1.3.1 (supported document)

Integration integrate cross-Cutting issues relevant to Gender, Environment and sustainability, Human Values and Professional Ethics have been included in the curriculum by the university

F.Y. B. Sc. Electronic Science

Paper I: Principles of Analog Electronics

Unit 1: Passive components (10)

Circuit symbols, working principle, classification according to construction, specifications, and applications of passive components - resistor, capacitor, inductor, transformer, switches, fuses, cables, connectors, batteries, relays and PCBs.

Unit 2: Basic Circuits Using passive components (14)

Concept of Ideal Voltage and Current source, internal resistance, ac and dc source, Ohms Law, potential divider arrangement, Different type of Signals in electronics, Step response of RC circuit, RC time constant, RC circuit with square wave input. Low pass, high pass and band pass filters using RLC circuits, Concept of reactance and impedance, Qualitative idea of resonance. Concept of phasor(using complex algebra) addition of voltage and current in phasor form, Impedance determination using phasor, phasor treatment for passive filter.

Unit 3: Network Theorems (10)

Kirchhoff's current and voltage law, Application of KVL& KCL to simple dc resistive networks. T and Π networks and their interconversion. Mesh current and loop current method of circuit analysis. Thevenin and Norton theorems and corresponding equivalent of simple resistive networks. Superposition theorem, Maximum power transfer theorem.

Unit 4: Semiconductor devices (18)

Circuit Symbol, construction, working principle, specifications, parameters, I-V characteristics, types and applications of rectifier pn junction diode, switching diode, varactor diode, Zener diode, LED, photo diode, optocoupler, BJT, UJT, JFET, MOS Capacitor, MOSFET, MESFET, SCR, DIAC and TRIAC.

Unit 5: Basic Circuits using Active Devices (16)

Diode circuits - Rectifiers, voltage doublers, clipping and clamping circuits, Zener regulator,

BJT circuits – basic amplifier, Potential divider biasing of BJT, comparative study of CE, CB, CC configurations, transistor as a switch and inverter, current mirror using BJT.

UJT circuits - Relaxation Oscillator using UJT.
FET circuits - FET as Voltage Variable Resistor, FET amplifier, comparative study of CD,CG, CS configurations, current source using JFET/MOSFET

Sr.NO	Name Of the Course	Course Code	Units	Issue
1	S.Y.B.SC	AECC-1	A shadow, La belle Dam sans merci whether the mind is without fear, my lost dollar	Human Values, Gender equality.
2	T.Y.B.sc	CH-505	Modern Approach to chemical industries, pollution control & copy right act, trade mark	Environment ,Sustainability, Professional ethics
3	S.Y.B.Sc	EL-231	Electromagnetic spectrum, Concept of noise, Environment noise, Frequency & Amplitude ,Modulation MAN,WAN Ethernet: 100MBPS Gigabit, 10 Gigabit	Environment & Sustainability
4	F.y.b.sc	BO-111	Utilization of Algae in bio fuel industry, Agriculture utilization of lichen in pollution indicators	Environment & Sustainability
5	F.Y.B.Sc	BO-112	Importance of morphology in plant utilization and anatomy into ecological interpretation	Environment &Sustainability
6	F.Y.B.Sc	ZO-112	Concepts of Ecology, Environment, Population, Community, Ecosystem, Biosphere, Autecology and synecology.	Environment, Sustainability, Human values
7	F.Y.B.Sc	ZO-112	Characteristic of population: Density, Nasality, Mortality, Fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion.	Environment, Sustainability, Human values
8	S.Y.B.Sc	CH-223	Practical course in chemistry – Chemical toxicology	Environment & Sustainability
9	S.Y.B.COM	244	Recent trends in Business Management	Equality Professional Ethics
10	T.Y.B.COM	303	Gender Development Index	Human Values & Gender
11	T.Y.B.COM	303	Gender Inequality Index	Human Values & Gender

12				

Unit 6: Operational amplifier. (4)

Idea of operational amplifier (OPAMP), Ideal OPAMP as black box, input and output impedance, Opamp circuits as buffer, inverting and non inverting amplifiers, adder and subtractor.

Reference Books –(Latest edition of)

1. B. L . Theraja . " A text book of electrical technology ", S.Chand and Co.
2. V.K. Mehta ,"Principals of Electronics " , S.Chand and Co.
3. Malvino ," Electronics Principles",Tata McGraw Hill
4. Motorshed A , "Electronic Devices and circuits ", Prentice Hall of India
5. Bolyestad ,"Electronic Devices and Circuits ", Tata McGraw Hill
6. Madhuri Joshi , Electronic Components and Materials " , A.H. Wheeler and Co.
7. S.Salivahanan , N,Sureshkumar , A.Vallavaraj ,"Semiconductor devices and circuits TMH(2002)"

Paper II Principles of Digital Electronics

Unit 1: Number systems (5)

Decimal, Binary, Octal and hexadecimal number systems and their interconversions, signed and fractional binary number representations, BCD, Excess-3 and Gray codes, alphanumeric representation in ASCII codes.

Unit 2: Logic Gates (5)

Positive and Negative Logic, Basic Logic gates & derived gates Symbol and truth table, circuit diagram for basic gates using switches, diodes and transistors, Applications of Ex-OR gates as parity checker and generator.

Unit 3: Boolean algebra (8)

Boolean axioms. Min terms, Max terms , Boolean expression in SOP form and POS form , conversion of SOP/POS expression to its standard SOP/POS form.DeMorgen's theorem, universal gates, Simplifications of Logic equations using laws of Boolean algebra and / or Karnaugh map (up to 4 variables).

Unit 4: Arithmetic Circuits (8)

Rules of binary addition, subtraction, subtraction using 1's and 2's complements, half adder, full adder, parallel adder, universal adder / subtractor, comparator.

Unit 5: Combinational Circuits (10)

Multiplexer & demultiplexer (max. 4 input or output)

Encoder & decoder, code converters - Decimal to binary, Binary to BCD, Hex to binary, BCD to seven segment decoder, 3x4 matrix keyboard encoder.

Unit 6: Sequential circuits (18)

Flip Flops - RS Flip flop using NAND/NOR gates, clocked RS, JK Flip flop, Master slave JK, D Flip flop, T Flip flop.

Counters – Ripple Binary counter, up down counter, concept of modulus counters, Decade counter, Counters for high-speed applications (Synchronous counters) with timing diagrams. Introduction to finite state machine.

Shift registers – SISO, SIPO, PISO, PIPO shift registers, ring counter, universal 4 bit shift register, applications

Unit 7: Logic families (10)

Digital Integrated Circuits, Integrated circuit technologies TTL, ECL, CMOS. Logic levels, switching speed, propagation delay, power dissipation, noise margins and fanout of TTL and CMOS. TTL NAND & NOT gate, Open collector gates, Wired OR operation. CMOS NOT, NAND, NOR gate, precautions while handling CMOS gates, Compatibility and interconnection of TTL and CMOS devices.

Unit 8: Semiconductor Memories (8)

Units of Binary data storage, Semiconductor memory cell (MOSFET based) and array, Memory address and capacity, RAM Static & Dynamic, ROM, EPROM, EEPROM.

Reference Books :

1. Malvino Leach , "Digital Principles & Applications",(IV Edition) McGraw Hill
2. T.M. Floyd R.P. Jain, "Digital fundamentals", Pearson Education
3. R.P.Jain, "Digital Electronics", Tata McGraw Hill
4. John P. Uyemura ,"First course in Digital System Design ", Brooks/Cole,Thompson Learning (2001)
5. Agrawal "Digital electronics " Himalaya publishing

List of Electronics Practicals for FYBSc

Paper III Practicals

1. **The practical course consists of 20 experiments.**
2. **Any two of the following activities with proper documentation will be considered as equivalent of 4 experiments weightage in term work. These will be evaluated in an oral examination for 20% marks at internal and term end examination.**

   i. **preparatory experiments**
   ii. **hobby projects**
   iii. **Internet Searching**
   iv. **industrial visit / live work experience**

3. **All the students are required to complete a minimum of 16 experiments (four from each group) from the following list.**

Group A Any Four

1. Study of forward and Reverse biased characteristics of PN Junction Diode
2. Study of breakdown characteristics and voltage regulation action of Zener diode
3. Study of output characteristics of Bipolar Junction Transistor in CE mode
4. Study of output and transfer characteristics JFET/MOSFET
5. Study of I-V characteristics of UJT and UJT based relaxation oscillator .
6. Study of I-V characteristics of SCR

Group B Any four

. 1. Verification of network theorems
   KCL / KVL, Thevenin, Norton, Maximum Power Transfer, Superposition theorem
2. Design, build and test Low pass and High pass RC filters
3. Study of low voltage Half-wave , Full-wave and Bridge rectifier circuits
4. Study of switching and amplification actions of BJT and JFET/MOSFET
5. Study of potential divider biasing of BJT and its use in DC motor driving
6. Build and test Inverting and noninverting amplifier using OPAMP.
7. Build and test adder and subtractor circuits using OPAMP.

Group C Any Four

1. Basic Logic gates using Diodes and transistors
2. Interconversion of logic expression , develop a circuit using ICs
3. Study of RS, JK and D flip flops using NAND gates
4. Study of Up/Down Counter
5. Study of decade counter IC circuit configurations
6. Study of 4-bit Shift register IC

Group D Any Four

1. Build and Test 4 bit parity checker/ generator using X-OR gate IC
2. Build and Test Half Adder, Full Adder and Subtractor using basic gate
3. Build and Test 2:1 Multiplexer / 1:2 Demultiplexer using gates
4. Build and Test 3X4 matrix Keyboard Encoder
5. Build and Test a Debounce switch using NAND or NOR gate IC
6. Build and Test Diode matrix ROM

Preparatory experiments

1. Identification of components / Tools
    - Minimum 10 different types of components must be given
    - Identification based on visual inspection / data sheets be carried out
2. Use of Multimeters (Analog and Digital)
    - Measurement of AC/DC voltage and Current – on different ranges
    - Measurement of R & C
    - Testing of Diodes & Transistors
    - Measurement of h_{fe}
    - Use of Multimeter in measurement of Variation of Resistance of LDR?Thermister (graph expected)
3. Study of Signal Generator/CRO
    - Understand how to use Signal Generator/CRO
    - Study of Front panel controls
    - Measurement of amplitude and frequency on Sine/Square waveform
    - Measurement of Phase with the help of RC circuit
    - Demonstration of Lissajous figures
    - Demonstrate the use of Component Facility

Hobby project Examples

Build and Test gadgets like

- Water level Indicator
- Photo relay / smoke detector
- Burglar Alarm
- Fan regulator
- Logic Probe

UNIVERSITY OF PUNE

FOR

S.Y.B. Sc. (Physics)

FROM ACADEMIC YEAR

2014-2015

Equivalence of Courses in 2013 pattern with 2008 pattern

Semester I

Paper	2008 Pattern (Old Course)	2013 Pattern (New Course)
Paper I (PHY211)	Mathematical Methods in Physics I	Mathematical Methods in Physics I
Paper II (PHY 212)	Electronics I	Electronics I
Paper II (PHY 212)	Instrumentation	Instrumentation

Semester II

Paper	2008 Pattern (Old Course)	2013 Pattern (New Course)
Paper I (PHY221)	Oscillations, Waves and Sound	Oscillations, Waves and Sound
Paper II (PHY 222)	Optics	Optics

S.Y.B. Sc. (Physics)

Semester I (Paper I)

PH211: MATHEMATICAL MEHODS IN PHYSICS

Learning Outcomes: After the completion of this course students will be able to

- Understand the complex algebra useful in physics courses
- Understand the concept of partial differentiation.
- Understand the role of partial differential equations in physics
- Understand vector algebra useful in mathematics and physics
- Understand the singular points of differential equation.

1. Complex Numbers **(12)**

1.1 Introduction to complex numbers.
1.2 Rectangular, polar and exponential forms of complex numbers.
1.3 Argand diagram
1.4 Algebra of complex numbers using mathematical and Argand diagram
1.5 De-Moivre's Theorem
1.6 Powers, roots and log of complex numbers.
1.7 Trigonometric, hyperbolic and exponential functions.
1.8 Applications of complex numbers to determine velocity and acceleration in curved motion
1.9 Problems.

2. Partial Differentiation **(12)**

2.1 Definition of partial differentiation
2.2 Successive differentiation
2.3 Total differentiation
2.4 Exact differential
2.5 Chain rule
2.6 Theorems of differentiation
2.7 Change of variables from Cartesian to polar co-ordinates.
2.8 Implicit and explicit functions
2.9 Conditions for maxima and minima (without proof)
2.10 Problems.

3. Vector Algebra **(06)**

3.1 Introduction to scalars and vectors:
3.2 dot product and cross product of two vectors and its physical significance
3.3 Scalar triple product and its geometrical interpretation.
3.4 Vector triple product and its proof.
3.5 Problems.

4. Vector Analysis **(12)**

4.1 Introduction
4.2 Scalar and vector fields
4.3 Differentiation of vectors with respect to scalar.
4.4 Vector differential operator and Laplacian operator
4.5 Gradient of scalar field and its physical significance.

4.6 Divergence of scalar field and its physical significance
4.7 Curl of vector field
4.8 Vector identities

a. $\nabla x \nabla \phi = 0$

b. $\nabla.(\nabla x \mathbf{V}) = 0$

c. $\nabla.(\nabla \phi) = \nabla^2 \phi$

d. $\nabla.(\phi \mathbf{A}) = \nabla \phi . \mathbf{A} + \phi (\nabla . \mathbf{A})$

e. $\nabla X (\phi \mathbf{A}) = \phi(\nabla X \mathbf{A}) + (\nabla \phi) X \mathbf{A}$

f. $\nabla.(\mathbf{A} X \mathbf{B}) = \mathbf{B}. (\nabla X \mathbf{A}) - \mathbf{A}.(\nabla X \mathbf{B})$

4.9 Problems.

5. Differential Equation (06)

5.1 Frequently occurring partial differential equations (Cartesian coordinates)
5.2 Degree, order, linearity and homogeneity of differential equation.
5.3 Concept of Singular points. Example of singular points ($x = 0$, $x = x0$ and $x = \infty$) of differential equation.
5.4 Problems.

Additional Activity:
Four tutorials containing 10 unsolved problems each from suggested references.

Reference Books:

1. Methods of Mathematical Physics by Laud, Takwale and Gambhir
2. Mathematical Physics by B. D. Gupta
3. Mathematical Physics by Rajput and Gupta
4. Mathematical Methods in Physical Science by Mary and Boas
5. Vector analysis by Spiegel and Murrey
6. Mathematical Methods for Physicists by Arfken and Weber, 5th Edition, Academic Press.

S.Y.B. Sc. (Physics)

Semester I (Paper II)

PH212: ELECTRONICS

Learning outcomes: On successful completion of this course the students will be able to

- Apply laws of electrical circuits to different circuits.
- Understand the relations in electricity
- Understand the properties and working of transistors.
- Understand the functions of operational amplifiers.
- Design circuits using transistors and operational amplifiers.
- Understand the Boolean algebra and logic circuits.

1. NETWORK THEOREMS (06)

1.1 Kirchhoff's laws (revision)
1.2 Voltage and Current divider circuits
1.3 Thevenin's theorem
1.4 Norton's theorem
1.5 Super-position theorem
1.6 Maximum power transfer theorem (All theorems 1.3 to 1.6 with proof)
1.7 Problems.

2. STUDY OF TRANSISTOR (14)

2.1) BIJUNCTION TRANSISTOR

1. Revision of bipolar junction transistor, types, symbols and basic action
2. Configurations (Common Base, Common Emitter & Common Collector)
3. Current gain factors (α &β) and their relations.
4. Input, output and transfer characteristics of CE, CB & CC configurations.
5. Biasing methods: Base bias, Emitter feedback and voltage divider
6. DC load lines (CE), Operating point (Q point)
7. Transistor as a switch
8. Problems.

2.2) UNI- JUNCTION TRANSISTOR

1. Symbol, types, construction, working principle, I-V characteristics, Specifications, Parameters of: Uni-Junction Transistor(UJT)
2. Use of UJT as a relaxation oscillator

3. OPERTAIONAL AMPLIFIERS (10)

3.1 Introduction
3.2 Ideal and practical Characteristics
3.3 Operational amplifier: IC 741- Block diagram and Pin diagram
3.4 Concept of virtual ground
3.5 Inverting and non-inverting operational amplifiers with concept of gain.

3.6 Operational amplifier as an adder and substracter.
3.7 Problems.

4. OSCILLATROS (04)

4.1 Concept of positive and negative feedback
4.2 Barkhausein criteria for an oscillator
4.3 Construction, working and applications of
Phase shift oscillator using IC-741
4.4 Problems.

5. POWER SUPPLY (06)

5.1 Concept and working of rectifier half wave, full wave and bridge rectifier
5.2 Ripple voltage
5.3 RC filter circuit
5.4 Unregulated and regulated power supply
5.5 Concept of load and line regulation
5.6 Zener as regulator
5.7 Problems.

6. NUMBER SYSTEM AND LOGIC GATES (08)

6.1 Number systems: Binary, Binary coded decimal (BCD), Octal, Hexadecimal
6.2 Addition and subtraction of binary numbers and binary fractions using one's and two's complement.
6.3 Basic logic gates (OR, AND, NOT)
6.4 Derived gates: NOR, NAND, EXOR, EXNOR with symbols and truth tables
6.5 Boolean Algebra
6.6 De Morgan's theorems and its verification
6.7 Problems.

Reference Books:

1. Electronics Principles, Malvino, 7th Edition TaTa Mc-Graw Hills.
2. Principles of Electronics, V. K. Mehta, S. Chand Publication New Delhi.
3. Op Amp and Linear integrated circuits, Ramakant Gaikwad, Prentice Hall of India Pub.
4. Integrated Circuts, Botkar, Khanna Publications, New Delhi
5. Digital Principles and Applications, Malvino and Leech Tata Mc-Graw Hills Pub

S.Y.B. Sc. (Physics)

Semester I (Paper II)

PH212: INSTRUMENTATION

(For the students who have offered Electronic Science at F. Y. B. Sc.)

Learning outcomes: After successful completion of this course the students will be able to

- Understand the functions of different instruments.
- Use different instruments for measurement of parameters.
- Design experiments using sensors.

1. Fundamentals of measurement (08)

1.1 Aims of measurement [Ref 1, Pages: 1-2]
1.2 Functional elements of typical measurement system (block diagram and its explanation) [Ref 1, Pages: 6-8]
1.3 Standard measurements and types of calibration methods [Ref 1, Pages: 19-27]
1.4 Static characteristics (accuracy, precision, sensitivity, linearity, repeatability, reproducibility, drift, hysteresis, resolution) [Ref 1, Pages: 29-33]
1.5 Dynamic characteristics: concepts, first and second order systems, examples of first-order resistance thermometer and thermal element, examples of second order: U-tube manometer and seismic motion [Ref 1, Pages: 81-106]
1.6 Errors in measurement
1.7 Problems.

2. Transducers (12)

2.1 Measurement of displacement: variable resistance, inductance and capacitance methods. Variable capacitance transducers [Ref 1, Pages: 815-825] and Piezoelectric transducers [Ref 1, Pages: 826-829]
2.2 Measurement of force: Load cell, column type devices, cantilever beam
2.3 Measurement of temperature:
  I) Scales of temperature (Kelvin, Celsius, Fahrenheit etc.)
  II) Methods of temperature measurement:
    a) Non-electrical method – liquid filled thermometer, bimetallic thermometer.
    b) Electrical method – Platinum resistance thermometer
    c) Thermistor – PTC and NTC with characteristics
    d) Radiation method – Type of pyrometers, selective radiation pyrometer (solar radiation) [Ref 1, Pages: 739-758, 788-793]
2.4 Problems.

3. Measurement of pressure, flow and magnetic field (10)

3.1 Unit of pressure, concept of vacuum, absolute gauge, and differential pressure
3.2 Elastic transducer – diaphragm, corrugated diaphragm, bellows, Bourdon tube

3.3 Electric type - LVDT, strain gauge
3.4 Pressure transducer – calibration by dead weight tester method.
3.5 Problems.

4. Signal conditioning and processing (12)

4.1 OP-AMP and its characteristics (ideal and practical), basic modes of operation
4.2 OP-AMP circuit used in instrumentation – inverter, adder, subtracter, multiplier, divider, integrator, differentiator, active rectifier, comparator , logarithmic convertors, current to voltage and voltage to current converters, buffer amplifier,
4.3 Instrumentation amplifier (three OP-AMP configuration) [Ref 1, Pages: 873-903]
4.4 Filters [Ref 1, Pages: 913-918]
4.5 Problems.

