and its applications. Covalent bond: Lewis theory - Valence bond theory — Coordinate bond. VSEPR theory and examples. Hybridisation: - *sp3, sp2* and sp(ethane, ethene, ethyne).

Unit 2: Fundamental Concepts in Chemistry (9 hrs) *Periodic Properties:* Modern periodic law — Long form of periodic table. Periodicity in propenies: Atomic radii, ionic radii, ionization enthalpy, electron affinity (electron gain enthalpy) and electronegativity (Pauling scale). Atomic mass - Molecular mass - Mole concept —Molar volume-Oxidation and reduction — Oxidation number and valency- Equivalent mass. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm andmillimoles.

Concept o[Equilibrium: Acids and Bases — basicity, Arrhenius, Lowry-Bronsted and Lewis theories. Ionic product of water - pH and pOH, Strengths of acids and bases - K, and K b, pK, and pKb Buffer solution-Examples (Acetate, carbonate and phosphate buffer systems). Henderson equation (No derivation)-Preparation of buffer solution having a known pH.Solvation, solubility, solubility product, common ion effect and their applications.

Unit 3: **Basic Principles of Analytical Chemistry** (9 Hrs) *Laboratory Operations* (Non-*evaluative):* Laboratory safety and first aid. Use of different glassware like pipette, burette, standard measuring flask, distillation apparatus; heating methods, filtration techniques, weighing principle in chemical balance, weighing in electronic balance.

Methods o[Analysis: Volumetric method of analysis - General principles. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions, end point. Acid baseandredox titrations with corresponding

indicators.

Data Analysis: Units, significant digits, rounding, scientific and prefix notation, graphing of data - Precision and accuracy — signal to noise ratio, Detection and Quantitation Limits (LOD and LOQ), Linear regression, R^2 value, Types of errors — Ways of expressing precision — Methods to reduce systematic errors.

Separation and Purification Techniques: Recrystallisation-single and multi-solvent method, use of drying agents, sublimation. General principles of distillation, fractional distillation, distillation under reduced pressure. Solvent extraction.

Unit 4: **Chromatographic Techniques (9 Hrs)** Chromatography - Principle of differential migration. Classification of chromatographic methods. Basic Principles, Instrumentation and applications of Chromatographic methods such as Thin layer chromatography (TLC), Column chromatography, Gas chromatography(GC), High performance Liquid chromatography (HPLC), Ion Exchange chromatography (IEC).

References

1. B. R. Puri, L. R. Sharma, M.S. Pathania, *Elements ofPhysical Chemistry,* 3rd edn. Vishal Pub. Co., 2008.

2. C. N. R. Rao, *University General Chemistry,* Macmillan,2009.

3. Manas Chanda, *Atomic Structure and MolecularSpectroscopy.*

4. P. L. Soni, *Inorganic Chemistry.*

S. R. A. Day Junior, A.L. Underwood, *Quantitative Analysis,* 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi,1988.

6. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis,* 6th edn. Pearson Education(2003).

7. R. Gopalan, *Analytical Chemistry,*

SEMESTER II — **IPH2CM06** – ***CHEMISTRY – II FUNDAMENTALS* OF *ORGANIC CHEMISTRY***

Credits-2 (36 Hrs)

Unit 1: **Fundamental Concepts of Organic Chemistry** (9 Hrs)

Introduction: Origin of organic chemistry — Uniqueness of carbon — Homologous series. IUPAC nomenclature of alkyl halides, alcohols, aldehydes, ketones, carboxylic acids and amines. Structural isomerism: Chain isomerism, position isomerism, functional isomerism, metamerism and tautomerism. Arrow formalism in organic chemistry. Bond fission - homolytic and heterolytic fission. Types of reagents - Electrophiles and nucleophiles. Polarity of bonds. Reaction Intermediates: Carbocations, carbanions and free radicals (preparation, structure, hybridization and stability). Types of organic reactions: Addition, Elimination, Substitution, Rearrangement and Redox reactions (definition and one example each).