5. Display, Recorders and Activators (06)

5.1 Type of recorders, graphic recorders (chart and X-T recorders),
5.2 Oscillographic recorders [Ref 1, Pages: 1034-1040]
5.3 Problems.

Ref Book:

1. A course in Electrical and Electronic Instrumentation [19th edition, 2012], A. K. Sawhney (Dhanpat Rai & Co. Pvt. Ltd., New Delhi)

Additional Reading:

1. Instrumentation devices and systems :- Rangan, Sarma, Mani [Tata Mc Graw Hill]
2. Instrumentation Measurement and Analysis – Nakra, Choudhari [Tata Mc Graw Hill]
3. Electronics Instrumentation – H.S.Kalsi [Tata Mc Graw Hill]
4. Sensor and Transducers – Patranabis [PHI]
5. Fundamental of Industrial Instrumentation- Alok Barua [Wiley India]

FOR S.Y.B. Sc. (Physics)

Semester II (Paper I)

PH221: OSCILLATIONS, WAVES AND SOUND

Learning outcomes:

On completion of this course, the learner will be able to:

- Understand the physics and mathematics of oscillations.
- Solve the equations of motion for simple harmonic, damped, and forced oscillators.
- Formulate these equations and understand their physical content in a variety of applications,
- Describe oscillatory motion with graphs and equations, and use these descriptions to solve problems of oscillatory motion.
- Explain oscillation in terms of energy exchange, giving various examples.
- Solve problems relating to undamped, damped and force oscillators and superposition of oscillations.
- Understand the mathematical description of travelling and standing waves.
- Recognise the one-dimensional classical wave equation and solutions to it.
- Calculate the phase velocity of a travelling wave.
- Explain the Doppler effect, and predict in qualitative terms the frequency change that will occur for a stationary and a moving observer.
- Define the decibel scale qualitatively, and give examples of sounds at various levels.
- Explain in qualitative terms how frequency, amplitude, and wave shape affect the pitch, intensity, and quality of tones produced by musical instruments

1. Undamped Free Oscillations (09)

1.1 Different types of equilibria (stable, unstable, and neutral equilibrium)
1.2 Potential well and periodic oscillations, Approximation of a general potential well V(x) to a parabola for small oscillations
1.3 Definition of linear and angular S.H.M.
1.4 Differential equation of S.H.M. and its solution (exponential form)
1.5 Composition of two perpendicular linear S.H.Ms. for frequencies 1:1 and 1:2 (analytical method)
1.6 Lissajous's figures and its uses, Applications (mechanical, electrical and optical)
1.7 Problems.

2. Damped Oscillations (09)

2.1 Introduction
2.2 Differential equation of damped harmonic oscillator and its solution, discussion of different cases.
2.3 Logarithmic decrement
2.4 Energy equation of damped oscillations
2.5 Power dissipation
2.6 Quality factor
2.7 Application: LCR series circuit
2.8 Problems.

3. Forced Oscillations (10)

3.1 Forced oscillation with one degree of freedom
3.2 Differential equation of forced oscillation and its solution (transient and steady state) Amplitude of forced oscillation
3.3 Resonance and its examples: mechanical (Barton's pendulum), optical (sodium vapour lamp),
3.4 Velocity and Amplitude resonance
3.5 Sharpness of resonance
3.6 Energy of forced oscillations
3.7 Power dissipation
3.8 Quality factor and Bandwidth
3.9 Application of forced oscillations
3.10 Equation of coupled oscillations,
3.11 Problems.

4. Wave Motion (08)

4.1 Differential equations of wave motion in continuous media
4.2 Equations for longitudinal waves and it's solution (one dimension only)
4.3 Equation for transverse waves and its solution (one dimension only)
4.4 Energy density and intensity of a wave
4.5 Discussion of seismic waves
4.6 Problems.

5. Doppler Effect (06)

5.1 Explanation of Doppler effect in sound
5.2 Expression for apparent frequency in different cases.
5.3 Asymmetric nature of Doppler effect in sound
5.4 Doppler effect in light, symmetric nature of Doppler effect in light.
5.5 Applications: Red shift, Violet shift, Radar,
5.6 Problems.

6. Sound (06)

6.1 Definition of sound intensity, loudness, pitch, quality and timber
6.2 Acoustic intensity level measurement
6.3 Acoustic pressure and it's measurement
6.4 Reverberation time and Reverberation of a hall
6.5 Sabine's formula (without derivation)
6.6 Stroboscope
6.7 Problems

Reference Books:

1. Waves and Oscillations, Stephenson
2. The physics of waves and oscillations, N. K. Bajaj, Tata McGraw- Hill, Publishing co. ltd.
3. Fundamentals of vibration and waves, SPPuri,Tata McGraw-Hill Publishing co. ltd.
4. A text book of sound, Subramanyam and Brijlal, Vikas Prakashan
5. Sound, Mee, Heinmann, Edition - London
6. Waves and Oscillations, R.N. Chaudhari, New age international (p) ltd.

S.Y.B. Sc. (PHYSICS)

SEMESTER II (PAPER II)

PH222: OPTICS

Learning Outcomes

This course will enable you to:

- acquire the basic concepts of wave optics
- describe how light can constructively and destructively interfere
- explain why a light beam spreads out after passing through an aperture
- summarize the polarization characteristics of electromagnetic waves
- appreciate the operation of many modern optical devices that utilize wave optics
- Understand optical phenomena such as polarisation, birefringence, interference and diffraction in terms of the wave model.
- analyse simple examples of interference and diffraction phenomena.
- be familiar with a range of equipment used in modern optics.

1. Geometrical Optics: (10)

1.1 Introduction
1.2 Lenses: thin and thick
1.3 Sign convention
1.4 Thin lenses: lens equation
1.5 Lens maker equation
1.6 Magnification of thin lens
1.7 Deviation by thin lens
1.8 Power of thin lens
1.9 Equivalent focal length of two thin lenses
1.10 Cardinal points
1.11 Problems.

2. Lens Aberrations (10)

Introduction
Types of aberration: Monochromatic and chromatic Types of monochromatic aberrations and their reductionsTypes of chromatic aberrations
Achromatism : lenses in contact and separated by finite distanceProblems.

3. Optical Instruments (10)

3.1 Introduction
3.2 Simple Microscope
3.3 Compound Microscope
3.4 Ramsdens eye piece
3.5 Huygens eye piece

3.6 Problems.

4. Interference and Diffraction (12)

4.1 Revision to Interference
4.2 Phase change on reflection (Stokes Treatment)
4.3 Interference by parallel sided thin films
    4.3.1 Interference due to reflected light
    4.3.2 Interference due to refracted light
4.4 Interference due to Wedge Shaped thin film
4.5 Types Diffraction : Fresenel's diffraction and Fraunhoffer's diffraction
4.6 Fraunhoffer's diffractions at a double slit
4.7 Plane diffraction grating
4.8 Newton's Rings
4.9 Rayleigh's criterion for resolution
4.10 Problems.

5. Polarization (06)

5.1 I ntroduction
5.2 Brewster's law
5.3 Law of Malus
5.4 Polarization by double refraction.
5.5 Nicol prism.
5.6 Problems.

Reference Books:

1. Optics, fourth edition, Pearson education, E. Hetch, A. R. Genesan
2. A Text book of Optics, N.Subhramanyam, Brijlal, M. N. Avadhanulu, S. Chand publication.
3. Physical Optics by A.K.Ghatak, McMillan, New Delhi
4. Fundamental of Optics, F.A.Jenkins, H.E.White, McGraw-Hill international Edition.
5. Principles of optics, D.S. Mathur, Gopal Press, Kanpur

S. Y. B. Sc. (PHYSICS)

PAPER III (SEMESTER I and II)

PH223: PRACTICAL COURSE

Learning Outcomes

- After completing this practical course students will be able to
- Use various instruments and equipment.
- Design experiments to test a hypothesis and/or determine the value of anunknown quantity.
- Investigate the theoretical background to an experiment.
- Set up experimental equipment to implement an experimental approach.
- Analyse data, plot appropriate graphs and reach conclusions from your dataanalysis.
- Work in a group to plan, implement and report on a project/experiment.
- Keep a well-maintained and instructive laboratory logbook.

Section I:

1) Oscillations, Waves and Sound (Any 4 experiments)

1. Logarithmic decrement (in air and water)
2. Study of coupled oscillators comprising two simple pendulum (Mechanical) and determination of coupling coefficient.
3. Study of musical scales using a signal generator and musical instruments.
4. Determination of frequency of AC mains using sonometer.
5. Measurement of coefficient of absorption of sound for different materials (cork, thermocol, mica, paper etc.)
6. Velocity of sound by phase shift method.
7. Determination of speed of sound by Quincke's method interferometer.
8. Directional characteristics of Microphone.

2) Optics (Any 4 experiments)

1. Newton's Ring: Determination of wavelength of monochromatic light source (λ)
2. Dispersive power of glass prism
3. Total internal reflection (using a LASER beam and glass prism).
4. Diffraction at the edge of a razor blade.
5. Optical activity of sugar solution (polarimeter)
6. Goniometer to determine cardinal points and focal length.
7. To determine temperature of sodium flame.
8. Double refracting prism.

Section II:

1) Electronics/Instrumentation (Any 6 experiments)

1. Circuit Theorems. (Thevenin's, Norton's and Maximum power transfer theorem)
2. Transistor characteristics (CE configuration):

3. Transistor amplifier (single stage)
4. Study of rectifiers (half wave and full wave) with different filters.
5. I-V characteristics of UJT
6. UJT as a Relaxation Oscillator.
6. Zener as a regulator, line and load regulation.
7. Study of Phase shift oscillator (using IC 741)
8. OPAMP as inverting and non inverting amplifier
9. OPAMP as an audio mixer.
10. Study of logic gates (using IC) and verification of De Morgan's theorem.
11. Use of CRO (AC/DC voltage measurement, frequency measurement).
12. To measure displacement (linear and angular) using potentiometer/variableinductor/variable capacitor.
13. To measure force using load cell.
14. To measure pressure using elastic diaphragm (in variable Capacitor/BourdenTube)
15. To measure magnetic field using Hall probe for a system of ring magnets.

2) Computer (2 experiments)

1. Plotting various trigonometric functions using spreadsheet/any graphic softwares:sinx, cosx, tanx, e^{x}, e^{-x}, logx, lnx, x^{n} and
2. equations for the following figures: circle, ellipse, parabola, hyperbola.
3. Inverse, determinant of matrix, solution of linear equations.

Additional Activities (Any Two)

1. Demonstrations- Any 4 demonstrations equivalent to 2 experiments
2. Study tour with report equivalent to 2 experiments
3. Mini project equivalent to 2 experiments
4. Computer aided demonstrations (Using computer simulations or animations)(AnyDemonstrations equivalent to 2 experiments)

Students have to perform at least two additional activities in addition to sixteen experiments mentioned above. Total laboratory work with additional activities shouldbe equivalent to twenty experiments.

REVISED SYLLABUS FOR S.Y. B.Sc. CHEMISTRY FROM 2014-2015

(According to Semester system 2014-2015)

Course structure: There will be four theory papers of 50 Marks each, (40 marks external

+ 10 marks internal) and one practical course of 100 marks. (80 marks External + 20 marks Internal).

The examination will be held semester-wise for theory papers whereas theexamination for practical course CH-223 will be held at the end of **SEMETER-II**

SEMESTER	PAPER	COURSE TITLE	MARKS
I	CH-211	PHYSICAL & ANALYTICAL CHEMISTRY	50
I	CH-212	ORGANIC & INORGANIC CHEMISTRY	50
II	CH-221	PHYSICAL & ANALYTICAL CHEMISTRY	50
II	CH-222	ORGANIC & INORGANIC CHEMISTRY	50

Practical Course in Chemistry: CH-223 - 100 Marks

Equivalence of Previous Syllabus:

Semester	Old Course (2009-10)	New Course (2014-15)
I	CH-211 : Physical Chemistry	CH-211 : Physical & Analytical Chemistry
I	CH-212 : Organic Chemistry	CH-212 : Organic & Inorganic Chemistry
II	CH-221 : Inorganic Chemistry	CH-222 : Organic & Inorganic Chemistry
II	CH-222 : Analytical Chemistry	CH-221 : Physical & Analytical Chemistry
	CH- 223: Practical	CH- 223: Practical

S. Y. B. Sc. (Chemistry) Syllabus

Semester - I

Paper 1: CH-211: Physical and Analytical ChemistryPaper 2: CH-212: Organic and Inorganic Chemistry

Semester - II

Paper 3: CH-221: Physical and Analytical ChemistryPaper 4: CH-222: Organic and Inorganic Chemistry

Practical Course in Chemistry CH-223 (To be conducteddduring both semesters)

SEMESTER – I

Paper 1: CH-211 Section – I Physical Chemistry

Chapter 1: Elementary Chemical Kinetics **[10]**

Introduction to Chemical kinetics, molecularity and order of reaction , reaction rates, rate laws, rate constant and its significance, Integrated rate law expression and its characteristics–first order, second order (single reactant, two reactants involved), examples of 1^{st} and 2^{nd} order reaction, pseudomolecular reactions, factors affecting rate of reaction, measurement of rate of reaction, numericals.

Aim: To introduce concept of kinetics at undergraduate level.

Objectives: Student should learn

i. Concept of kinetics , terms used , rate laws , types of order
ii. Discuss examples of first order and second order reaction
iii. Pseudo molecular reactions
iv. Factors affecting on rate of reaction
v. Techniques of measurement of rate of reaction
vi. To solve problems

Chapter 2: Photochemistry [10]

Introduction, thermal reactions and photochemical reactions, laws of photochemistry,quantum yield, measurement of quantum yield, types of photochemical reactions- photosynthesis, photolysis, photocatalysis, photosensitization, photophysical process– fluorescence, phosphorescence, quenching, chemiluminiscence, numericals.

Aim: To impart basic knowledge of photochemistry and its applications

Objectives: After studying the chapter student should be able to

i. Know about photochemistry
ii. Understand difference between thermal and photochemical reactions
iii. Understand laws of photochemistry
iv. Learn what is quantum yield and it's measurement
v. Know Types of photochemical reactions and photophysical process
vi. Know about quenching and chemiluminence
vii. To solve numericals

Chapter 3: Distribution law [04]

Nernst distribution law, Statement and thermodynamic proof for Nernst distribution law, association and dissociation of solute in solvent, application of distribution law, Numericals.

Aim: To understand Nernst Distribution Law and its applications **Objectives**: Students should learn

i. Concept of distribution of solute amongst pair of immiscible solvents
ii. Distribution law and it's thermodynamic proof
iii. Distribution law and nature of solute in solution state
iv. Application – Solvent extraction
v. To solve numericals

Ref.1: Page no. 298 to 302 and 775-800

Section – II

Analytical Chemistry

Chapter 4: Introduction to Analytical Chemistry [3]

Introduction, Chemical analysis, applications of chemical analysis, sampling, types of analysis, Common techniques, Instrumental methods, other techniques, factors affectingon choice of method

Aim: To introduce basics of analytical chemistry

Objectives: Students should learn

i. What is Analytical Chemistry
ii. Chemical analysis and its applications
iii. Sampling
iv. Common techniques
v. Instrumental methods and other techniques
vi. Choice of method

Ref: Vogel chapter 1 (Page 1 - 11) up to section 1.9 except use of literature.

Chapter 5: Errors in Quantitative Analysis [5]

Introduction, Error, Accuracy, precision, methods of expressing accuracy and precision, classification of errors, significant figures and computations, distribution of random errors,mean and standard deviations, reliability of results, Numericals.

Aim: To understand errors and its interpretation

Objectives: Students should learn

i. Meaning of error and terms related to expression & estimation of errors
ii. Methods of expressing accuracy and precision
iii. Classification of errors
iv. Significant figures and computations
v. Distribution of errors
vi. Mean and standard deviations
vii. Reliability of results

Ref: Vogel, 5thedn chapter 4 (127-137 up to section 4.10) extended up to 4.13

Chapter 6: Inorganic Qualitative Analysis **[8]**

Basic principle, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (phosphate and borate), detection of acid radicals.

Aim: To study the theory underlying Inorganic Qualitative analysis

Objectives: A student should know

i. Basic principles in qualitative analysis
ii. Meaning of common ion effect
iii. Role of common ion effect and solubility product
iv. Different groups for basic radicals
v. Group reagent and precipitating agents
vi. Interfering anions and its removal
vii. Separation for basic radicals
vii. Method of detection of acidic radicals

Chapter 7: Analysis of Organic Compounds (Qualitative & Quantitative) [8]

I. Qualitative

A. Types of organic compounds, Characteristic tests and classifications, reactions ofdifferent functional groups, analysis of binary mixtures.

II Quantitative

B. Analysis–estimation of C, H, (O) by combustion tube, detection of nitrogen, sulfur,halogen and phosphorous by Lassigen's test.
C. Estimation of nitrogen by Dumas's Kjeldahl's method, estimation of halogen,sulphur and phosphate by Carious method.
D. Determination of empirical and molecular formula, numerical problems.

Aim: To disseminate knowledge of qualitative & quantitative analysis of organic compounds

Objectives: A student should know-

i. Classification of compounds with different functional groups
ii. Different tests for detection of elements like C, H, (O), N, S & P.
iii. Characteristic tests for different functional groups
iv. Different colour tests and the reactions
v. Quantitative analysis of C, H by Liebig's method
vi. Kjeldahl's method with example
vii. Carius tube method with example
vii. Empirical and molecular formula
vii. To solve numericals.

Name of the reference book:

1. Analytical Chemistry by G.D. Christian, sixth edition. Pages: 1-10
2. Vogel's textbook of Quantitative Analysis, sixth edition J. Mendham, R.C. Denney, J.D. Barnes, MJK Thomas
3. A textbook of macro & semi micro qualitative analysis by A.J. Vogel, fifth edition
4. Quantitative Organic Analysis, fourth edition, A.J. Vogel, ELBS

Paper 2: CH-212 Section

– I Organic Chemistry

Chapter 1: Stereoisomerism [12]

Introduction to optical isomerism: Chirality, optical activity and polarimetry, enantiomers, absolute configuration, R/S system nomenclature with wedge and Fischer representationof two chiral centres, erythro, threo, meso-diastereomers with R/S configuration. Stereoisomerism Baeye'rs strain theory, heat of combustion, cycloalkanes, factors affecting the stability of conformation, Conformation of cyclohexane - equatorial and axial

bonds, Monosubstituted cyclohexane stability with $-CH_3$ and $-C(CH_3)_3$ substitutes. Structures of geometrical isomers of dimetylcyclohexane only.

Ref. 3

Aims and Objectives Students

should be able to –

i) Identify chiral center in the given organic compounds.

ii) Define Erythro, threo, meso, diasteroisomers with suitable examples.

iii) Able to find R/S configuration in compounds containing two chiral centers.

iv) Explain Bayer's strain theory, Heat of combustion and relates stability of cycloalkanes.

v) Explain the stability of cyclohexanes.

vi) Draw the structure of boat and chair configuration of cyclohexane.

vii) Draw axial and equatorial bonds in cyclohexane.

viii) Draw structure of conformations of mono- & disubstituted cyclohexanes

ix) Explain the stability of axial and equatorial conformation of monosubstitutedcyclohexanes.

Chapter 2: Organic reaction Mechanism [12]

Introduction, types of reagents–electrophile, nucleophile and free radical.

Types of organic reactions: Addition, Elimination (β-elimination and Hofmann elimination), substitution (aliphatic electrophilic and nucleophilic, aromatic electrophilic)and rearrangement.

Mechanism: (i) Aldol condensation (ii) Markovnikov and anti-Markovnikov addition reaction (iii) Saytzeff and Hoffmann elimination (iv) S_N^1 and S_N^2 reactions (v) Hofmann rearrangement.

Ref. 1 & 4

Aims and Objectives Students

should be able to –

i) Define and classify heterocyclic compounds.

ii) Use Huckel rule to predict aromaticity.

iii) Suggest synthetic route for preparation of various heterocyclic compounds.

iv) Write and complete various reactions of heterocyclic compounds.

v) Predict products.

Reference Books:

Ref. 1: Organic Chemistry-6h Ed. Morrison and Boyd Prentice Hall of India Prt Ltd,NewDelhi-2001.

Ref. 2: Outline of Biochemistry 5h Ed., Conn, Stumpf Bruening and Roy Doi John Wiley1987.

Ref. 3: Stereochemistry of carbon compounds - E. L. Eliel Ref. 4:

Reactions, rearrangements and reagents – S N Sanyal

Section – II Inorganic Chemistry

Chapter 3: General Principles of Metallurgy: [6]

Introduction, occurrence of metals, ores and minerals, types of ores, operations involved in metallurgy, crushing, connotation, various methods of concentration such as hand picking,gravity separation, magnetic separation. Froth flotation, Calcinations, Roasting etc. Reduction, various methods of reduction such as smelting, Aluminothermic process and electrolytic reduction, Refining of metals, various methods of refining such as poling, liquation, electrolytic and vapour phase refining (Van Arkel Process).

Aims: To study principles and process of metallurgy.

Objectives: A student should be able -

i) To differentiate between ore and minerals.

ii) To differentiate between calcination and roasting and smelting.

iii) To know the different methods for separation of gangue or matrix from metalliccompounds.

iv) To know the terms smelting, flux.

References:

i) Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu, pages 262-271.

ii) Text book of Inorganic Chemistry, P.L. Soni, pages 2.3-2.8, 2.13-2.17.

Chapter 4: Metallurgy of Aluminium (Electrometallurgy): [4]

Occurrence, Physiochemical principles, Extraction of Aluminium, Purification of bauxite by Baeyer's process, Electrolysis of alumina, application of aluminum and its alloys.

Aims: To study metallurgy of Aluminium.

Objectives: A student should be able -

i) To know physico-chemical principles involved in electrometallurgy.

ii) To understand electrolysis of alumina and its refining.

iii) To explain the uses of Aluminum and its alloys.

iv) To know purification of bauxite ore.

References:

i) Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 458-463.

ii) Text book of Inorganic Chemistry, P.L. Soni pages 2.209 to 2.211

Chapter 5: Metallurgy of Iron and Steel (Pyrometallurgy) [8]

Occurrence, concentration, calcination, smelting physio-chemical principles, reactions in the blast furnace, wrought iron, manufacture of steel by Bessemer and L.D. process, its composition and applications.

Aims: To study metallurgy of Iron.

Objectives: A student should be able -

i) To explain the term pyrometallurgy and to explain the physico chemical principlesinvolved in the reduction process by carbon monoxide.

ii) To know different reactions in the blast furnace.

iii) To differentiate between properties of pig iron and wrought iron.

iv) To explain the basic principles of different methods for preparation of steel.

v) To explain the merits and demerits of different methods.

Reference:

i) Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 830-849.

Chapter 6: Corrosion and Passivity: [6]

(a) Corrosion : Definition of corrosion, Types of corrosion, Atmospheric, Immersed,Mechanism of electrochemical corrosion, Factors affecting corrosion - position of metal in

E. C. S., purity effect of moisture, effect of oxygen, pH, physical state of metal, methodsof protection of metal from corrosion- alloy formation, making metal cathodic, controlling

external condition. Coating-galvanising, Tinning, electroplating, metal cladding, organic coating.

(b) Passivity : Definition, Theories of passivity - (i) Oxide film theory (ii) Gaseous film theory (iii) Physical film theory, Valence theory, Catalytic theory, Allotropic theory,Electrochemical passivity.

A student should know -

i) Definition of corrosion.

ii) Types of corrosion.

iii) Mechanism of corrosion.

iv) Factors affecting corrosion.

v) Methods of prevention of metal from corrosion.

vi) Meaning of passivity.

vii) Different theories of passivity.

viii) Galvanising, Tinning, Electroplating from corrosion.

Reference:

i) Introduction to Electrochemistry by S. Glasstone, 2nd Ed. pages 491-503.

SEMESTER – II

Paper 3: CH-221 Section – I Physical Chemistry

Chapter 1: Free Energy and Equilibrium [12]

Introduction, Helmholtz free energy, variation of Helmholtz free energy with volume and temperature, Helmholtz free change energy for chemical reaction,Gibb's free energy, Variation of Gibb's free energy with pressure and temperature, Gibb's free energy change for chemical reaction, Free energy change for physical transitions, Free energy change for an ideal gas; standard free energy change, Gibb's-Helmholtz equation, Properties and significance of Gibb's free change, Van't Hoff reaction isotherm, thermodynamic equilibrium constants, Relation between Kp and Kc for gaseous reactions, variation of equilibrium constant with temperature, Criteria for chemical equilibrium, Physical equilibrium, Clapeyron equation, Clausius–Clapeyron equation, Application of Clausius–Clapeyron equation, numericals.

Aim: To conceptualize phenomenon of free energy and equilibria.

Objectives: The student should able to know

i. Free energy concepts, types and its variation
ii. Free energy change for chemical reaction and physical transition
iii. Free energy change for ideal gases
iv. Gibb's Helmholtz equations and its properties & significance
v. van't Hoff reaction isotherm and thermodynamic equilibrium constants,
vi. Chemical and physical equilibrium
vii. Clausius –Clapeyron equation and its applications

vii. To solve numericals. Ref.

1: Page no. 189 to 200, 206Ref. 2:

Relevant pages.

Chapter 2: Solutions of Liquids in Liquids [12]

Types of solutions, Ideal solutions, Raoult's law, ideal and non ideal solutions, Henry's law, Application of Henry's law with example CS_2 in acetone, problems based on Raoult'slaw and Henry's law, vapor pressure–composition diagram of ideal and non ideal solution,temperature composition diagram of miscible binary solutions, distillation from temperature–composition diagram, Azeotropes, Partially immiscible liquids.

Aim: To distinguish behavior of liquid phase solutions.

Objectives: The student should to know

i. Ideal and non ideal solutions and laws governing these solutions
ii. Interpretation of vapor pressure–composition diagram
iii. Interpretation of temperature composition diagram.
iv. Distillation from temperature – composition diagram,
v. Azeotropes
vi. Partially immiscible liquids.
vii. To solve numericals

Ref.2: Pages 229 to 247, 254 to 258

Reference books:

1. Principles of Physical Chemistry by S.H. Maron & C. Prutton 4th edition.
2. Physical Chemistry by W.J. Moore 5th edition.
3. Physical Chemistry by P.W. Atkin 4th edition
4. Physical Chemistry by D. Alberty 3rd edition.

Section – II

Analytical Chemistry

Chapter 3: Introduction to volumetric analysis [6]

Introduction, methods of expressing concentrations, primary and secondary standard solutions. Apparatus used and their calibration: burettes, microburettes, volumetric pipettes, graduated pipettes, volumetric flask, methods of calibration, Instrumental & non- instrumental analysis – principles & types.

Aim: To provide basic knowledge essential for volumetric analysis

Objectives: A student should be able to know

i. Meaning of equivalent weight, molecular weight, normality, molality, primary and secondary standards.
ii. Different way to express concentrations of the solution.
iii. Preparation of standard solution.
iv. To solve numerical problems.
v. Calibrate various apparatus such as burette, pipette, volumetric flask, barrel pipetteetc.
vi. Types instrumental and non instrumental analysis

Chapter 4: Non Instrumental volumetric analysis [18]

Indicators–theory of indicators, acid base indicators, mixed and universal indicators [3] Acid–Base titrations: Strong acid–Strong base, Weak acid–strong base, Weak acid-Weak base titration, Displacement titrations, polybasic acid titrations. (Discuss titration with respect to neutralization and equivalence point determination and limitations) [6]

Redox titrations: Principle of redox titration, detection of equivalence point using suitable indicators. [3]

Complexometric titrations: Principle, EDTA titrations, choice of indicators [6]

Iodometry and Iodimetry: Principle, detection of end point, difference between iodometry and iodimetry, Standardization of sodium thiosulphate solution using potassium dichromate and iodine method, Applications – estimation of Cu , estimation of Cl_2.

Aim: To learn and equip with non instrumental volumetric techniquesObjectives: The student should able to

i. Explain role of indicators.
ii. Know mixed and universal indicators.
iii. Know neutralization curves for various acid base titration
iv. Know principle of complexometric precipitation and redox titrations.
v. Know the definitions and difference between iodometry and iodimetry.
vi. To know standardization of sodium thiosulphate and EDTA.
vii. Reactions between $CuSO_4$ and Iodine and liberated I_2 and $Na_2S_2O_3$
viii. Choice of suitable indicator.
ix. Estimate copper from $CuSO_4$ and available chlorine in bleaching powder.
x. Prepare standard silver nitrate solution.
xi. Mohr's and Fajan's method.
xii. Determine the amount of halides separately and in presence of each other.

Paper 4: CH-222 Section

– I Organic Chemistry

Chapter 1: Reagents in Organic Synthesis [8]

Catalytic hydrogenation including liquid phase hydrogenation, Birch reduction, $NaBH_4$, $LiAlH_4$, Sn/HCl

Oxidation reagents: $KMnO_4$, $K_2Cr_2O_7$, Jones reagent, PCC, Per acids, OsO_4.

Student should understand:

i) Concept of different reagents used in the one type of conversion

ii) Merits & demerits of different reagents

iii) Reagent based mechanisms

iv) Use of different hydrogen donors for hydrogenation Ref. 1 & 4

Chapter 2: Chemistry of heterocyclic compounds with one hetero atom. [6]

Definition and classification of heterocyclic compounds, nomenclature and aromatic character. Synthesis of Pyrrole, Furan, Thiophene, Pyridine and their reactions: Nitration, Sulphonation, Acylation and Catalytical reduction. Structure and synthesis of quinoline and Isoquinoline.

Student should know:

i) Define and classify heterocyclic compounds.

ii) Use Huckel rule to predict aromaticity.

iii) Suggest synthetic route for preparation of various heterocyclic compounds.

iv) Write and complete various reactions of heterocyclic compounds.

v) Predict products. Ref. 1

Chapter 3: Introduction of Bio-molecules [10]

Carbohydrates: Definition, classification, reaction of monosaccharide (glucose)-oxidation, reduction, osazone and ester formation, isomerization, Killiani-Fischer synthesis and Ruff

degradation, Configuration of D/L configuration of (+) Glucose, Fischer-Haworth and chair formulae, Brief account of disaccharides: Sucrose, cellobiose, maltose and lactose.

Polysaccharides: Starch, cellulose and glycogen.

Amino acids: Fischer projection, relative configuration, classification, structures and reactions of amino acids, Properties and chemical reactions with amino and carboxylic group.

Proteins: Formation of Peptide linkage, α-helical conformation, β-plated structure, primary, secondary, tertiary and quaternary structure of proteins.

Ref. 2 & 3

Student should know

i) Know different biomolecules.

ii) Appreciate the role of biochemistry in the day to day life.

iii) Understand the importance of biochemistry.

iv) Define carbohydrates.

v) Classify carbohydrates giving suitable examples.

vi) Write and complete various reactions of glucose.

vii) Explain optical activity in carbohydrates.

viii) Write Fischer projection and perspective formula with glyceraldehydes as reference compound.

ix) Explain the principle in Killani Fischer synthesis.

x) Explain stereoisomerism in monosaccharide.

xi) Draw structure of some common aldoses and ketoses.

xii) Distinguish between diastereomers and epimers.

xiii) Write cyclic structure of glucose in Fischer, Haworth and chair form.

xiv) Know the phenomenon of mutaroatation.

xv) Draw the structure and bonding in maltose, lactose, cellobiose and sucrose.

xvi) Know about polysaccharide, structures of starch and cellulose.

xvii) Classify the naturally occurring amino acids.

xviii) Explains the amphoteric nature of amino acids.

xix) Know the important reactions of α-amino acids.

xx) Outline the formation of peptide bond.

xxi) Explain the hydrogen bonding in α-helical structure.

xxii) Relate the stability of α-helical chain and their R-groups.

xxiii) Define primary, secondary, tertiary and quaternary structure of proteins.

xxiv) Classify proteins.

Reference Books:

Ref. 1: Organic Chemistry-6h Ed. Morrison and Boyd Prentice Hall of India Prt Ltd, NewDelhi-2001.

Ref. 2: Outline of Biochemistry 5h Ed., Conn, Stumpf Bruening and Roy Doi John Wiley1987.

Ref. 3: Stereochemistry of carbon compounds - E. L. Eliel Ref. 4:

Reactions, rearrangements and reagents – S N Sanyal

Section – II

Inorganic Chemistry

Chapter 4: Chemistry of d-block elements [6]

Position of d-block in periodic table, electronic configuration, trends in properties of these elements w.r.t.(a) size of atoms & ions (b) reactivity (c) catalytic activity (d) oxidationstate (e) complex formation ability (f) colour (g) magnetic properties (h) non- stoichiometry (i) density, melting & boiling points.

Student should know:

i) To know position of d-block elements in periodic table.

ii) To know the general electronic configuration & electronic configuration of elements.

iii) To know trends in periodic properties of these elements w.r.t. size of atom and ions, reactivity, catalytic activity, oxidation state, complex formation ablility, colour, magnetic properties, non-stoichiometry, density, melting point, boiling point.

Chapter 5: Organometallic Chemistry [6]

Definition of Organometallic compounds and Organometallic chemistry, CO as a π-acid donor ligand, binary metal carbonyls, methods of synthesis; (a) Direct reaction (b) Reductive carbonylation (c) Photolysis and thermolysis. Molecular and electronic structures (18 electron rule) of metal carbonyls. Homogenous catalysis-Hydroformylation (Oxo Process) and Wacker Process.

Aim: To study the metal carbonyl complexes and their uses in the homogenous catalysis.

Objectives:

Students should be able:

i) To understand M-C bond and to define organometallic compounds

ii) To define organometallic chemistry

iii) To understand the multiple bonding due to CO ligand.

iv) To know methods of synthesis of binary metal carbonyls.

v) To understand the structure and bonding using valence electron count (18 electron rule)

vi) To understand the catalytic properties of binary metal carbonyls.

vii) To understand the uses of organometallic compounds in the homogenous catalysis.

References:

1. Concise Inorganic Chemistry by J. D. Lee-relevant pages.

2. General Chemistry-Raymond Chang- relevant pages.

Chapter 6: Acids, Bases and Solvents [6]

Definition of acids and bases, Arrhenius theory, Lowry-Bronsted theory, Lewis concept, Lux-Flood theory, strength of acids and bases, trends in the strength of hydracids and oxyacids, Properties of solvents, M.P-B.P range, dipole moment, dielectric constant, Lewis acid-base character and types of solvents.

Ref: Basic Inorganic Chemistry – F. A. Cotton (Pages- 163-173)

(6) Acids, Bases, Solvents and reactions in non-aqueous solvents:

Aims: To study different solvents and to know the different theories of acids and bases.

Objectives: A student should be able -

i) To define acids and bases according to Arrhenius theory Lowery- Bronsted concept,Lewis concept.

ii) To explain the merits and demerits of different theories of acids and bases.

iii) To define the conjugate acid and base pairs.

iv) To explain the leveling effect of solvents.

v) To demonstrate the trends in the strength of hydracids, oxyacids.

vi) To define hard and soft acids.

vii) To know the trends in the strength of hydra and oxyacids.

viii) To know the rules governing the strength of oxyacids.

ix) To explain the properties of a solvent that determines their utility.

x) To know some useful solvents.

xi) To explain the reactions in non-aqueous solvents like HF and NH3.

Chapter 7: Chemical Toxicology [6]

Toxic chemicals in the environment, Impact of toxic chemistry on enzymes. Biochemical effect of Arsenic, Cadmium, Lead, Mercury, Biological methylation.A student should be able -

i) To know toxic chemical in the environment.

ii) To know the impact of toxic chemicals on enzyme.

iii) To know the biochemical effect of Arsenic, Cd, Pb, Hg.

iv) To explain biological methylation.

Reference:

i) Fundamental Chemistry by A. K. Dee. (3rd Ed.)

Practical Course in Chemistry CH – 223

A) Physical Chemistry practicals (Any Five)

i. To determine critical solution temperature of phenol water system

ii. To determine molecular weight of given organic liquid by steam distillation

iii. Determination of solubility of benzoic acid at different temperature and todetermine ΔH of dissociation process.

iv. To study neutralization of acid (HCl) base (NaOH) and CH_3COOH byNaOH and H_2SO_4 by NaOH.

v. To determine the rate constant (or to study kinetics) of acid catalyzed esterhydrolysis.

vi. To determine the rate constant of base catalyzed ester hydrolysis.

vii. Partition coefficient of iodine between water and carbon tetrachloride. Aim: To equip students to correlate theoretical and experimental knowledge Objectives: After completion of practical course student should be able to

i. Verify theoretical principles experimentally

ii. Interpret the experimental data

iii. Improve analytical skills

iv. Correlate the theory and experiments and understand their importance

B) Inorganic Qualitative Analysis (Minimum Five mixtures)

i. One simple mixture (without phosphate or borate)

ii. Two Mixtures containing PO_4^{3-} (With PO_4^{3-} removal)

iii. Two Mixtures containing BO_3^{3-} (With BO_3^{3-} removal)

Inorganic Qualitative Analysis of Binary Mixtures (including phosphate andborate removal).

Sodium carbonate extract is to be used wherever necessary for detecting acidic radicals.

C) Organic Chemistry Practical

a. Organic qualitative analysis of Binary Mixtures without ether separation(**Four only**)

Two: solid-solid, one: solid-liquid, one: liquid-liquid

b. Organic Preparation: (**Any two including Crystallization, MP, TLC**)

i) Pthalic anhydride to pthalamide

ii) Glucose to osazone

iii) Acetanilide to p-bromoactanilide

iv) Benzaldehyde to dibenzylidene acetone

After completion of practical course student should be able to –

i) Verify theoretical principles experimentally.

ii) Acquire skill of crystallisation, record correct m. p. / b. p.

iii) Perform the complete chemical analysis of the given organic compound andshould be able to recognize the type of compound.

iv) Write balanced equation for all the reactions, they carry in the laboratory.

v) Perform the given organic preparation according to the given procedure.

vi) Follow the progress of the reaction by using TLC technique.

vii) Set up the apparatus properly for the given experiments.

viii) Perform all the activities in the laboratory with neatness and cleanness.Ref. 1 Organic Qualitative Analysis: A. I. Vogel

D) Analytical Chemistry Practicals (Any Five)

i. Estimation of sodium carbonate content of washing soda.(Vogel 5thEdition: 10.30 page 295).

ii. Determination of Ca in presence of Mg using EDTA.
Ref.2: Page 412

iii. a) Preparation of standard 0.05 N oxalic acid solution andstandardization of approx. 0.05N $KMnO_4$ solution.
b) Determination of the strength of given H_2O_2 solution with standard 0.05 N $KMnO_4$solution.

iv. Estimation of Aspirin from a given tablet and find errors in quantitativeanalysis.

v. Estimation of Al (III) from the given aluminium salt solution by using Erichrome Black–T indicator (Back titration method)

vi. Iodometric estimation of copper.

vii. Report on one day industrial educational visit.

Reference books

1. Analytical Chemistry by G.D. Christian 6th edition.
2. Vogel's Textbook of Quantitative chemical analysis 6th edition R.C. Denney, J.D. Barnes, M.J.K. Thomas

Aim: To equip students to correlate theoretical and experimental knowledge

Objectives: After completion of practical course student should be able to

i. Verify theoretical principles experimentally

ii. Interpret the experimental data

iii. Improve analytical skills

iv. Correlate the theory and experiments and understand their importance

N.B. - Industrial visit during the academic year is compulsory.