Unit 2: Mechanisms of Organic Reactions (9 Hrs)

Polarity of bonds. Electron Displacement Effects: Inductive effect - Definition - Characteristics - +I and -I groups. Effect of substituent on the acidity of aliphatic carboxylic acids. Mesomeric effect: Definition — Characteristics - +M and-M groups. Comparison of electron density in benzene, nitrobenzene and phenol. Hyperconjugation: Definition — Characteristics. Baker-Nathan effect, Comparison of stability of 2-methyl-1-butene & 2- methyl-2-butene. Steric effect. Substitution reactions: nucleophilic substitution of alkyl halides- SN1 and SN2 mechanisms. Electrophilic substitutions in benzene - reaction mechanisms of nitration, Friedel-Crafts Alkylation and Acylation. Addition reactions: electrophilic addition to alkenesand alkynes - Markwonikoff's rule, Peroxide effect. Elimination reactions: El and E2 mechanisms.

Unit 3: **Stereochemistry of Organic Compounds** (9 Hrs)

Stereoisomerism — definition, classification. Geometrical Isomerism: Definition — Condition — Geometrical isomerism in but-2-ene and but-2-ene-1,4-dioic acid. cis and trans, E and Z configurations. Methods of distinguishing and interconversion of geometrical isomers. Optical Isomerism: Optical activity — Chirality — Enantiomers - Meso compounds - Diastereoisomers — Optical isomerism in lactic acid and tartaric acid - Racemisation and resolution (elementary idea only). Conformations: Newman projection, Saw-horse projection. Conformations of ethane, n-butane, and cyclohexane - Relative stability and energy diagrams.

Unit 4: **Natural and Synthetic Polymers** (9 Hrs)

Introduction. Classification of polymers: Natural, synthetic; linear, cross-linked and network; plastics, elastomers, fibres; homopolymers and copolymers. Polymerization reactions. Typical examples: Polyethylene, PVC, andphenol-formaldehyde resin, polyamides (nylons) and

polyesters. Natural rubber: structure, latex processing methods, vulcanization and uses. Synthetic rubbers: SBR, nitrile rubber and neoprene. Biodegradability of polymers, environmental hazards. Recycling of plastics.

References

1. I. L. Finar, Organic Chemistry Vol. I , 6th edn. Pearson.

2. M.K. Jain, S.C. Sharma, Modern Organic Chemistry, Vishal Publishing Co. 2010.

3. S. M. Mukherji, S. P Singh, R. P Kapoor, Organic Chemistry Vol.1, New Age International Pvt. Ltd, **2006.**

4. S. Sengupta, Basic Stereochemisty of Organic Molecules, 2014.

5. E. L. Eliel, S.H. Wilen, Sterechemistry of Organic Compounds, Wiley, 1994.

6. Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, 6th edn. Orient Longman, 1988.

7. S. M. Mukherji, S.P Singh, Reaction Mechanism in Organic Chemistry, Macmillan, 3 rdedn., **2003.**

8. V.R. Gowarikar, N.V. Viswanathan, J. Sreedhar, Polymer Science, 2nd edn., New Age International Pvt. Ltd., 2015

MAHATMA GANDHI UNIVERSITY
UG BOARD OF STUDIES (MATHEMATICS)
COMPLEMENTARY COURSE FOR INTEGRATED M.Sc. PHYSICS

SYLLABUS

(Use of Non-Programmable Scientific Calculator is permitted)

SEMESTER I
IPH1CM05
DIFFERENTIAL CALCULUS, MATRICES AND TRIGONOMETRY

4 hours/ week (Total Hours: 72) 3 credits

Text Books:-

1. George B. Thomas, Jr: Thomas' Calculus (12th Edition), Pearson.
2. Shanthi Narayanan & P K Mittal, A Text Book of Matrices, S. Chand.
3. S L Loney, Plane Trigonometry Part–II, AITBS Publishers India, 2009.

Module I: Application of Derivatives

(14 hours)

The chain rule, Implicit Differentiation, Extreme values of functions, The mean-value theorem, Monotonic functions and the first derivative test, Indeterminate forms and L'Hôpital's rule.

Text 1 Chapter 3 (Sections 3.6 and 3.7), Chapter 4 (Sections 4.1, 4.2, 4.3 and 4.5) (Proofs of all Theorems in Module I are excluded.)

Module II: Partial Differentiation

(14 Hours)

Functions of several variables (Definitions and simple graphs only), Partial derivatives, The chain rule.

Text 1 Chapter 14 (Sections14.1 (Definitions and simple graphs only), 14.3 and 14.4)

Module III: Matrices

(21 Hours)

Rank of a matrix, Elementary transformations of a matrix, Reduction to normal form, Employment of only row (column) transformations, System of linear homogeneous equations, Systems of linear non homogenous equations, Characteristic roots and characteristic vectors of a square matrix, Characteristic matrix and characteristic equation of a matrix, Cayley-Hamilton theorem, Expression of the inverse of a nonsingular matrix A as a polynomial in A with scalar coefficients

Text 2 Chapter 4 (Sections 4.1 to 4.8 and 4.11), Chapter 6 (Sections 6.1, 6.2 and 6.6), Chapter11 (Sections 11.1 and 11.11) (Proofs of all Theorems in Module II are excluded.)

Module IV: Trigonometry (23 Hours)

Expansions of sin $n\theta$, cos $n\theta$, tan $n\theta$, $\sin^n \theta$, $\cos^n \theta$, $\sin^n \theta \cos^m \theta$, Circular and hyperbolic functions, Inverse circular and hyperbolic function, Separation into real and imaginary parts, Summation of infinite series based on $C + iS$ method.

Text 3 (Relevant Sections of Chapters 3 to 5 and 8)

Reference Books:

1. H Anton, I Bivens and S Davis: Calculus, 10th Edition, John Wiley & Sons.
2. Shanti Narayan: Differential Calculus, S Chand.
3. K F Riley, M P Hobson & S J Bruce, Mathematical Methods for Physics and Engineering (3rd Edition), Cambridge University Press.
4. George B.Thomas Jr. and Ross L. Finney: Calculus, LPE, 9th Edition, Pearson Education.
5. S S Sastry: Engineering Mathematics, Volume1, 4th Edition PHI.
6. Muray R Spiegel: Advanced Calculus, Schaum's Outline Series.
7. Frank Ayres Jr: Matrices, Schaum's Outline Series, TMH Edition (Allied).
8. David W. Lewis: Matrix Theory.

SEMESTER II

IPH2CM05

INTEGRAL CALCULUS AND FOURIER SERIES

4 hours/ week (Total Hours: 72)
3 credits

Text Books:-

1. George B. Thomas, Jr: Thomas' Calculus (12th Edition), Pearson.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.

Module I: Integral Calculus

(22 hours)

The Definite Integral, The Fundamental Theorem of Calculus (Review of ideas through problems), Indefinite Integrals and the Substitution Method, Substitution and Area Between Curves.

Text 1: Chapter 5 (Sections 5.3, 5.4, 5.5 and 5.6) (Proofs of all Theorems in Module I are excluded).

Module II: Application of Integrals

(15 hours)

Volumes using Cross-Sections, Volumes using Cylindrical Shells, Arc Length, Areas of Surfaces of Revolution.

Text 1: Chapter 6 (Sections 6.1 to 6.4).

Module III: Multiple Integrals

(17 hours)

Double and Iterated Integrals over Rectangles, Double Integrals over General Regions, Area by Double Integration, Triple Integrals in Rectangular Co-ordinates.

Text 1: Chapter 15 (Sections 15.1, 15.2, 15.3 and 15.5).

Module IV: Fourier, Taylor and Maclaurian Series

(18 hours)

Periodic Functions, Trigonometric Series, Fourier series, Functions of any period $p=2L$, Even and Odd functions, Half-range Expansions, Taylor series and Maclaurian series.

Text 2: Chapter 10 (Sections 10.1 to 10.4)

Text 1: Chapter 10 (Section 10.8) (Proofs of all Theorems in Module IV are excluded)

Reference Books:

1. Shanti Narayan, P. K. Mittal, Integral Calculus (S. Chand & Company).
2. James Stewart, Calculus: Early Transcendentals, 7th Edition, Cengage Private Limited.
3. Richard Courant and Fritz John, Introduction to Calculus and Analysis I, Springer.
4. R. K. Ghosh, K. C. Maity: Integral Calculus, New Central Books.
5. Michael D. Spivak, Calculus, 4th Edition, Publish or Perish, 2008.
6. Tom Apostol, Calculus, Volume 1, 2nd Edition, Wiley, India.
7. Michael D. Greenberg: Advanced Engineering Mathematics, Pearson Education, 2002.
8. B. S. Grewal: Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.
9. P.P.G Dyke: An Introduction to Laplace Transforms and Fourier Series, Springer 2005.

SEMESTER III

IPH3CM04

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

5 hours/ week (Total Hours: 90)
4 credits

Text Books:-

1. A. H. Siddiqi, P. Manchanada : A first Course in Differential Equations with Applications (Macmillan India Ltd 2006).