UNIVERSITY OF PUNE
BOARD OF STUDIES IN ZOOLOGY

Revised Syllabus for S. Y. B. Sc. (Zoology)
To beimplemented from June, 2014

S.Y. B. Sc. (Zoology) New Syllabus

Semester-I

Paper I- ZY-211: Animal Systematics and Diversity –

IIIPaper II- ZY-212: Applied Zoology – I

Semester-II

Paper I- ZY-221: Animal Systematics and Diversity –

IVPaper II- ZY-222: Applied Zoology – II

Semester-I and II (Annual Examination)

Paper III- ZY-223: Practical course (Corresponding to Theory papers)

UNIVERSITY OF PUNE BOARD
OF STUDIES IN ZOOLOGY
COURSE STRUCTURE OF UNDERGRADUATE CLASSES

Class: F.Y. B. Sc. (To be implemented from June 2013)

Paper	Course No.	Term I	Term II
I	ZY 101	Animal Systematics and Diversity -I	Animal Systematics and Diversity –II
II	ZY 102	Fundamentals of Cell Biology	Genetics
III	ZY 103	Practical course	

Class: S.Y. B. Sc. (To be implemented from June 2014)

Paper	Course No.	Semester I	Course No.	Semester II
I	ZY.211	Animal Systematics and Diversity - III	ZY. 221	Animal Systematics and Diversity –IV
II	ZY.212	Applied Zoology I	ZY.222	Applied Zoology II
III	ZY.223	Practical course		

Class: T.Y. B. Sc. (To be implemented from June 2015)

Paper	Course	Semester III	Course	Semester IV
I	ZY.331	Animal Systematics and Diversity V	ZY.341	Biological Techniques
II	ZY.332	Mammalian Histology	ZY.342	Mammalian Physiology and Endocrinology
III	ZY.333	Biological Chemistry	ZY.343	Genetics and Molecular Biology
IV	ZY.334	Environmental Biology and Toxicology	ZY.344	Organic Evolution
V	ZY.335	Parasitology	ZY.345	General Embryology
VI	ZY.336	General Pathology or Cell Biology	ZY.346	Public Health and Hygiene or Medical Entomology
VII	ZY.347	Practicals corresponding to ZY 331, ZY 332, ZY 341 & ZY 342		
VIII	ZY.348	Practicals corresponding to ZY 333, ZY 334, ZY 343 & ZY 344		
IX	ZY.349	Practicals corresponding to ZY 335, ZY 336, ZY 345 & ZY 346		

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Prin. (Dr) D. K. Mhaske
Chairman, B.O.S. in Zoology
University of Pune

University of Pune

Draft of Syllabus to be implemented from June 2014

S. Y. B. Sc. Zoology

Semester-I

Paper I- ZY-211: Animal Systematics and Diversity –

IIIPaper II- ZY-212: Applied Zoology – I

Semester-II

Paper I- ZY-221: Animal Systematics and Diversity –

IVPaper II- ZY-222: Applied Zoology – II

Semester-I and II (Annual Examination)

Paper III- ZY-223: Practical course (Corresponding to Theory papers)

Equivalence of Previous Syllabus:

Semester	**Old Course (2009 Pattern)**	**New Course (2014 Pattern)**
Semester-I	Paper I: General Zoology and Biological Techniques-I	Paper I: Animal Systematics and Diversity –III
Semester-I	Paper II: Applied Zoology-I	Paper II: Applied Zoology-I
Semester-II	Paper I: General Zoology and Biological Techniques-II	Paper I: Animal Systematics and Diversity –IV
Semester-II	Paper II: Applied Zoology-II	Paper II: Applied Zoology-II
Annual Examination	Paper III: Practical course	Paper III: Practical course

PAPER I: FIRST SEMESTER

ZY-211: ANIMAL SYSTEMATICS AND DIVERSITY -III

1. Salient features and classification upto classes of the following: (any two examples from each class) : 15

1.1 Arthropoda :- Crustacea, Arachnida, Insecta, Myriapoda, Onychophora.

1.2 Mollusca:- Aplacophora, Gastropoda, Pelecypoda, Scaphopoda, Cephalopoda.

1.3 Echinodermata:- Asteroidea, Ophuroidea, Holothuria, Echinoidea, Crinoidea.

2. Study of following with reference to: 15

2.1 Arthropoda:- Mouthparts in Insects, Metamorphosis in Insects, Mimicry inInsects,

Economic importance of Insects, Larval forms in Crustacea

2.2 Mollusca:- Economic importance of mollusc, Shell and foot modification inmollusc,

Torsion and Detorsion in mollusc, Larval forms in molluscs

2.3 Echinodermata:- Origin of Echinodermata, Types of Pedicellariae, Larvalforms in Echinodermata,

3. Study of Starfish : 18

4.1 Systematic position, Habit and habitat

4.2 External characters

4.3 Digestive system

4.4 Water vascular system

4.5 Reproductive system

4.6 Autotomy and regeneration

PAPER –I: SECOND SEMESTER

ZY-221: ANIMAL SYSTEMATICS AND DIVERSITY – IV

1. Salient features of following classes and its subclasses with two examples of each: 12

- **1.1** Reptilia
- **1.2** Aves
- **1.3** Mammalia

2. General topics: 16

- **2.1** Poisonous and non-poisonous snakes (Two examples each)
- **2.2** Desert adaptations in reptiles in brief.
- **2.3** Beak and feet modifications in birds
- **2.4** Migration in birds
- **2.5** Aerial adaptations in birds
- **2.6** Egg laying mammals
- **2.7** Aquatic mammals

3. Study of *Scoliodon* : 20

- **3.1** Systematic position, Habit and habitat
- **3.2** External characters
- **3.3** Digestive system, food, feeding and physiology of digestion
- **3.4** Respiratory system
- **3.5** Blood vascular system
- **3.6** Nervous system and sense organs
- **3.7** Male urinogenital system and female reproductive system

PAPER II: FIRST SEMESTER

ZY-212: APPLIED ZOOLOGY – I

1. Fisheries :

1.1 An introduction to fisheries and its types (in brief) : Freshwater fisheries, Marine fisheries, Brackish water fisheries.

2

1.2 Different types of ponds used in fishery : Nursery pond, Rearing pond Stock pond

2

1.3 Habit, habitat and culture methods of following freshwater forms : **10**

- **a)** Rohu (*Labeo rohita*)
- **b)** Catla (*Catla catla*)
- **c)** Mrigal (*Cirrhinus mrigala*)
- **d)** Giant prawn (*Macrobrachium rosenbergi*)

1.4 Harvesting methods of following marine forms : **4**

- ***a)*** *Harpadon*
- **b)** Mackerel
- **c)** Lobster
- **d)** Pearl oyster

1.5 Crafts and gears in Indian Fishery : **2**

- **a)** Crafts – Catamaran, Machwa, Dinghy, Dug out canoe, Built – up boatGears – Gill net, Dol net, Purse net, Rampani net, Cast net

1.6 Fishery byproducts : **2**

- **a)** Fish meal
- **b)** Fish flour
- **c)** Liver oil
- **d)** Ising glass
- **e)** Fish glue
- **f)** Fish manure
- **g)** Fish fin soup

1.7 Fish preservation technique : **2**

- **a)** Chilling
- **b)** Freezing

c) Salting

2. Agricultural Pests and their control :

2.1 An introduction to Pest, types of pests (agricultural, household, stored grain, structural, veterinary, forestry and nursery) **2**

2.2 Major insect pests of agricultural importance (Marks of identification, life cycle, nature of damage and control measures) **9**

a) Jowar stem borer

b) Red cotton bug

c) Brinjal fruit borer

d) Mango stem borer

e) Pulse beetle

f) Rice weevil

2.3 Non insect pest : Rats and Bandicoots, Crabs, Snails, Slugs, Birds and Squirrels **2**

2.4 Pest control practices in brief : Cultural control, Physical control, Mechanicalcontrol, Chemical control, Biological control, Pheromonal control and Concept of IPM in brief **6**

2.5 Plant protection appliances : Rotary duster, Knapsack sprayer, Cynogas Pump.

3

2.6 Hazards of pesticides on human and antidotes. **2**

PAPER II: SECOND SEMESTER ZY-

222: APPLIED ZOOLOGY – II

1. Apiculture :

1.1 An introduction to Apiculture, Study of habit, habitat and nesting behavior of *Apis dorsata*, *Apis indica*, *Apis florae* and *Apis mellifera*. **3**

1.2 Life cycle, Colony organization and division of labour, Polymorphism **3**

1.3 Bee behaviour and bee communication. **3**

1.4 Bee keeping equipments : **a)** Bee box (Langstroth type) **b)** Honey extractor **c)** Smoker **d)** Bee-veil **e)** Gloves **f)** Hive tool **g)** Bee Brush **h)** Queen excluder **3**

1.5 Bee keeping and seasonal management. **2**

1.6 Bee products (collection methods, composition and uses: **a)** Honey **b)** Wax **c)** Bee Venom **d)** Propolis **e)** Royal jelly **f)** Pollen grains **4**

1.7 Diseases and enemies of Bees:

a) Bee diseases – Protozoan, Bacterial, Viral, Fungal – with two examples.

b) Bee pests – Wax moth (Greater and Lesser), Wax beetle.

c) Bee Enemies – Bee eater, King crow, Wasp, Lizard, Bear, Man. **5**

1.8 Bee pollination **1**

2. Sericulture :

2.1 An introduction to sericulture, Study of different types of silk moths, their distribution and varieties of silk produced by Mulberry, Tassar, Eri and Muga silkworms in India. **4**

2.2 External morphology and life cycle of *Bombyx mori.* **3**

2.3 Cultivation of mulberry (moriculture): **a)** Varieties for cultivation, **b)** Rainfed and irrigated mulberry cultivation – Fertilize schedule, Prunning methods and leaf yield. **4**

2.4 Harvesting of mulberry: **a)** Leaf plucking **b)** Branch cutting **c)** Whole shoot cutting. **2**

2.5 Silk worm rearing: **a)** Types of rearing **b)** Rearing house **c)** Rearing techniques **d)** Important diseases and pests. **7**

2.6 Post harvest processing of cocoons:

a) Harvesting and Preparation of cocoons for marketing

b) Stiffling, Sorting, Storage, Deflossing and Riddling

c) Cocoon cooking, Reeling Equipment and Rereeling,
Washing and Polishing. **4**

PAPER III: FIRST AND SECOND SEMESTERZY-223:

PRACTICAL COURSE

Practical 1. Study and classification with reasons of the following animals
Phylum Arthropoda:- Scorpion, Crab, Cockroach, Head louse, Centipede, Peripatus (D)

Practical 2. Study and classification with reasons of the following animals
Phylum Mollusca:- Chiton, Snail, Bivalve, Dentalium, Octopus, (D)

Practical 3. Study and classification with reasons of the following animals
Phylum Echinodermata:- Star fish, Brittle star, Holothuria, Sea Urchin, Echinus (D)

Practical 4. Study of permanent slides of mouthparts of the following insects : (D)
Cockroach, Mosquito, Plant bug/Bed bug, Butterfly, Honey Bee and Housefly

Practical 5. A) Study of Shell:- Chiton, Pila, Sepia, Pecten, Dentalium,
B) Study of Foot:- Chiton,Patella, Aplysia, Sepia, Octopus, Dentalium (D)Practical 6. To Study the external characters and digestive system of *starfish*. (E)

Practical 7. A) Study of water vascular system of *starfish*. (E)
B) Temporary preparation of gonads from *starfish.* (E)

Practical 8. A) Study of permanent slides of T. S. of arm and types of pedicellariae of *starfish*. (D)
B) Larval forms in Echinodermata. (D)

Practical 9. Identification, Classification and study of habit, habitat and economic importance of the following:
a) Rohu, Catla, Mrigal, Pomphret. (D)
b) Prawn, Crab, Oyster. (D)

Practical 10. Study and maintenance of Aquarium. (E)

Practical 11. Study of any three types of crafts and gears in fishing. (D)

Practical 12. Study of insect pests with respect to marks of identification, nature of damage and economic importance (Examples related to theory course) (D)Practical 13. Study of pest control appliances (Sprayer/Duster) (D)

Practical 14. Study and classification with reasons of the following animals (D)
Class Reptilia – Cobra, Garden lizard, Turtle, Rat snake, Draco

Practical 15.	Study and classification with reasons of the following animals Class Aves – Sparrow, Crow, Parrot, Woodpecker Class Mammals – Rabbit, Mungoose, Kangaroo	(D)
Practical 16.	Identification of Poisonous and non- poisonous snakes with the help of identification key with two examples of each	(D)
Practical 17.	Study of modifications of beaks and feet in birds (Museum specimen)	(D)
	a) Beaks: tearing and piercing, fruit eating, mud probing, fish catching, woodchiseling and flower probing.	
	b) Feet: perching, raptorial, climbing, swimming, running.	
Practical 18.	Study of external characters and digestive system of *Scoliodon*.	(E)
Practical 19.	Study of brain of *Scoliodon*	(E)
Practical 20.	a) Temporary preparation of placoid scales from *Scoliodon*	(E)
	b) Study of cranial nerves, eye ball muscles of *Scoliodon*	(D)
	c) Study of Membranous labyrinth of *Scoliodon*	(D)
Practical 21.	a) Study of life cycle of Honey bee	(D)
	b) Study of mouth parts, thoracic appendages (legs and wings) and sting apparatus of Honey bee	(E)
Practical 22.	Study of various bee keeping equipments	(D)
Practical 23.	Study of: a) bee products, b) bee pests, d) bee enemies	(D)
Practical 24.	a) Study of life cycle of *Bombyx mori*.	(D)
	b) Study of any five equipments in Sericulture.	(D)
Practical 25.	Compulsory submission of field visit report along with at least five Photographs/ sketches of insect pest/fishes/any animal correspondingto theory courses	
Practical 26.	Compulsory study tour/visit to sea coast/fishery institute/sericulture farm/ apiculture institute / agricultural farm.	

Practical Skeleton Paper

Class – S.Y.B.Sc. **Subject – Zoology**

Time – 10.00 am onwards **Max. Marks – 80**

Q.1 – Dissect Starfish/*Scoliodon* so as to expose its……system. (16)

Q.2 – Make a stained temporary preparation of ……

from Honey bee/Starfish/*Scoliodon* (10)

Q.3 – Identification (Non-chordates and Chordates) (21)

a) Identify and classify giving reasons (Arthropoda)

b) Identify and classify giving reasons (Mollusca/Echinodermata)

c) Identify and classify giving reasons (Cyclostomata/Reptiles)

d) Identify and classify giving reasons (Aves/Mammals)

e) Identify and describe the types of mouthparts of insect

f) Identify and describe (Shell/Foot of mollusca/Poisonous/Non poisonous snake)

g) Identify and comment on its modifications (Beak/feet modifications in birds)

Q.4 – Identification (Applied Zoology) (18)

a) Identify and give its economic importance (Any fish)

b) Identify and describe (Any gear/craft)

c) Identify and give its application (Plant protection appliance)

d) Identify and describe (One stage of life cycle of honeybee/silkworm)

e) Identify and describe (Sericulture equipment)

f) Identify and describe (Bee keeping equipment/Bee product)

Q.5 – a) Tour report and Certified Journal (05)

b) Viva- voce (05)

Q.6- Submission of field visit report along with five photographs/sketches of insect pest/fishes/any animal (05)

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ZY-211 Animal Systematics and Diversity - III

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ZY- 212 Applied Zoology Part- I

Fisheries & Agricultural pests and their Control

1. Fishes . Mary Chandy. N.B.T. India, 2005.
2. Economic Zoology, Shukla Upadhyay, Rastogi Publication, Meerut, India, 1998.
3. Fisheries Developments, K.K. Trivedi, Oxford and IBH Pub. Co.
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ZY- 221 Animal Systematics and Diversity - IV

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2. Chordate Zoology, 1982, P.S Dhami and J.K.Dhami, R.Chand and Co., New Dehli.
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5. Chordate Zoology, E.L. Jordon. S. Chand & Co., New Dehli.
6. Organic Evolution. R.S. Lull. Light & Life Publishers.
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ZY-222 Applied Zoology Part-II

Apiculture and Sericulture

1. Destructive and useful Insects, their habit and Control, 1973. C.L. Metcalf and W. p.Flint, Tata McGraw Hill Publications, New Dehli.
2. A Text Book Of Entomology, 1974. V.K. Mathur and K.D. Upadhayay, Goel PrintingPress, Barani.
3. Imm's Text Book of Entomology, Vol I & II, Richard and Owen.
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ZY- 223 Practical Courses

1. Invertebrates Practical Zoology. V. Banerjee. Bharati Bhavan, Patana, 1997
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Revised SyllabusFor

B. Sc.
(Physics)

From Academic Year 2013-2014

Structure of Syllabus

UNIVERSITY OF PUNE

Proposed Structure of B.Sc. (Physics) Syllabus

1) Preamble:

The systematic and planned curricula from first year to the third year shall motivate and encourage the students for pursuing higher studies in Physics and for becoming an entrepreneur.

Objectives:

- To provide in depth knowledge of scientific and technological aspects of Physics
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving, hand on activities, study visits, projects etc.
- To train students in skills related to research, education, industry, and market.
- To create foundation for research and development in Electronics
- To develop analytical abilities towards real world problems
- To help students build-up a progressive and successful career in Physics

2) Eligibility:

1 **First Year B.Sc.:** Higher Secondary School Certificate (10+2) Science stream or its equivalent Examination as per the University of Pune eligibility norms.

2 **Second Year B.Sc.:** Keeping terms of First Year of B. Sc. with Physics as one of the subjects. Other students if they fulfil the conditions approved by the equivalence committee of Faculty of Science of the University of Pune are also eligible.

3 **Third Year B. Sc.:** Student shall pass all First Year B. Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Physics as one of the subjects.

Note: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune. Reservation and relaxation will be as per the Government rules.

F.Y. B. Sc.
(From Academic Year 2013-2014)
(To be implemented from Academic Year 2013-14

Paper	Title
Paper I	Section I (For Term 1): Mechanics
	Section II (For Term 2): Heat and Thermodynamics
Paper II	Section I (For Term 1): Physics Principles and Applications
	Section II (For Term 2): Electromagnetics
Paper III	(For Term1 and Term 2): Practical

For each theory course: 36 Lectures per term/2 Credits per termFor practical course: 20 practicals/4Credits

S. Y. B. Sc.
(Semester Pattern)
(From Academic Year 2014-2015)

Semester I

Paper	Title
Paper I (PHY211)	Mathematical Methods in Physics I
Paper II (PHY 212)	Electronics I /Instrumentation

Semester II

Paper	Title
Paper I (PHY221)	Oscillations, Waves and Sound
Paper II (PHY 222)	Optics

Practical Course (Annual)

Paper III (PHY 223) (Annual)	Practical

T. Y. B. Sc. (Physics)
(Semester Pattern)

(From Academic Year 2015-2016)

Theory Courses (Semester)	
Semester III	**Semester IV**
PH331: Mathematical Methods in Physics II	PH341: Solid State Physics
PH332: Classical Electrodynamics	PH342: Quantum Mechanics
PH333: Classical Mechanics	PH343: Thermodynamics and Statistical Physics
PH334: Atomic and Molecular Physics	PH344: Nuclear Physics
PH335: Computational Physics	PH345: Electronics II /Advanced Electronics

PH336: Elective I (Select any One)	PH346: Elective II (Select any One)
A: Astronomy and Astrophysics	F: Renewable Energy Sources
B: Elements of Materials Science	G: Physics of Nano materials
C: Motion Picture Physics	H: Microcontrollers
D: Biophysics	I: Electro Acoustics and Entertainment Electronics
E: Medical Electronics	J: Lasers
	K: Methods of Experimental Physics
Practical Courses (Annual)	
PH347: Laboratory Course I	
Phy348: Laboratory Course II	
PH349: Laboratory Course III (Project)	

Examination:

A) Pattern of Examination:

i) F. Y. B. Sc.

(a) There shall be university examination at the end of the academic year for 80 marks for each theory paper.

(b) 20 marks for each paper are allotted to the comprehensive internal assessment of the student by the respective teacher, teaching the course.The teacher shall evaluate the performance of the student for 10 marks in each term; on the basis of written tests. Ordinarily written tests shall consist of
(i) multiple choice questions, (ii) True/False, (iii) basic definitions, (iv) tricky computational problems involving minimal calculations. Student is asked to answer 20 questions in 40 minutes. Each question will be of ½ marks. In the same classroom setup, different set of equivalent sets of question papers may be experimented. It will be preferred to have two such tests in each term, per course(one at the middle of the term and one at the end of the term) and average (or best of the two tests) be considered as internal marks out of 10 for that term. Internal Test shall cover the entire syllabus. If teacher prefers to have one test only, it shall be at the end of the term covering the entire syllabus).

(c) Practical examination be conducted by respective colleges at the end of the academic year 80 marks be assigned to practicals and 20 marks for internal examination, journal attendance (Journal 10 marks, Oral 10 marks).

ii) S. Y. B. Sc. and T. Y. B. Sc.

(a) There shall be university examination at the end of semester for 40 marks for each theory paper.

(b) 10 marks for each paper are allotted to the comprehensive internal assessment of the student by the respective teacher, teaching the course. Pattern of internal assessment shall be on the lines of F.Y.B. Sc.

(c) University Practical examination be conducted at the end of the academic year 80 marks be assigned to practicals and 20 marks for internal examination, journal attendance (Journal 10 marks, Oral 10 marks).

For practical examination:

(1) At least one examiner should be external

(2) Certified journals be compulsory

(3) There shall be two experts for all subjects.

(4) (a) At T. Y. B. Sc. level, it is preferred to have project work in lien of one of the practical course.

(b) Blue print for Model Question Paper: Each Board of Studies shall frameat least 5 sets of model theory papers and 10 sets of model question setfor internal assessment.

II) Pattern of the Question paper:

For theory paper (University examination) shall be as follows.

F. Y. B. Sc. (80 Marks) (Time Allotted: 3 hrs)

Q1. 16 marks for 8 sub-questions, each sub-question for two marks. Sub- questions shall be answerable in two to four lines and shall be based on complete syllabus.

Q2. and Q3. Student shall attempt four out of six questions. Each shortanswer type question shall carry four marks and be answerable in 6 to 8 lines.

Q4. Student shall attempt 2 out of 4 long answer type questions. Each question will be for 8 marks and be answerable in 12 to 16 lines.

Q5. Long easy type question for 16 marks. Student shall attempt one out of two questions.

OR

Q5. Shall be on the pattern of question 4.

(Question paper of a particular course should contain minimum of 30%weightage to problems)

S. Y. B. Sc. and T. Y. B. Sc. (Theory) University Question Paper Pattern:

(40 marks, Time allotted: 2 hrs)

Q1. 10 sub-question each for 1 mark. Sub-questions be answerable within 2to 4 lines and shall be based on complete syllabus. All sub-questions arecompulsory.

Q2 and Q3: (10 Marks for each questions) Three sub questions. Students have to attempt any two questions.

Q4. Long Essay type question for 8 marks and one question of two marks.

B) Standard of Passing: 40 % marks

C) ATKT Rules

(i) Students shall clear 8 heads of passing (out of 12 such heads) while going from F. Y. B. Sc. to S.Y.B.Sc. However he must pass in all F. Y. B. Sc. subjects while going to T. Y. B. Sc.

(ii) Student shall clear 12 heads of passing (out of 20 such heads) while going from S. Y. B. Sc. to T. Y. B. Sc. (Practical course of S. Y. B. Sc. will be equivalent to 2 heads of passing)

D) Award of Class: As per University norms.

E) External Students: Not applicable

F) Setting of question paper/Pattern of Question paper: As mentioned above

6) Structure of the Course:

a) Compulsory paper: a) At F.Y.B.Sc. and S.Y.B.Sc. all papers are compulsory and at T.Y.B.Sc. 8 papers are compulsory and one paper is optional.

b) Optional papers: At T.Y.B.Sc. one paper per semester is optional.

c) Question papers and papers etc.: As mentioned above

d) Medium of Instructions: English

7) Equivalence of previous syllabus along with propose syllabus: The papers are similar so no equivalence is required at B. Sc. level.

8) University terms: 6 terms

9) Subject-wise detailed syllabus: Attached with this format.

10) Recommended books: Given in the syllabus at the end of each course.

11) Qualification of teachers: As per UGC regulations.

F. Y. B. Sc.
Term -I

Physics Paper I: Section I: Mechanics

Lectures: 36 **Credits: 2**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1. Demonstrate an understanding of Newton's laws and applying them in calculations of the motion of simple systems.
2. Use the free body diagrams to analyse the forces on the object.
3. Understand the concepts of energy, work, power, the concepts of conservation of energy and be able to perform calculations using them.
4. Understand the concepts of elasticity and be able to perform calculations using them.
5. Understand the concepts of surface tension and viscosity and be able to perform calculations using them.
6. Use of Bernoulli's theorem in real life problems.
7. Demonstrate quantitative problem solving skills in all the topics covered.

Syllabus:

1. Newton's laws of motion **(6 Lectures)**

1.1 Newton's First and Second Law and their explanation
1.2 Working with Newton's First and Second Law
1.3 Newton's Third Law of motion and its explanation
1.4 Various types of forces in nature (explanation) and concept of field
1.5 Frame of reference (Inertial, Non-inertial)
1.6 Pseudo Forces (e.g. Centrifugal Force)

2. Work and Energy **(8 Lectures)**

2.1 Kinetic Energy
2.2 Work and Work-Energy Theorem
2.3 Calculation of Work done with
i) Constant Force
ii) Variable Force
Illustration
2.4 Conservative and Non-conservative Forces
2.5 Potential energy and conservation of Mechanical energy
2.6 Change in potential energy in rigid body motion
Mass-energy equivalence

3. Elasticity **(8 Lectures)**

3.1 Hook's law and coefficient of elasticity
3.2 Young's modulus, Bulk modulus and Modulus of rigidity
3.3 Work done during longitudinal strain, volume strain, and shearing strain
3.4 Poisson's ratio
3.5 Relation between three elastic moduli (Y, η, K)
3.6 Determination of Y of rectangular thin bar loaded at the centre
3.7 Torsional oscillations
Torsional rigidity of a wire, to determine η by torsional oscillations

4. Surface Tension **(5 Lectures)**

4.1 Surface Tension, Angle of Contact, Capillary Rise Method
4.2 Rise of liquid in a conical capillary tube
4.3 Energy required to raise a liquid in capillary tube

4.4 Factors affecting surface tension
4.5 Jeager's Method for Determination of surface tension
4.6 Applications of Surface Tension

5. Viscosity and Fluid Mechanics (9 Lectures)

5.1 Concept of Viscous Forces and Viscosity
5.2 Pressure in a fluid and buoyancy
5.3 Pascal's law
5.4 Atmospheric Pressure and Barometer
5.5 Pressure difference and Buoyant Force in accelerating fluids
5.6 Steady and Turbulent Flow, Reynolds's number
5.8 Equation of continuity
5.9 Bernoulli's Principle
5.10 Application of Bernoulli's equation
i) Speed of Efflux
ii) Ventury meter
iii) Aspirator Pump
iv) Change of plane of motion of a spinning ball.

Reference Books:

1. University Physics: Sears and Zeemansky, XIth edition, Pearson education
2. Concepts of Physics: H.C. Varma, Bharati Bhavan Publishers
3. Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd.
4. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir, VI Edition, Pearson Education/Prentice Hall International, New Delhi
5. Properties of Matter: D. S. Mathur, Shamlal Chritable Trust New Delhi
6. Mechanics: D.S Mathur, S Chand and Company New Delhi-5.

F. Y. B. Sc.
Term –II

Physics Paper I: Section II: Heat and Thermodynamics

Lectures: 36 **Credits: 2**

Learning Outcomes:

After successfully completing this course, the student will be able to do the following:

1. Describe the properties of and relationships between the thermodynamic properties of a pure substance.
2. Describe the ideal gas equation and its limitations.
3. Describe the real gas equation.
4. Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.
5. Analyse the heat engines and calculate thermal efficiency.
6. Analyze the refrigerators, heat pumps and calculate coefficient of performance.
7. Understand property 'entropy' and derive some thermo dynamical relations using entropy concept.
8. Understand the types of thermometers and their usage.

Syllabus

1. Equation of state (8 lectures)

1.1 Equations of state
1.2 Andrew's experiment
1.3 Amagat's experiment
1.4 Van der Waals' equation of state
1.5 Critical constants
1.6 Reduced equation of state
1.7 Joule-Thomson porous plug experiment

2. Concepts of Thermodynamics (8 lectures)

2.1 Thermodynamic state of a system and Zeroth law of Thermodynamics
2.2 Thermodynamic Equilibrium
2.3 Adiabatic and isothermal changes
2.4 Work done during isothermal changes
2.5 Adiabatic relations for perfect gas
2.6 Work done during adiabatic change
2.7 Indicator Diagram
2.8 First law of Thermodynamics
2.9 Reversible and Irreversible processes

3. Applied Thermodynamics (8 lectures)

3.1 Conversion of Heat into Work and its converse
3.2 Carnot's Cycle and Carnot's Heat Engine and its efficiency
3.3 Second law of Thermodynamics
3.4 Concept of Entropy
3.5 Temperature-Entropy Diagram
3.6 T-dS Equation
3.7 Clausius-Clapeyron Latent heat equations

4. Heat Transfer Mechanisms (8 lectures)

4.1 Heat Engines
   i. Otto cycle and its efficiency
   ii. Diesel cycle and its efficiency

4.2 Refrigerators:
- i. General Principle and Coefficient of performance of refrigerator
- ii. The Carnot Refrigerator
- iii. Simple structure of vapour compression refrigerator

4.3 Air conditioning: principle and its applications

5. Thermometry (4 lectures)

5.1 Temperature Scales: Centigrade, Fahrenheit and Kelvin scale

5.2 Principle, construction and working of following thermometers
- i. Liquid and Gas Thermometers
- ii. Resistive Type Thermometer
- iii. Thermocouple as thermometer
- iv. Pyre heliometer

Reference Books:

1. Physics: 4th Edition, Volume I, Resnick/Halliday/Krane JOHN WILEY & SONS (SEA) PTE LTD
2. Concept of Physics: H.C. Verma, Bharati Bhavan Publishers
3. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand & Company Ltd, New Delhi
4. Heat and Thermodynamics: Mark. W. Zemansky, Richard H. Dittman, Seventh Edition, McGraw-Hill International Editions
5. Thermodynamics and Statistical Physics: J.K. Sharma, K.K. Sarkar, Himalaya Publishing House
6. Thermal Physics (Heat & Thermodynamics): A.B. Gupta, H.P. Roy Books and Allied (P) Ltd, Calcutta.

F. Y. B. Sc.

Term I

Physics Paper II: Section I: Physics Principles and Applications

Lectures: 36 **Credits: 2**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1. To demonstrate an understanding of electromagnetic waves and its spectrum.
2. Understand the types and sources of electromagnetic waves and applications.
3. To understand the general structure of atom, spectrum of hydrogen atom.
4. To understand the atomic excitation and LASER principles.
5. To understand the bonding mechanism in molecules and rotational and vibrational energy levels of diatomic molecules.
6. To demonstrate quantitative problem solving skills in all the topics covered.

Syllabus:

1. Physics of Atoms (12Lectures)

1. The concept of atom (Atomic Models: Thompson and Rutherford)
2. Atomic Spectra
3. Bohr Theory
4. Hydrogen atom Spectra
5. Frank Hertz experiment
6. The LASER

   Absorption, Spontaneous Emission, and Stimulated Emission, PopulationInversion and Laser Action, Applications of Lasers

2. Physics of Molecules (10 Lectures)

1. Bonding Mechanisms: A Survey
   - i. Ionic Bonds
   - ii. Covalent Bonds
   - iii. Van der Waals Bonds
   - iv. The Hydrogen Bond
   - v. Metallic Bond
2. Variation of potential energy with inter-atomic distance
3. Concept of Rotational and vibrational energy levels of diatomic molecule

3. Electromagnetic Waves (14 Lectures)

1. Historical Perspective of Electromagnetic Waves
2. Production of electromagnetic waves : Hertz experiment
3. Electromagnetic spectrum
4. Planck hypothesis of photons (Concept only)
5. Sources of electromagnetic waves : Radio waves, Microwaves, Infrared, Visible light, Ultraviolet, X-rays, Gamma rays
6. Applications
   - i. microwave oven
   - ii. RADAR
   - iii. Pyro electric thermometer
   - iv. X-ray radiography and CT Scan
   - v. Solar cell

References

1. Concepts of Modern Physics: A Beiser (6th ed., McGraw Hill, 2003
2. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer
3. Sears and Zemansky's University Physics: H.D. Young R. A. Freedman, Sandin (11^{th} Ed. Pearson Education)
4. Nanotechnology : Principles and Practices: S. K. Kulkarni, Capital Publishing Company.

F. Y. B. Sc.
Term II

Physics Paper II: Section II: Electromagnetics

Lectures: 36 **Credits: 2**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1. Demonstrate an understanding of the electric force, field and potential, and related concepts, for stationary charges.
2. Calculate electrostatic field and potential of simple charge distributions using Coulomb's law and Gauss's law.
3. Demonstrate an understanding of the dielectric and effect on dielectric due to electric field.
4. Demonstrate an understanding of the magnetic field for steady currents using Biot-Savart and Ampere's laws.
5. Demonstrate an understanding of magnetization of materials.
6. Demonstrate quantitative problem solving skills in all the topics covered.

Syllabus

1. Electrostatics (9 Lectures)

1. Revision of Coulomb's law
2. Superposition principle
3. Electric field due to an electric dipole, line and disc
4. Revision of Gauss's law
5. Coulomb's law from Gauss's law
6. Gauss's law applications in Cylindrical, planar and spherical symmetry

2. Dielectrics (9 Lectures)

1. Electric Dipole
2. Electric dipole and dipole moment
3. Electric potential and intensity at any point due to dipole
4. Torque on a dipole placed in an electric field
5. Polar and non-polar molecules
6. Electric polarization of dielectric material
7. Gauss' law in dielectric
8. Electric vectors and relation between them

3. Magneto statics (9 Lectures)

1. Revision of Biot-Savart's law with examples
2. Amperes' law, e.g. Solenoid and Toroid
3. Gauss law for magnetism

4. Magnetic properties of materials (9 Lectures)

1. Magnetic materials and Bohr magneton
2. Magnetization (M), magnetic intensity (H), magnetic induction (B), magnetic susceptibility and permeability
3. Relation between B, M and H
4. Hysteresis

References:

1. Fundamentals of Physics: 8th Edition, Halliday Resnik and Walkar
2. Electromagnetics: B. B. Laud

F. Y. B. Sc.
Term I and II

Physics paper III: Practical

Total Practicals: 20 **Credits: 4**

Learning Outcomes:

After successfully completing this laboratory course, the students will be able to dothe following:

1. Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
2. Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
3. Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
4. Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
5. Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

Syllabus:

1. Mechanics

1. Range and Least Count of Instruments, Measurements using various instruments and error analysis (Vernier caliper, screw gauge, travelling microscope, spectrometer etc.)
2. Determination MI of disc using ring
3. MI of Flywheel
4. Determination of coefficient of viscosity by Poiseulli's method
5. Determination of Y and n by flat spiral spring
6. Determination of Y by bending
7. Surface Tension by Jeager's method.

2. Heat and Thermodynamics

1. Interpretation of isothermal and adiabatic curves on PV diagrams (Theoretical). Theoretical study of Carnot's cycle by drawing graphs of isothermal and adiabatic curves.
2. Temperature coefficient of resistance
3. Study of thermocouple and determination of inversion temperature
4. Thermal conductivity by Lee's method
5. Specific heat of graphite

3. Light

1. Study of spectrometer and determination of angle of prism
2. Spectrometer calibration. Determination of refractive indices of different colours and plotting the graph of refractive index vs wavelength.
3. Study of total internal reflection using LASER
4. Study of polarization of light by reflection
5. Determination of wavelength of LASER light by plane diffraction grating or cylindrical obstacle.

4. Electricity and magnetism

1. Charging and discharging of a capacitor

2. Study of LR circuit
3. Study of LCR series circuit
4. Study of Kirchhoff's laws
5. Diode characteristics
6. Study of millimetres (all AC, DC ranges, Least Count)
7. Determination of frequency of AC mains

Students have to perform minimum three experiments from each section and totalsixteen experiments. Students can perform any two experiments from Computer Aided experiments in place of any two experiments in above four sections.

Additional Activities

1. Demonstrations (Any four demonstrations equivalent to two experiments)
    1. Magnet –magnet interaction
    2. Collision by using balls
    3. Study of Signal generator using CRO (Sine, square wave signal, measurement of AC voltage, frequency)
    4. Demonstration of action potential
    5. Measurement of sound pressure level
2. Computer aided demonstrations (Using computer simulations or animations) (Any two demonstrations equivalent to two experiments)
    1. Coulomb's law
    2. Vectors : visualization of vectors
    3. Bohr's model
    4. Carnot engine, diesel engine
    5. Graphs and their slopes, and Kinematics graphs (using computer simulations)
3. Mini projects/Hand on activities
    (Any one equivalent to two experiments)
    1. Students should collect the information of at least five Physicists with their work.
    2. Students should carry out mini projects
4. Study tour (Equivalent to two experiments)
    Students participated in study tour must submit a study tour report.

Students have to perform at least two additional activities out of four activities in addition to sixteen experiments mentioned above. Total Laboratory work with additional activities should be equivalent to twenty experiments.

UNIVERSITY OF PUNE

Proposed Structure of B.Sc. (Physics) Syllabus

3) Preamble:

The systematic and planned curricula from first year to the third year shall motivate and encourage the students for pursuing higher studies in Physics and for becoming an entrepreneur.

Objectives:

- To provide in depth knowledge of scientific and technological aspects of Physics
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving, hand on activities, study visits, projects etc.
- To train students in skills related to research, education, industry, and market.
- To create foundation for research and development in Electronics
- To develop analytical abilities towards real world problems
- To help students build-up a progressive and successful career in Physics

4) Eligibility:

4 **First Year B.Sc.:** Higher Secondary School Certificate (10+2) Science stream or its equivalent Examination as per the University of Pune eligibility norms.

5 **Second Year B.Sc.:** Keeping terms of First Year of B. Sc. with Physics as one of the subjects. Other students if they fulfil the conditions approved by the equivalence committee of Faculty of Science of the University of Pune are also eligible.

6 **Third Year B. Sc.:** Student shall pass all First Year B. Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Physics as one of the subjects.

Note: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune. Reservation and relaxation will be as per the Government rules.

F.Y. B. Sc.
(From Academic Year 2013-2014)
(To be implemented from Academic Year 2013-14

Paper	Title
Paper I	Section I (For Term 1): Mechanics
	Section II (For Term 2): Heat and Thermodynamics
Paper II	Section I (For Term 1): Physics Principles and Applications
	Section II (For Term 2): Electromagnetics
Paper III	(For Term1 and Term 2): Practical

For each theory course: 36 Lectures per term/2 Credits per termFor practical course: 20 practicals/4Credits

S. Y. B. Sc.
(Semester Pattern)
(From Academic Year 2014-2015)

Semester I

Paper	Title
Paper I (PHY211)	Mathematical Methods in Physics I
Paper II (PHY 212)	Electronics I /Instrumentation

Semester II

Paper	Title
Paper I (PHY221)	Oscillations, Waves and Sound
Paper II (PHY 222)	Optics

Practical Course (Annual)

Paper III (PHY 223) (Annual)	Practical

T. Y. B. Sc. (Physics)
(Semester Pattern)

(From Academic Year 2015-2016)

Theory Courses (Semester)	
Semester III	**Semester IV**
PH331: Mathematical Methods in Physics II	PH341: Solid State Physics
PH332: Classical Electrodynamics	PH342: Quantum Mechanics
PH333: Classical Mechanics	PH343: Thermodynamics and Statistical Physics
PH334: Atomic and Molecular Physics	PH344: Nuclear Physics
PH335: Computational Physics	PH345: Electronics II /Advanced Electronics

PH336: Elective I (Select any One)	PH346: Elective II (Select any One)
A: Astronomy and Astrophysics	F: Renewable Energy Sources
B: Elements of Materials Science	G: Physics of Nano materials
C: Motion Picture Physics	H: Microcontrollers
D: Biophysics	I: Electro Acoustics and Entertainment Electronics
E: Medical Electronics	J: Lasers
	K: Methods of Experimental Physics
Practical Courses (Annual)	
PH347: Laboratory Course I	
Phy348: Laboratory Course II	
PH349: Laboratory Course III (Project)	

Examination:

A) Pattern of Examination:

i) F. Y. B. Sc.

(d) There shall be university examination at the end of the academic year for 80 marks for each theory paper.

(e) 20 marks for each paper are allotted to the comprehensive internal assessment of the student by the respective teacher, teaching the course.The teacher shall evaluate the performance of the student for 10 marks in each term; on the basis of written tests. Ordinarily written tests shall consist of
(i) multiple choice questions, (ii) True/False, (iii) basic definitions, (iv) tricky computational problems involving minimal calculations. Student is asked to answer 20 questions in 40 minutes. Each question will be of ½ marks. In the same classroom setup, different set of equivalent sets of question papers may be experimented. It will be preferred to have two such tests in each term, per course(one at the middle of the term and one at the end of the term) and average (or best of the two tests) be considered as internal marks out of 10 for that term. Internal Test shall cover the entire syllabus. If teacher prefers to have one test only, it shall be at the end of the term covering the entire syllabus).

(f) Practical examination be conducted by respective colleges at the end of the academic year 80 marks be assigned to practicals and 20 marks for internal examination, journal attendance (Journal 10 marks, Oral 10 marks).

ii) S. Y. B. Sc. and T. Y. B. Sc.

(d) There shall be university examination at the end of semester for 40 marks for each theory paper.

(e) 10 marks for each paper are allotted to the comprehensive internal assessment of the student by the respective teacher, teaching the course. Pattern of internal assessment shall be on the lines of F.Y.B. Sc.

(f) University Practical examination be conducted at the end of the academic year 80 marks be assigned to practicals and 20 marks for internal examination, journal attendance (Journal 10 marks, Oral 10 marks).

For practical examination:

(1) At least one examiner should be external

(2) Certified journals be compulsory

(3) There shall be two experts for all subjects.

(4) (a) At T. Y. B. Sc. level, it is preferred to have project work in lien of one of the practical course.

(b) Blue print for Model Question Paper: Each Board of Studies shall frameat least 5 sets of model theory papers and 10 sets of model question setfor internal assessment.

II) Pattern of the Question paper:

For theory paper (University examination) shall be as follows.

F. Y. B. Sc. (80 Marks) (Time Allotted: 3 hrs)

Q1. 16 marks for 8 sub-questions, each sub-question for two marks. Sub- questions shall be answerable in two to four lines and shall be based on complete syllabus.

Q2. and Q3. Student shall attempt four out of six questions. Each shortanswer type question shall carry four marks and be answerable in 6 to 8 lines.

Q4. Student shall attempt 2 out of 4 long answer type questions. Each question will be for 8 marks and be answerable in 12 to 16 lines.

Q5. Long easy type question for 16 marks. Student shall attempt one out of two questions.

OR

Q5. Shall be on the pattern of question 4.

(Question paper of a particular course should contain minimum of 30%weightage to problems)

S. Y. B. Sc. and T. Y. B. Sc. (Theory) University Question Paper Pattern:

(40 marks, Time allotted: 2 hrs)

Q1. 10 sub-question each for 1 mark. Sub-questions be answerable within 2to 4 lines and shall be based on complete syllabus. All sub-questions arecompulsory.

Q2 and Q3: (10 Marks for each questions) Three sub questions. Students have to attempt any two questions.

Q4. Long Essay type question for 8 marks and one question of two marks.

B) Standard of Passing: 40 % marks

C) ATKT Rules

(iii) Students shall clear 8 heads of passing (out of 12 such heads) while going from F. Y. B. Sc. to S.Y.B.Sc. However he must pass in all F. Y. B. Sc. subjects while going to T. Y. B. Sc.

(iv) Student shall clear 12 heads of passing (out of 20 such heads) while going from S. Y. B. Sc. to T. Y. B. Sc. (Practical course of S. Y. B. Sc. will be equivalent to 2 heads of passing)

D) Award of Class: As per University norms.

E) External Students: Not applicable

F) Setting of question paper/Pattern of Question paper: As mentioned above

12) Structure of the Course:

a) Compulsory paper: a) At F.Y.B.Sc. and S.Y.B.Sc. all papers are compulsory and at T.Y.B.Sc. 8 papers are compulsory and one paper is optional.

b) Optional papers: At T.Y.B.Sc. one paper per semester is optional.

c) Question papers and papers etc.: As mentioned above

d) Medium of Instructions: English

13) Equivalence of previous syllabus along with propose syllabus: The papers aresimilar so no equivalence is required at B. Sc. level.

14) University terms: 6 terms

15) Subject-wise detailed syllabus: Attached with this format.

16) Recommended books: Given in the syllabus at the end of each course.

17) Qualification of teachers: As per UGC regulations.

F. Y. B. Sc.
Term -I

Physics Paper I: Section I: Mechanics

Lectures: 36 **Credits: 2**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

8. Demonstrate an understanding of Newton's laws and applying them in calculations of the motion of simple systems.
9. Use the free body diagrams to analyse the forces on the object.
10. Understand the concepts of energy, work, power, the concepts of conservation of energy and be able to perform calculations using them.
11. Understand the concepts of elasticity and be able to perform calculations using them.
12. Understand the concepts of surface tension and viscosity and be able to perform calculations using them.
13. Use of Bernoulli's theorem in real life problems.
14. Demonstrate quantitative problem solving skills in all the topics covered.

Syllabus:

6. Newton's laws of motion **(6 Lectures)**

6.1 Newton's First and Second Law and their explanation
6.2 Working with Newton's First and Second Law
6.3 Newton's Third Law of motion and its explanation
6.4 Various types of forces in nature (explanation) and concept of field
6.5 Frame of reference (Inertial, Non-inertial)
6.6 Pseudo Forces (e.g. Centrifugal Force)

7. Work and Energy **(8 Lectures)**

7.1 Kinetic Energy
7.2 Work and Work-Energy Theorem
7.3 Calculation of Work done with
i) Constant Force
ii) Variable Force
Illustration
7.4 Conservative and Non-conservative Forces
7.5 Potential energy and conservation of Mechanical energy
7.6 Change in potential energy in rigid body motion
Mass-energy equivalence

8. Elasticity **(8 Lectures)**

8.1 Hook's law and coefficient of elasticity
8.2 Young's modulus, Bulk modulus and Modulus of rigidity
8.3 Work done during longitudinal strain, volume strain, and shearing strain
8.4 Poisson's ratio
8.5 Relation between three elastic moduli (Y, η, K)
8.6 Determination of Y of rectangular thin bar loaded at the centre
8.7 Torsional oscillations
Torsional rigidity of a wire, to determine η by torsional oscillations

9. Surface Tension **(5 Lectures)**

9.1 Surface Tension, Angle of Contact, Capillary Rise Method
9.2 Rise of liquid in a conical capillary tube
9.3 Energy required to raise a liquid in capillary tube

9.4 Factors affecting surface tension
9.5 Jeager's Method for Determination of surface tension
9.6 Applications of Surface Tension

10. Viscosity and Fluid Mechanics

(9 Lectures)

10.1 Concept of Viscous Forces and Viscosity
10.2 Pressure in a fluid and buoyancy
10.3 Pascal's law
10.4 Atmospheric Pressure and Barometer
10.5 Pressure difference and Buoyant Force in accelerating fluids
10.6 Steady and Turbulent Flow, Reynolds's number
5.11 Equation of continuity
5.12 Bernoulli's Principle
5.13 Application of Bernoulli's equation
i) Speed of Efflux
ii) Ventury meter
iii) Aspirator Pump
iv) Change of plane of motion of a spinning ball.

Reference Books:

7. University Physics: Sears and Zeemansky, XIth edition, Pearson education
8. Concepts of Physics: H.C. Varma, Bharati Bhavan Publishers
9. Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd.
10. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir, VI Edition,Pearson Education/Prentice Hall International, New Delhi
11. Properties of Matter: D. S. Mathur, Shamlal Chritable Trust New Delhi
12. Mechanics: D.S Mathur, S Chand and Company New Delhi-5.

F. Y. B. Sc.
Term –II

Physics Paper I: Section II: Heat and Thermodynamics

Lectures: 36 **Credits: 2**

Learning Outcomes:

After successfully completing this course, the student will be able to do the following:

1. Describe the properties of and relationships between the thermodynamic properties of a pure substance.
2. Describe the ideal gas equation and its limitations.
3. Describe the real gas equation.
4. Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.
5. Analyse the heat engines and calculate thermal efficiency.
6. Analyze the refrigerators, heat pumps and calculate coefficient of performance.
7. Understand property 'entropy' and derive some thermo dynamical relations using entropy concept.
8. Understand the types of thermometers and their usage.

Syllabus

6. Equation of state (8 lectures)

6.1 Equations of state
6.2 Andrew's experiment
6.3 Amagat's experiment
6.4 Van der Waals' equation of state
6.5 Critical constants
6.6 Reduced equation of state
6.7 Joule-Thomson porous plug experiment

7. Concepts of Thermodynamics (8 lectures)

7.1 Thermodynamic state of a system and Zeroth law of Thermodynamics
7.2 Thermodynamic Equilibrium
7.3 Adiabatic and isothermal changes
7.4 Work done during isothermal changes
7.5 Adiabatic relations for perfect gas
7.6 Work done during adiabatic change
7.7 Indicator Diagram
7.8 First law of Thermodynamics
7.9 Reversible and Irreversible processes

8. Applied Thermodynamics (8 lectures)

8.1 Conversion of Heat into Work and its converse
8.2 Carnot's Cycle and Carnot's Heat Engine and its efficiency
8.3 Second law of Thermodynamics
8.4 Concept of Entropy
8.5 Temperature-Entropy Diagram
8.6 T-dS Equation
8.7 Clausius-Clapeyron Latent heat equations

9. Heat Transfer Mechanisms (8 lectures)

9.1 Heat Engines
   i. Otto cycle and its efficiency
   ii. Diesel cycle and its efficiency

9.2 Refrigerators:
- i. General Principle and Coefficient of performance of refrigerator
- ii. The Carnot Refrigerator
- iii. Simple structure of vapour compression refrigerator

9.3 Air conditioning: principle and its applications

10. Thermometry (4 lectures)

10.1 Temperature Scales: Centigrade, Fahrenheit and Kelvin scale

10.2 Principle, construction and working of following thermometers
- i. Liquid and Gas Thermometers
- ii. Resistive Type Thermometer
- iii. Thermocouple as thermometer
- iv. Pyre heliometer

Reference Books:

7. Physics: 4th Edition, Volume I, Resnick/Halliday/Krane JOHN WILEY & SONS (SEA) PTE LTD
8. Concept of Physics: H.C. Verma, Bharati Bhavan Publishers
9. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand & Company Ltd, New Delhi
10. Heat and Thermodynamics: Mark. W. Zemansky, Richard H. Dittman, Seventh Edition, McGraw-Hill International Editions
11. Thermodynamics and Statistical Physics: J.K. Sharma, K.K. Sarkar, Himalaya Publishing House
12. Thermal Physics (Heat & Thermodynamics): A.B. Gupta, H.P. Roy Books and Allied (P) Ltd, Calcutta.

F. Y. B. Sc.

Term I

Physics Paper II: Section I: Physics Principles and Applications

Lectures: 36 **Credits: 2**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1. To demonstrate an understanding of electromagnetic waves and its spectrum.
2. Understand the types and sources of electromagnetic waves and applications.
3. To understand the general structure of atom, spectrum of hydrogen atom.
4. To understand the atomic excitation and LASER principles.
5. To understand the bonding mechanism in molecules and rotational and vibrational energy levels of diatomic molecules.
6. To demonstrate quantitative problem solving skills in all the topics covered.

Syllabus:

4. Physics of Atoms (12Lectures)

1. The concept of atom (Atomic Models: Thompson and Rutherford)
2. Atomic Spectra
3. Bohr Theory
4. Hydrogen atom Spectra
5. Frank Hertz experiment
6. The LASER

   Absorption, Spontaneous Emission, and Stimulated Emission, PopulationInversion and Laser Action, Applications of Lasers

5. Physics of Molecules (10 Lectures)

1. Bonding Mechanisms: A Survey
   i. Ionic Bonds
   ii. Covalent Bonds
   iii. Van der Waals Bonds
   iv. The Hydrogen Bond
   v. Metallic Bond
2. Variation of potential energy with inter-atomic distance
3. Concept of Rotational and vibrational energy levels of diatomic molecule

6. Electromagnetic Waves (14 Lectures)

1. Historical Perspective of Electromagnetic Waves
2. Production of electromagnetic waves : Hertz experiment
3. Electromagnetic spectrum
4. Planck hypothesis of photons (Concept only)
5. Sources of electromagnetic waves : Radio waves, Microwaves, Infrared, Visible light, Ultraviolet, X-rays, Gamma rays
6. Applications
   i. microwave oven
   ii. RADAR
   iii. Pyro electric thermometer
   iv. X-ray radiography and CT Scan
   v. Solar cell

References

5. Concepts of Modern Physics: A Beiser (6th ed., McGraw Hill, 2003
6. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer
7. Sears and Zemansky's University Physics: H.D. Young R. A. Freedman, Sandin (11^{th} Ed. Pearson Education)
8. Nanotechnology : Principles and Practices: S. K. Kulkarni, Capital Publishing Company.

F. Y. B. Sc.
Term II

Physics Paper II: Section II: Electromagnetics

Lectures: 36 **Credits: 2**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

7. Demonstrate an understanding of the electric force, field and potential, and related concepts, for stationary charges.
8. Calculate electrostatic field and potential of simple charge distributions using Coulomb's law and Gauss's law.
9. Demonstrate an understanding of the dielectric and effect on dielectric due to electric field.
10. Demonstrate an understanding of the magnetic field for steady currents using Biot-Savart and Ampere's laws.
11. Demonstrate an understanding of magnetization of materials.
12. Demonstrate quantitative problem solving skills in all the topics covered.

Syllabus

4. Electrostatics (9 Lectures)

1. Revision of Coulomb's law
2. Superposition principle
3. Electric field due to an electric dipole, line and disc
4. Revision of Gauss's law
5. Coulomb's law from Gauss's law
6. Gauss's law applications in Cylindrical, planar and spherical symmetry

5. Dielectrics (9 Lectures)

1. Electric Dipole
2. Electric dipole and dipole moment
3. Electric potential and intensity at any point due to dipole
4. Torque on a dipole placed in an electric field
5. Polar and non-polar molecules
6. Electric polarization of dielectric material
7. Gauss' law in dielectric
8. Electric vectors and relation between them

6. Magneto statics (9 Lectures)

1. Revision of Biot-Savart's law with examples
2. Amperes' law, e.g. Solenoid and Toroid
3. Gauss law for magnetism

4. Magnetic properties of materials (9 Lectures)

1. Magnetic materials and Bohr magneton
2. Magnetization (M), magnetic intensity (H), magnetic induction (B), magnetic susceptibility and permeability
3. Relation between B, M and H
4. Hysteresis

References:

3. Fundamentals of Physics: 8th Edition, Halliday Resnik and Walkar
4. Electromagnetics: B. B. Laud

F. Y. B. Sc.
Term I and II

Physics paper III: Practical

Total Practicals: 20 **Credits: 4**

Learning Outcomes:

After successfully completing this laboratory course, the students will be able to dothe following:

6. Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
7. Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
8. Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
9. Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
10. Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

Syllabus:

5. Mechanics

1. Range and Least Count of Instruments, Measurements using various instruments and error analysis (Vernier caliper, screw gauge, travelling microscope, spectrometer etc.)
2. Determination MI of disc using ring
3. MI of Flywheel
4. Determination of coefficient of viscosity by Poiseulli's method
5. Determination of Y and n by flat spiral spring
6. Determination of Y by bending
7. Surface Tension by Jeager's method.

6. Heat and Thermodynamics

1. Interpretation of isothermal and adiabatic curves on PV diagrams (Theoretical). Theoretical study of Carnot's cycle by drawing graphs of isothermal and adiabatic curves.
2. Temperature coefficient of resistance
3. Study of thermocouple and determination of inversion temperature
4. Thermal conductivity by Lee's method
5. Specific heat of graphite

7. Light

1. Study of spectrometer and determination of angle of prism
2. Spectrometer calibration. Determination of refractive indices of different colours and plotting the graph of refractive index vs wavelength.
3. Study of total internal reflection using LASER
4. Study of polarization of light by reflection
5. Determination of wavelength of LASER light by plane diffraction grating or cylindrical obstacle.

8. Electricity and magnetism

1. Charging and discharging of a capacitor

2. Study of LR circuit
3. Study of LCR series circuit
4. Study of Kirchhoff's laws
5. Diode characteristics
6. Study of millimetres (all AC, DC ranges, Least Count)
7. Determination of frequency of AC mains

Students have to perform minimum three experiments from each section and totalsixteen experiments. Students can perform any two experiments from Computer Aided experiments in place of any two experiments in above four sections.

Additional Activities

5. Demonstrations (Any four demonstrations equivalent to two experiments)
    1. Magnet –magnet interaction
    2. Collision by using balls
    3. Study of Signal generator using CRO (Sine, square wave signal, measurement of AC voltage, frequency)
    4. Demonstration of action potential
    5. Measurement of sound pressure level
6. Computer aided demonstrations (Using computer simulations or animations) (Any two demonstrations equivalent to two experiments)
    1. Coulomb's law
    2. Vectors : visualization of vectors
    3. Bohr's model
    4. Carnot engine, diesel engine
    5. Graphs and their slopes, and Kinematics graphs (using computer simulations)
7. Mini projects/Hand on activities
    (Any one equivalent to two experiments)
    1. Students should collect the information of at least five Physicists with their work.
    2. Students should carry out mini projects
8. Study tour (Equivalent to two experiments)
    Students participated in study tour must submit a study tour report.

Students have to perform at least two additional activities out of four activities in addition to sixteen experiments mentioned above. Total Laboratory work with additional activities should be equivalent to twenty experiments.

UNIVERSITY OF PUNE

Proposed Structure of B.Sc. (Physics) Syllabus

5) Preamble:

The systematic and planned curricula from first year to the third year shall motivate and encourage the students for pursuing higher studies in Physics and for becoming an entrepreneur.

Objectives:

- To provide in depth knowledge of scientific and technological aspects of Physics
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving, hand on activities, study visits, projects etc.
- To train students in skills related to research, education, industry, and market.
- To create foundation for research and development in Electronics
- To develop analytical abilities towards real world problems
- To help students build-up a progressive and successful career in Physics

6) Eligibility:

7 **First Year B.Sc.:** Higher Secondary School Certificate (10+2) Science stream or its equivalent Examination as per the University of Pune eligibility norms.

8 **Second Year B.Sc.:** Keeping terms of First Year of B. Sc. with Physics as one of the subjects. Other students if they fulfil the conditions approved by the equivalence committee of Faculty of Science of the University of Pune are also eligible.

9 **Third Year B. Sc.:** Student shall pass all First Year B. Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Physics as one of the subjects.

Note: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune. Reservation and relaxation will be as per the Government rules.

F.Y. B. Sc.
(From Academic Year 2013-2014)
(To be implemented from Academic Year 2013-14

Paper	Title
Paper I	Section I (For Term 1): Mechanics
	Section II (For Term 2): Heat and Thermodynamics
Paper II	Section I (For Term 1): Physics Principles and Applications
	Section II (For Term 2): Electromagnetics
Paper III	(For Term1 and Term 2): Practical

For each theory course: 36 Lectures per term/2 Credits per termFor practical course: 20 practicals/4Credits

S. Y. B. Sc.
(Semester Pattern)
(From Academic Year 2014-2015)

Semester I

Paper	Title
Paper I (PHY211)	Mathematical Methods in Physics I
Paper II (PHY 212)	Electronics I /Instrumentation

Semester II

Paper	Title
Paper I (PHY221)	Oscillations, Waves and Sound
Paper II (PHY 222)	Optics

Practical Course (Annual)

Paper III (PHY 223) (Annual)	Practical

T. Y. B. Sc. (Physics)
(Semester Pattern)

(From Academic Year 2015-2016)

Theory Courses (Semester)	
Semester III	**Semester IV**
PH331: Mathematical Methods in Physics II	PH341: Solid State Physics
PH332: Classical Electrodynamics	PH342: Quantum Mechanics
PH333: Classical Mechanics	PH343: Thermodynamics and Statistical Physics
PH334: Atomic and Molecular Physics	PH344: Nuclear Physics
PH335: Computational Physics	PH345: Electronics II /Advanced Electronics

PH336: Elective I (Select any One)	PH346: Elective II (Select any One)
A: Astronomy and Astrophysics	F: Renewable Energy Sources
B: Elements of Materials Science	G: Physics of Nano materials
C: Motion Picture Physics	H: Microcontrollers
D: Biophysics	I: Electro Acoustics and Entertainment Electronics
E: Medical Electronics	J: Lasers
	K: Methods of Experimental Physics
Practical Courses (Annual)	
PH347: Laboratory Course I	
Phy348: Laboratory Course II	
PH349: Laboratory Course III (Project)	

Examination:

A) Pattern of Examination:

i) F. Y. B. Sc.

(g) There shall be university examination at the end of the academic year for 80 marks for each theory paper.

(h) 20 marks for each paper are allotted to the comprehensive internal assessment of the student by the respective teacher, teaching the course.The teacher shall evaluate the performance of the student for 10 marks in each term; on the basis of written tests. Ordinarily written tests shall consist of
(i) multiple choice questions, (ii) True/False, (iii) basic definitions, (iv) tricky computational problems involving minimal calculations. Student is asked to answer 20 questions in 40 minutes. Each question will be of ½ marks. In the same classroom setup, different set of equivalent sets of question papers may be experimented. It will be preferred to have two such tests in each term, per course(one at the middle of the term and one at the end of the term) and average (or best of the two tests) be considered as internal marks out of 10 for that term. Internal Test shall cover the entire syllabus. If teacher prefers to have one test only, it shall be at the end of the term covering the entire syllabus).

(i) Practical examination be conducted by respective colleges at the end of the academic year 80 marks be assigned to practicals and 20 marks for internal examination, journal attendance (Journal 10 marks, Oral 10 marks).

ii) S. Y. B. Sc. and T. Y. B. Sc.

(g) There shall be university examination at the end of semester for 40 marks for each theory paper.

(h) 10 marks for each paper are allotted to the comprehensive internal assessment of the student by the respective teacher, teaching the course. Pattern of internal assessment shall be on the lines of F.Y.B. Sc.

(i) University Practical examination be conducted at the end of the academic year 80 marks be assigned to practicals and 20 marks for internal examination, journal attendance (Journal 10 marks, Oral 10 marks).

For practical examination:

(1) At least one examiner should be external

(2) Certified journals be compulsory

(3) There shall be two experts for all subjects.

(4) (a) At T. Y. B. Sc. level, it is preferred to have project work in lien of one of the practical course.

(b) Blue print for Model Question Paper: Each Board of Studies shall frameat least 5 sets of model theory papers and 10 sets of model question setfor internal assessment.

II) Pattern of the Question paper:

For theory paper (University examination) shall be as follows.

F. Y. B. Sc. (80 Marks) (Time Allotted: 3 hrs)

Q1. 16 marks for 8 sub-questions, each sub-question for two marks. Sub- questions shall be answerable in two to four lines and shall be based on complete syllabus.

Q2. and Q3. Student shall attempt four out of six questions. Each shortanswer type question shall carry four marks and be answerable in 6 to 8 lines.

Q4. Student shall attempt 2 out of 4 long answer type questions. Each question will be for 8 marks and be answerable in 12 to 16 lines.

Q5. Long easy type question for 16 marks. Student shall attempt one out of two questions.

OR

Q5. Shall be on the pattern of question 4.

(Question paper of a particular course should contain minimum of 30%weightage to problems)

S. Y. B. Sc. and T. Y. B. Sc. (Theory) University Question Paper Pattern:

(40 marks, Time allotted: 2 hrs)

Q1. 10 sub-question each for 1 mark. Sub-questions be answerable within 2to 4 lines and shall be based on complete syllabus. All sub-questions arecompulsory.

Q2 and Q3: (10 Marks for each questions) Three sub questions. Students have to attempt any two questions.

Q4. Long Essay type question for 8 marks and one question of two marks.

B) Standard of Passing: 40 % marks

C) ATKT Rules

(v) Students shall clear 8 heads of passing (out of 12 such heads) while going from F. Y. B. Sc. to S.Y.B.Sc. However he must pass in all F. Y. B. Sc. subjects while going to T. Y. B. Sc.

(vi) Student shall clear 12 heads of passing (out of 20 such heads) while going from S. Y. B. Sc. to T. Y. B. Sc. (Practical course of S. Y. B. Sc. will be equivalent to 2 heads of passing)

D) Award of Class: As per University norms.

E) External Students: Not applicable

F) Setting of question paper/Pattern of Question paper: As mentioned above

18) Structure of the Course:

a) Compulsory paper: a) At F.Y.B.Sc. and S.Y.B.Sc. all papers are compulsory and at T.Y.B.Sc. 8 papers are compulsory and one paper is optional.

b) Optional papers: At T.Y.B.Sc. one paper per semester is optional.

c) Question papers and papers etc.: As mentioned above

d) Medium of Instructions: English

19) Equivalence of previous syllabus along with propose syllabus: The papers aresimilar so no equivalence is required at B. Sc. level.

20) University terms: 6 terms

21) Subject-wise detailed syllabus: Attached with this format.

22) Recommended books: Given in the syllabus at the end of each course.

23) Qualification of teachers: As per UGC regulations.

F. Y. B. Sc.
Term -I

Physics Paper I: Section I: Mechanics

Lectures: 36 **Credits: 2**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

15. Demonstrate an understanding of Newton's laws and applying them in calculations of the motion of simple systems.
16. Use the free body diagrams to analyse the forces on the object.
17. Understand the concepts of energy, work, power, the concepts of conservation of energy and be able to perform calculations using them.
18. Understand the concepts of elasticity and be able to perform calculations using them.
19. Understand the concepts of surface tension and viscosity and be able to perform calculations using them.
20. Use of Bernoulli's theorem in real life problems.
21. Demonstrate quantitative problem solving skills in all the topics covered.

Syllabus:

11. Newton's laws of motion (6 Lectures)

11.1 Newton's First and Second Law and their explanation
11.2 Working with Newton's First and Second Law
11.3 Newton's Third Law of motion and its explanation
11.4 Various types of forces in nature (explanation) and concept of field
11.5 Frame of reference (Inertial, Non-inertial)
11.6 Pseudo Forces (e.g. Centrifugal Force)

12. Work and Energy (8 Lectures)

12.1 Kinetic Energy
12.2 Work and Work-Energy Theorem
12.3 Calculation of Work done with
i) Constant Force
ii) Variable Force
Illustration
12.4 Conservative and Non-conservative Forces
12.5 Potential energy and conservation of Mechanical energy
12.6 Change in potential energy in rigid body motionMass-energy equivalence

13. Elasticity (8 Lectures)

13.1 Hook's law and coefficient of elasticity
13.2 Young's modulus, Bulk modulus and Modulus of rigidity
13.3 Work done during longitudinal strain, volume strain, and shearing strain
13.4 Poisson's ratio
13.5 Relation between three elastic moduli (Y, η, K)
13.6 Determination of Y of rectangular thin bar loaded at the centre
13.7 Torsional oscillations
Torsional rigidity of a wire, to determine η by torsional oscillations

14. Surface Tension (5 Lectures)

14.1 Surface Tension, Angle of Contact, Capillary Rise Method
14.2 Rise of liquid in a conical capillary tube

14.3 Energy required to raise a liquid in capillary tube

14.4 Factors affecting surface tension
14.5 Jeager's Method for Determination of surface tension
14.6 Applications of Surface Tension

15. Viscosity and Fluid Mechanics

(9 Lectures)

15.1 Concept of Viscous Forces and Viscosity
15.2 Pressure in a fluid and buoyancy
15.3 Pascal's law
15.4 Atmospheric Pressure and Barometer
15.5 Pressure difference and Buoyant Force in accelerating fluids
15.6 Steady and Turbulent Flow, Reynolds's number
5.14 Equation of continuity
5.15 Bernoulli's Principle
5.16 Application of Bernoulli's equation
i) Speed of Efflux
ii) Ventury meter
iii) Aspirator Pump
iv) Change of plane of motion of a spinning ball.

Reference Books:

13. University Physics: Sears and Zeemansky, XIth edition, Pearson education
14. Concepts of Physics: H.C. Varma, Bharati Bhavan Publishers
15. Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd.
16. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir, VI Edition,Pearson Education/Prentice Hall International, New Delhi
17. Properties of Matter: D. S. Mathur, Shamlal Chritable Trust New Delhi
18. Mechanics: D.S Mathur, S Chand and Company New Delhi-5.

F. Y. B. Sc.
Term –II

Physics Paper I: Section II: Heat and Thermodynamics

Lectures: 36 **Credits: 2**

Learning Outcomes:

After successfully completing this course, the student will be able to do the following:

1. Describe the properties of and relationships between the thermodynamic properties of a pure substance.
2. Describe the ideal gas equation and its limitations.
3. Describe the real gas equation.
4. Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.
5. Analyse the heat engines and calculate thermal efficiency.
6. Analyze the refrigerators, heat pumps and calculate coefficient of performance.
7. Understand property 'entropy' and derive some thermo dynamical relations using entropy concept.
8. Understand the types of thermometers and their usage.

Syllabus

11. Equation of state (8 lectures)

- 11.1 Equations of state
- 11.2 Andrew's experiment
- 11.3 Amagat's experiment
- 11.4 Van der Waals' equation of state
- 11.5 Critical constants
- 11.6 Reduced equation of state
- 11.7 Joule-Thomson porous plug experiment

12. Concepts of Thermodynamics (8 lectures)

- 12.1 Thermodynamic state of a system and Zeroth law of Thermodynamics
- 12.2 Thermodynamic Equilibrium
- 12.3 Adiabatic and isothermal changes
- 12.4 Work done during isothermal changes
- 12.5 Adiabatic relations for perfect gas
- 12.6 Work done during adiabatic change
- 12.7 Indicator Diagram
- 12.8 First law of Thermodynamics
- 12.9 Reversible and Irreversible processes

13. Applied Thermodynamics (8 lectures)

- 13.1 Conversion of Heat into Work and its converse
- 13.2 Carnot's Cycle and Carnot's Heat Engine and its efficiency
- 13.3 Second law of Thermodynamics
- 13.4 Concept of Entropy
- 13.5 Temperature-Entropy Diagram
- 13.6 T-dS Equation
- 13.7 Clausius-Clapeyron Latent heat equations

14. Heat Transfer Mechanisms (8 lectures)

- 14.1 Heat Engines

i. Otto cycle and its efficiency
ii. Diesel cycle and its efficiency

14.2 Refrigerators:
- i. General Principle and Coefficient of performance of refrigerator
- ii. The Carnot Refrigerator
- iii. Simple structure of vapour compression refrigerator

14.3 Air conditioning: principle and its applications

15. Thermometry (4 lectures)

15.1 Temperature Scales: Centigrade, Fahrenheit and Kelvin scale

15.2 Principle, construction and working of following thermometers
- i. Liquid and Gas Thermometers
- ii. Resistive Type Thermometer
- iii. Thermocouple as thermometer
- iv. Pyre heliometer

Reference Books:

13. Physics: 4th Edition, Volume I, Resnick/Halliday/Krane JOHN WILEY & SONS (SEA) PTE LTD
14. Concept of Physics: H.C. Verma, Bharati Bhavan Publishers
15. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand & Company Ltd, New Delhi
16. Heat and Thermodynamics: Mark. W. Zemansky, Richard H. Dittman, Seventh Edition, McGraw-Hill International Editions
17. Thermodynamics and Statistical Physics: J.K. Sharma, K.K. Sarkar, Himalaya Publishing House
18. Thermal Physics (Heat & Thermodynamics): A.B. Gupta, H.P. Roy Books and Allied (P) Ltd, Calcutta.

F. Y. B. Sc.

Term I

Physics Paper II: Section I: Physics Principles and Applications

Lectures: 36 **Credits: 2**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1. To demonstrate an understanding of electromagnetic waves and its spectrum.
2. Understand the types and sources of electromagnetic waves and applications.
3. To understand the general structure of atom, spectrum of hydrogen atom.
4. To understand the atomic excitation and LASER principles.
5. To understand the bonding mechanism in molecules and rotational and vibrational energy levels of diatomic molecules.
6. To demonstrate quantitative problem solving skills in all the topics covered.

Syllabus:

7. Physics of Atoms (12Lectures)

1. The concept of atom (Atomic Models: Thompson and Rutherford)
2. Atomic Spectra
3. Bohr Theory
4. Hydrogen atom Spectra
5. Frank Hertz experiment
6. The LASER

   Absorption, Spontaneous Emission, and Stimulated Emission, PopulationInversion and Laser Action, Applications of Lasers

8. Physics of Molecules (10 Lectures)

1. Bonding Mechanisms: A Survey
   i. Ionic Bonds
   ii. Covalent Bonds
   iii. Van der Waals Bonds
   iv. The Hydrogen Bond
   v. Metallic Bond
2. Variation of potential energy with inter-atomic distance
3. Concept of Rotational and vibrational energy levels of diatomic molecule

9. Electromagnetic Waves (14 Lectures)

1. Historical Perspective of Electromagnetic Waves
2. Production of electromagnetic waves : Hertz experiment
3. Electromagnetic spectrum
4. Planck hypothesis of photons (Concept only)
5. Sources of electromagnetic waves : Radio waves, Microwaves, Infrared, Visible light, Ultraviolet, X-rays, Gamma rays
6. Applications
   i. microwave oven
   ii. RADAR
   iii. Pyro electric thermometer
   iv. X-ray radiography and CT Scan
   v. Solar cell

References

9. Concepts of Modern Physics: A Beiser (6th ed., McGraw Hill, 2003
10. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer
11. Sears and Zemansky's University Physics: H.D. Young R. A. Freedman, Sandin (11^{th} Ed. Pearson Education)
12. Nanotechnology : Principles and Practices: S. K. Kulkarni, Capital Publishing Company.

F. Y. B. Sc.
Term II

Physics Paper II: Section II: Electromagnetics

Lectures: 36 **Credits: 2**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

13. Demonstrate an understanding of the electric force, field and potential, and related concepts, for stationary charges.
14. Calculate electrostatic field and potential of simple charge distributions using Coulomb's law and Gauss's law.
15. Demonstrate an understanding of the dielectric and effect on dielectric due to electric field.
16. Demonstrate an understanding of the magnetic field for steady currents using Biot-Savart and Ampere's laws.
17. Demonstrate an understanding of magnetization of materials.
18. Demonstrate quantitative problem solving skills in all the topics covered.

Syllabus

7. Electrostatics (9 Lectures)

1. Revision of Coulomb's law
2. Superposition principle
3. Electric field due to an electric dipole, line and disc
4. Revision of Gauss's law
5. Coulomb's law from Gauss's law
6. Gauss's law applications in Cylindrical, planar and spherical symmetry

8. Dielectrics (9 Lectures)

1. Electric Dipole
2. Electric dipole and dipole moment
3. Electric potential and intensity at any point due to dipole
4. Torque on a dipole placed in an electric field
5. Polar and non-polar molecules
6. Electric polarization of dielectric material
7. Gauss' law in dielectric
8. Electric vectors and relation between them

9. Magneto statics (9 Lectures)

1. Revision of Biot-Savart's law with examples
2. Amperes' law, e.g. Solenoid and Toroid
3. Gauss law for magnetism

4. Magnetic properties of materials (9 Lectures)

1. Magnetic materials and Bohr magneton
2. Magnetization (M), magnetic intensity (H), magnetic induction (B), magnetic susceptibility and permeability
3. Relation between B, M and H
4. Hysteresis

References:

5. Fundamentals of Physics: 8th Edition, Halliday Resnik and Walkar
6. Electromagnetics: B. B. Laud

F. Y. B. Sc.
Term I and II

Physics paper III: Practical

Total Practicals: 20 **Credits: 4**

Learning Outcomes:

After successfully completing this laboratory course, the students will be able to dothe following:

11. Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
12. Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
13. Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
14. Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
15. Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

Syllabus:

9. Mechanics

1. Range and Least Count of Instruments, Measurements using various instruments and error analysis (Vernier caliper, screw gauge, travelling microscope, spectrometer etc.)
2. Determination MI of disc using ring
3. MI of Flywheel
4. Determination of coefficient of viscosity by Poiseulli's method
5. Determination of Y and n by flat spiral spring
6. Determination of Y by bending
7. Surface Tension by Jeager's method.

10. Heat and Thermodynamics

1. Interpretation of isothermal and adiabatic curves on PV diagrams (Theoretical). Theoretical study of Carnot's cycle by drawing graphs of isothermal and adiabatic curves.
2. Temperature coefficient of resistance
3. Study of thermocouple and determination of inversion temperature
4. Thermal conductivity by Lee's method
5. Specific heat of graphite

11. Light

1. Study of spectrometer and determination of angle of prism
2. Spectrometer calibration. Determination of refractive indices of different colours and plotting the graph of refractive index vs wavelength.
3. Study of total internal reflection using LASER
4. Study of polarization of light by reflection
5. Determination of wavelength of LASER light by plane diffraction grating or cylindrical obstacle.

12. Electricity and magnetism

1. Charging and discharging of a capacitor

2. Study of LR circuit
3. Study of LCR series circuit
4. Study of Kirchhoff's laws
5. Diode characteristics
6. Study of millimetres (all AC, DC ranges, Least Count)
7. Determination of frequency of AC mains

Students have to perform minimum three experiments from each section and totalsixteen experiments. Students can perform any two experiments from Computer Aided experiments in place of any two experiments in above four sections.

Additional Activities

9. Demonstrations (Any four demonstrations equivalent to two experiments)
    1. Magnet –magnet interaction
    2. Collision by using balls
    3. Study of Signal generator using CRO (Sine, square wave signal,measurement of AC voltage, frequency)
    4. Demonstration of action potential
    5. Measurement of sound pressure level
10. Computer aided demonstrations (Using computer simulations or animations)(Any two demonstrations equivalent to two experiments)
    1. Coulomb's law
    2. Vectors : visualization of vectors
    3. Bohr's model
    4. Carnot engine, diesel engine
    5. Graphs and their slopes, and Kinematics graphs (using computersimulations)
11. Mini projects/Hand on activities
    (Any one equivalent to two experiments)
    1. Students should collect the information of at least five Physicists with theirwork.
    2. Students should carry out mini projects
12. Study tour (Equivalent to two experiments)
    Students participated in study tour must submit a study tour report.

Students have to perform at least two additional activities out of four activities in addition to sixteen experiments mentioned above. Total Laboratory work with additional activities should be equivalent to twenty experiments.

Savitribai Phule Pune University [SPPU]

B.Sc. (Chemistry)

(Three Years Integrated Degree Program)

Choice Based Credit System [CBCS]

From Academic

Year2019-2020

First Year (F.Y. B. Sc.)

Board of Studies (Chemistry)
Savitribai Phule Pune University
[SPPU]Pune-41107

Structure of F. Y. B. Sc. Chemistry

Semester	Course	Discipline Specific Core Course (DSCC)*
I	Theory	CH-101 : Physical Chemistry (2 credit , 36 L)
	Theory	CH-102 : Organic Chemistry (2 credit, 36 L)
	Practical	CH-103 : Chemistry Practical –I (1.5 Credit, 46.8 L)
II	Theory	CH-201 :Inorganic Chemistry (2 credit , 36 L)
	Theory	CH-202 : Analytical Chemistry (2 credit, 36 L)
	Practical	CH-203 : Chemistry Practical –II (1.5 Credit, 46.8 L)

*N.B.:

i. **Each lecture (L) will be of 50 minutes.**
ii. Each practical of 3h 15 min and 12 practicals per semester
iii. **12 weeks for teaching 03 weeks for Contentious assessments**
iv. **For details refer UG rules and regulations (CBCS for Science program under science& Technology) given in Appendix**

Savitribai Phule Pune University, Pune

F.Y.B.Sc. Chemistry Syllabus

(CBCS Semester Pattern)

From Academic Year 2019-2020

Equivalence with Previous Syllabus

New Course (2019 Semester Pattern)(50 min /L)	**Old Course (2013 Annual Pattern)(48 min /L)**
CH-101 : Physical Chemistry (2 credit , 36 L) 50 Marks	Paper I : Physical and InorganicChemistry (72 L) 100 Marks
CH-201 :Inorganic Chemistry (2 credit , 36 L)50 Mark	
CH-102 : Organic Chemistry (2 credit, 36 L) 50 Marks	Paper II : Organic and Inorganic Chemistry (72 L) 100 Marks
CH-202 : Analytical Chemistry (2 credit, 36 L) 50 Marks	
CH-103 : Chemistry Practical–I (1.5 Credit, 46.8 L) 50 Marks	Paper III : Chemistry Practical 100 Marks
CH-203 : Chemistry Practical-II (1.5 Credit, 46.8L) 50 Marks	

Preamble:

The syllabus of Chemistry for First year has been redesigned for Choice based Credit System (CBCS) to be implemented form 2019-2020.

In CBCS pattern semester system has been adopted for FY, SY and TY which includes Discipline Specific Core Course (DSCC) at F Y level, Ability Enhancement Compulsory Course (AECC), Discipline Specific Elective Course (DSEC) and Skill Enhancement Course (SEC). DSCC courses has been introduced at FY level and AECC courses at SY level along with DSEC. At TY level DSEC and SEC courses has been introduced.

Syllabus for Specific Core Courses of Chemistry (2 Theory and 1 Practical) subject for F. Y. B. Sc.is to be implemented from the year 2019-20. Syllabus for S. Y. and T. Y. B. Sc. will be implemented from the year 2020-21 and 2021-22 respectively as per structure approved.

Learning Objectives:

1. To understand basic concept of physical, organic and Inorganic chemistry.
2. To impart practical skills and learn basics behind experiments.
3. To prepare background for advanced and applied studies in chemistry.

SEMESTER-I

CH- 101: Physical Chemistry (2 Credits, 36 Lectures of 50 min.)

1. Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances, problems **[11]**

2. Chemical Equilibrium:

Introduction: Free Energy and equilibrium - Concept, Definition and significance
The reaction Gibbs Energy, Exergonic and endergonic reaction. The perfect gas equilibrium, the general case of equilibrium, the relation between equilibrium constants, Molecular interpretation of equilibrium constant. The response of equilibria to conditions- response to pressure , response to temperature, Van't Haff equation, Value of K at different temperature, Problems **[11]**

3. Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts– applications of solubility product principle. **[14]**

Learning Outcome

1. Chemical Energetics

1. Students will be able to apply thermodynamic principles to physical and chemical process
2. Calculations of enthalpy , Bond energy, Bond dissociation energy , resonance energy
3. Variation of enthalpy with temperature –Kirchoff's equation
4. Third law of thermodynamic and its applications

2. Chemical Equilibrium

Knowledge of Chemical equilibrium will make students to understand

1. Relation between Free energy and equilibrium and factors affecting on equilibrium constant.
2. Exergonic and endergonic reaction
3. Gas equilibrium, equilibrium constant and molecular interpretation of equilibrium constant
4. Van't Haff equation and its application

3. Ionic equilibria

Ionic equilibria chapter will lead students to understand

1. Concept to ionization process occurred in acids, bases and pH scale
2. Related concepts such as Common ion effect hydrolysis constant, ionic product, solubilityproduct
3. Degree of hydrolysis and pH for different salts , buffer solutions

CH- 102: Organic Chemistry (2 Credits, 36 Lectures of 50 min.)

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **[09]**

Stereochemistry

Introduction, classification, Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Conformations with respect to ethane, butane and cyclohexane. Configuration: Geometrical - *cis – trans,* and E / Z Nomenclature (for upto two C=C systems). Optical isomerism Enantiomerism, Diastereomerism and Meso compounds). Concept of chirality (upto two carbon atoms). Threo and erythro; D and L; nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms)

[14]

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Up to 5 Carbons) *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Up to 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Up to 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalide *Reactions:* formationof metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$.

[13]

Learning Outcome

1. The students are expected to understand the fundamentals, principles, and recent developments in thesubject area.
2. It is expected to inspire and boost interest of the students towards chemistry as themain subject.
3. To familiarize with current and recent developments in Chemistry.
4. To create foundation for research and development in Chemistry.

Reference Books

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley & Sons(2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition,2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).
4. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
5. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
8. Samuel Glasstone, *Thermodynamics for Chemists*, Affiliated East West Private Limited.
9. B S Bahl, G D Tuli, Arun Bahl, Essentials of Physical Chemistry
10. Peter Atkins and Julio de Paula, Elements of Physical Chemistry, Sixth edition (2013), Oxfordpress
11. Ball D. W., Physical Chemistry, Thomson Press , India (2007)
12. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
13. Atkins' Physical Chemistry –Thermodynamics and Kinetics, 11th Edition, Oxford Press
14. Thomas Engel, Philip Reid; *Physical Chemistry*, Pearson Education (2006)
15. J. N. Gurtu, A. Gurtu; *Advanced Physical Chemistry,* Pragati Edition
16. Mortimer R. G., Physical Chemistry, 3rd Edition, Elsevier, Noida (UP)
17. Samuel H. Maron and Carl F. Prutton, *Principal of physical Chemistry*, 4th Edition, CollierMacmillan Ltd.

CH- 103: Chemistry Practical Course I

(1.5 Credits, 46.8 Lectures of 50 min.)

Section A: Chemical and Lab Safety (Compulsory)

1. Toxicity of the compounds used in chemistry laboratory.
2. Safety symbol on labels of pack of chemicals and its meaning
3. What is MSDS sheets? Find out MSDS sheets of at least hazardous chemicals ($K_2Cr_2O_7$, Benzene,cadmium nitrate, sodium metal, etc.)
4. Precautions in handling of hazardous substances like Conc. acids, ammonia, organic solvents, etc.

Section B: Physical Chemistry

a. Thermochemistry (Any three)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

b. Ionic equilibria (Two experiments)

1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (usedilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

OR

1. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.
2. Preparation of buffer solutions **(Any One)**

(i) Sodium acetate-acetic acid and determine its buffer capacity

(ii) Ammonium chloride-ammonium hydroxide and determine its buffer capacity

Section C: Organic Chemistry (Five experiments)

1. To determine type and detection of extra elements (N, S, Cl, Br, I) in organic compounds (containingup to two extra elements) **(Three)**
2. Separation of constituents of mixtures by Chromatography: Measure the R_f value in each case **(Two)**

(a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acids) / pigments from plant extract/ 2 organic compounds by paper chromatography

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Note: Combination of two compounds/plant extract to be given

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Text book of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R.Chand & Co.: New Delhi (2011).
6. Prof. Robert H. Hill Jr., David C. Finster Laboratory Safety for Chemistry Students, 2nd Edition Wiley ISBN: 978-1-119-02766-9 May 2016
7. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version, ISBN 978-0-309-13864-2 | DOI 10.17226/12654, THE NATIONAL ACADEMIES PRESS Washington, D.C.

Learning Outcome

1. Importance of chemical safety and Lab safety while performing experiments in laboratory
2. Determination of thermochemical parameters and related concepts
3. Techniques of pH measurements
4. Preparation of buffer solutions
5. Elemental analysis of organic compounds (non instrumental)
6. Chromatographic Techniques for separation of constituents of mixtures

SEMESTER-II

CH-201: Inorganic Chemistry (2 Credits, 36 Lectures of 50 min.)

1. Atomic Structure

Origin of Quantum Mechanics: Why study quantum mechanics? Quantum mechanics arose out of interplay of experiments and Theory Energy quantization- i) Black body radiation ii) The photoelectric effect iii) Wave particle duality-a) The particle character of electromagnetic radiation b) the wave character of particle, iv) diffraction by double slit v) atomic spectra, Review of-Bohr's theory and its limitations, Heisenberg Uncertainty principle.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it, Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*). **[14]**

2. Periodic table and Periodicity of Elements

Periodic table: periodic table after 150 years, review on the eve of international year of periodic table[IYPT].

Periodicity of elements: Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations

Long form of periodic table-s, p, d and f block elements,

Detailed discussion of following properties of elements with reference to s and p block

a) Effective nuclear charge, shielding or screening effect
b) Atomic and ionic radii
c) Crystal radii
d) Covalent radii
e) Ionization energies
f) Electronegativity, Pauling's / electronegativity scale
g) Oxidation states of elements

[10]

3. Chemical Bonding

Attainment of stable electronic configurations, Types of Chemical bonds: Ionic, covalent, coordinate and metallic bonds

Ionic Bond: General characteristics of ionic bonding, Types of ions, Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy,

Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bond: Valence Bond Approach, Hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. VSEPR theory, Assumptions, need of theory, application of theory to explain geometries of molecules such as i) ClF_3 ii) Cl_2O iii) BrF_5 iv) XeO_3 v) $XeOF_4$ **[12]**

Learning Outcome

1. Atomic Structure

1. Various theories and principles applied to revel atomic structure
2. Origin of quantum mechanics and its need to understand structure of hydrogen atom
3. Schrodinger equation for hydrogen atom
4. Radial and angular part of hydrogenic wave functions
5. Significance of quantum numbers
6. Shapes of orbitals

2. Periodicity of Elements

1. Explain rules for filling electrons in various orbitals- Aufbau's principle, Pauli exclusion principle,Hund's rule of maximum multiplicity
2. Discuss electronic configuration of an atom and anomalous electronic configurations.
3. Describe stability of half-filled and completely filled orbitals.
4. Discuss concept of exchange energy and relative energies of atomic orbitals
5. Design Skeleton of long form of periodic table.
6. Describe Block, group, modern periodic law and periodicity.
7. Classification of elements as main group, transition and inner transition elements
8. Write name, symbol, electronic configuration, trends and properties.
9. Explain periodicity in the following properties in details:
    a. Effective nuclear charge, shielding or screening effect; some numerical problems.
    b. Atomic and ionic size.
    c. Crystal and covalent radii
    d. Ionization energies
    e. Electronegativity- definition, trend, Pauling electronegativity scale.
    f. Oxidation state of elements

3. Chemical Bonding

1. Attainment of stable electronic configurations.
2. Define various types of chemical bonds- Ionic, covalent, coordinate and metallic bond
3. Explain characteristics of ionic bond, types of ions, energy consideration in ionic bonding, lattice and solvation energy and their importance in the context of stability and solubility of ionic compounds
4. Summarize Born-Lande equation and Born-Haber cycle,
5. Define Fajan's rule, bond moment, dipole moment and percent ionic character.

6. Describe VB approach, Hybridization with example of linear, trigonal, square planer, tetrahedral,TBP, and octahedral.
7. Discuss assumption and need of VSEPR theory.
8. Interpret concept of different types of valence shell electron pairs and their contribution in bonding.
9. Application of non-bonded lone pairs in shape of molecule
10. Basic understanding of geometry and effect of lone pairs with examples such as ClF_3, Cl_2O, BrF_5,XeO_3 and $XeOF_4$.

CH- 202: Analytical Chemistry (2 Credits, 36 Lectures of 50 min.)

1. Introduction to Analytical Chemistry

What is analytical Chemistry, the analytical perspectives, Common analytical problems. **[03]**

2. Calculations used in Analytical Chemistry

Some important units of measurements-SI units, distinction between mass and weight, mole,millimole and Calculations, significant figures

Solution and their concentrations- Molar concentrations, Molar analytical Concentrations, Molar equilibrium concentration, percent Concentration, part per million, part per billion, part per thousand, Solution –dilatant volume ration, functions , density and specific gravity of solutions, problems

Chemical Stoichiometry – Empirical and Molecular Formulas, Stoichiometric Calculations,Problems. **[10]**

3. Qualitative Analysis of Organic Compounds

Types of organic compounds, characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures.

Analysis – Detection of nitrogen, sulfur, halogen and phosphorous by Lassiagen's test.

Purification of organic compounds- Introduction, recrystallization, distillation, sublimation **[05]**

4. Chromatographic Techniques –Paper and Thin Layer Chromatography

Introduction- Introduction to chromatography, IUPAC definition of chromatography.

History of Chromatography- paper chromatography, Thin Layer Chromatography, Ion exchange Chromatography, Gas permeation Chromatography, affinity chromatography, Gas chromatography, Supercritical fluid chromatography, High Performance Liquid Chromatography, Capillaryelectrophoresis, Classification of chromatographic methods – according to separation methods, according to development procedures.

Thin Layer Chromatography: Theory and principles, outline of the method, surface adsorption and spot shape, Comparison of TLC with other forms of chromatography, adsorbents, preparation of plates, application of samples, development.

Paper Chromatography- Origin, overview of technique, sample preparation, types of paper, solvents, equilibrium, development, sample application and detection, Identification, Quantitative methods, applications of paper chromatography **[14]**

5. pH meter

Introduction, pH meter, Glass pH electrode, combination of pH electrode-Complete Cell, Standard Buffer –reference for pH measurement, Accuracy of pH measurement, Using pH meter –How does it works? Applications of pH meter. **[04]**

Learning Outcomes

1. Introduction to Analytical Chemistry
   - i. Analytical Chemistry –branch of chemistry
   - ii. Perspectives of analytical Chemistry
   - iii. analytical problems
2. Calculations used in Analytical Chemistry
   - i. Calculations of mole, molar concentrations and various units of concentrations which will behelpful for preparation of solution
   - ii. Relation between molecular formula and empirical formula
   - iii. Stoichiometric calculation
   - iv. Define term mole, millimole, molar concentration, molar equilibrium concentration and PercentConcentration.
   - v. SI units, distinction between mass and weight
   - vi. Units such as parts per million, parts per billion, parts per thousand, solution-dilatant volume ratio,function density and specific gravity of solutions.
3. Qualitative Analysis of Organic Compounds

   Basics of type determination, characteristic tests and classifications, reactions of different functional groups.
   - i. Separation of binary mixtures and analysis
   - ii. Elemental analysis -Detection of nitrogen, sulfur, halogen and phosphorous by Lassiagen's test.
   - iii. Purification techniques for organic compounds.
4. Chromatographic Techniques – Paper and Thin layer Chromatography
   - i. Basics of chromatography and types of chromatography
   - ii.Theoretical background for Paper and Thin Layer Chromatography
5. pH metry
   - i. pH meter and electrodes for pH measurement
   - ii. Measurement of pH
   - iii. Working of pH meter
   - iv. Applications of pH meter

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in InorganicChemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of*

Structureand Reactivity, Pearson Education India, 2006.

5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley & Sons (2014).
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
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11. A Braithwait and F. J. Smith, *Chromatographic method*, 5th edition, Kluwer Academic publishers
12. G D Christian -Analytical Chemistry
13. Qualitative Organic Analysis 4th Edn by A I Vogel (ELBS)
14. Vogel's Quantitative Analysis
15. Douglas A Skoog, Donald M West, F James Holler ,Stainly R Crounch , *Fundamentals of AnalyticalChemistry*, 9th edition
16. David Harvey, *Modern Analytical Chemistry*, McGraw Hill Higher education
17. Gurudeep R Chatwal, Sham K Anand, *Instrumental Methods of Chemical Analysis*, HimalayaPublishing House.
18. Barrow, G.M. *Physical Chemistry* Tata McGraw- Hill (2007).
19. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd.,New Delhi (2009).
20. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
21. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
22. *Atkins' Physical Chemistry,* 10th edition (2014), Oxford University Press
23. Thomas Engel, Philip Reid; *Physical Chemistry* , Pearson Education (2006)
24. J. N. Gurtu, A. Gurtu, *Advanced Physical Chemistry,* Pragati Edition
25. McQuarrie, D. A., & Simon, J. D., *Physical Chemistry: A molecular approach*. Sausalito, CA: University Science Books (1997)
26. Atkins, P., & de Paula, J., *Physical Chemistry for the Life Sciences*. New York: W. H. Freeman andCompany (2006)
27. McMahon, D. (2005). *Quantum Mechanics Demystified*. NewYork: McGraw-Hill Professional
28. Ladd, M. *Introduction to Physical Chemistry* (3rd ed). Cambridge, UK: Cambridge University Press (1998)

CH- 203: Chemistry Practical –II (1.5 Credits, 46.8 Lectures of 50 min.)

Section A: Inorganic Chemistry

Wherever required standardization of volumetric reagent must be performed.

I] Synthesis of commercially important inorganic compounds (any two)

1) Synthesis of potash alum from aluminium metal (scrap Aluminium metal)
2) Synthesis of Mohr's Salt [$(FeSO_4)$ $(NH_4)_2SO_4$]•$6H_2O$
3) Preparation of Dark red inorganic pigment: Cu_2O
4) Synthesis of $FeSO_4$•$7H_2O$

Note:

i. In synthesized compound student must confirm the particular cation and anion by performing qualitative tests.
ii. Costing of product for 100 g pack can be calculated on the basis of cost of raw materials used and percent yield of the product.
iii. Synthesized compounds should be collected from all students and stored properly. They should be used in other experiments such as Mohr's salt for determination of water of crystallization. Potash alum and $FeSO_4$ can be given in IQA experiments or for estimations at SY and TY level.

II] Volumetric Analysis (Any Two)

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Determination of basicity of boric acid or oxalic acid or citric acid hence determination of theirequivalent weight.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

III] Analysis of Commercial products containing inorganic substances (any two)

1) Estimation of Ca from calcium supplementary tablet by complexometric titration.
2) Estimation of acid neutralizing capacity of antacids like Gelusil tablet/ Gellusil syrup etc.
3) Estimation of selectively Cu(II) from brass alloy by iodometrically (Use KIO_3 as primary standard forstandardization of $Na_2S_2O_3$ and **not** $K_2Cr_2O_7$).

IV] To draw polar plots of s and p orbitals.

Section B: Organic Chemistry

I] Organic Purification Techniques

1. Purification of organic compounds by i) crystallization (from water and alcohol) ii) distillation (TwoCompounds), iii) Sublimation (micro technique).

II] Organic preparations: Derivatives

2. Preparations: Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yields to be done. (Any Two)

a) Bromination of Cinnamic acid using sodium bromide and Sodium bromate. (Green Chemistry Approach)

OR

a) Bromination of acetanilide using KBr and Cerric ammonium nitrate in aqueous medium. (Green Chemistry Approach)

3) Semicarbazone derivatives of aldehydes and ketones

4) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Note: Presence of extra element in the synthesized compound must be tested (Br and N in respective compound)

N. B.:

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. Use optimum concentrations and volumes
3. **Two burette method should be used for volumetric analysis (Homogeneous mixtures)**
4. **Use of microscale technique is recommended wherever possible**

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook ofPractical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.:New Delhi (2011).

Learning Outcome

1. Inorganic Estimations using volumetric analysis
2. Synthesis of Inorganic compounds
3. Analysis of commercial products
4. Purification of organic compounds
5. Preparations and mechanism of reactions involved

Course Outcome

CH- 101: Physical Chemistry

After completing the course work learner will be acquired with knowledge of chemical energetics, Chemical equilibrium and ionic equilibria.

CH- 102: Organic Chemistry

Students will learn Fundamentals of organic chemistry, stereochemistry (Conformations, configurations and nomenclatures) and functional group approach for aliphatic hydrocarbons.

CH- 201: Inorganic Chemistry

Students will learn quantum mechanical approach to atomic structure, Periodicity of elements, various theories for chemical bonding.

CH-202: Analytical Chemistry

Students will know about basics of analytical chemistry, some techniques of analysis andable to do calculations essential for analysis.

Lab Course CH 103 and CH-203

1. The practical course is in relevance to the theory courses to improve the Understanding of the concepts.
2. It would help in development of practical skills of the students.
3. Use of microscale techniques wherever required

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Botany

(Faculty of Science & Technology)

F.Y.B.Sc. Botany

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: B. Sc Botany

1. Structure of Course:

Structure B.Sc. Botany syllabus					
Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Compulsory Course	BO 111	Plant life and utilization I	2
			BO 112	Plant morphology and Anatomy	2
			BO 113	Practical based on BO 111 & BO 112	1.5
	2	Compulsory Course	BO 121	Plant life and utilization II	2
			BO 122	Principles of plant science	2
			BO 123	Practical based on BO 121 & BO 122	1.5
2	3	Compulsory Course	BO 231	Botany Theory Paper 1	2
			BO 232	Botany Theory Paper 2	2
			BO 233	Botany Practical Paper	2
	4	Compulsory Course	BO 241	Botany Theory Paper 1	2
			BO 242	Botany Theory Paper 2	2
			BO 243	Botany Practical Paper	2
3	5	Discipline Specific Elective Course	BO 351	Botany Theory Paper 1	2
			BO 352	Botany Theory Paper 2	2
			BO 353	Botany Theory Paper 3	2
			BO 354	Botany Theory Paper 4	2
			BO 355	Botany Theory Paper 5	2
			BO 356	Botany Theory Paper 6	2
			BO 357	Botany Practical Paper 1	2
			BO 358	Botany Practical Paper 2	2
			BO 359	Botany Practical Paper 3	2
		Skill Enhancemen tcourse	BO 3510	Botany Theory Paper 7	2
			BO 3511	Botany Theory Paper 8	2
3	6	Discipline Specific Elective Course	BO 361	Botany Theory Paper 1	2
			BO 361	Botany Theory Paper 2	2
			BO 362	Botany Theory Paper 3	2
			BO 363	Botany Theory Paper 4	2
			BO 364	Botany Theory Paper 5	2
			BO 365	Botany Theory Paper 6	2
			BO 366	Botany Practical Paper 1	2
			BO 367	Botany Practical Paper 2	2
			BO 368	Botany Practical Paper 3	2
		Skill	BO 3610	Botany Theory Paper 7	2

		Enhancemen tcourse	BO 3611	Botany Theory Paper 8	2

2. Equivalence of Previous Syllabus:

Old Course (2013 Pattern)	New Course (2019 CBCS Pattern)
Fundamentals of Botany: PAPER – ITerm- I: Plant Diversity	BO 111 Plant life and utilization I
Botany Theory Paper II Term I –Industrial Botany	BO 112 Plant morphology and Anatomy
Fundamentals of Botany: PAPER - ITerm- II: Morphology and Anatomy	BO 121 Plant life and utilization II
Botany Theory Paper II Term-II –Industrial Botany	BO 122 Principles of plant science
F. Y. B. Sc. Botany Practical Paper - IIIbased on Theory Paper I and Paper II	BO 113 Practical based on BO 111 & BO112 and BO 123 Practical based on BO 121 & BO122

SEMESTER-I: PAPER-I

BO-111: PLANT LIFE AND UTILIZATION I (30 Lectures)

CREDIT-I **15 Lectures (15 Hours)**

1. INTRODUCTION 3 L

General outline of plant kingdom (**Lower Cryptogams**: Thallophytes-Algae, Fungi & Lichens; **Higher Cryptogams**: Bryophytes and Pteridophytes; **Phanerogams**: Gymnosperms and Angiosperms- Dicotyledons and Monocotyledons). Distinguishing characters of thesegroups and mention few common examples from each.

2. ALGAE 9 L

2.1: Introduction
2.2: General Characters
2.3: Classification (Bold and Wynne 1978) up to classes with reasons
2.4: Life Cycle of *Spirogyra* w.r.t. Habit, Habitat, Structure of thallus, structureof typical cell, Reproduction- Vegetative, Asexual and Sexual, systematic position with reasons
2.5: Utilization of Algae in Biofuel Industry, Agriculture, Pharmaceuticals,Food and Fodder

3. LICHENS 3 L

3.1: Introduction
3.2: General Characters
3.3: Nature of Association, forms- Crustose, Foliose and Fruticose.3.4: Utilization of lichens.

CREDIT-II **15 Lectures (15 Hours)**

4. FUNGI 9 L

4.1: Introduction
4.2: General Characters
4.3: Classification (Ainsworth, 1973)
4.4: Life Cycle of Mushroom- *Agaricus bisporus* w.r.t. Habit, Habitat, Structure of thallus, Structure of Sporocarp, Structure of Gill, Reproduction- Asexualand sexual, Systematic position.
4.5: Utilization of Fungi in Industry, Agriculture, Food and Pharmaceuticals.

5. BRYOPHYTES 6 L

5.1: Introduction
5.2: General Characters
5.3: Classification (G.M. Smith 1955)
5.4: Life Cycle of *Riccia* w.r.t. Habit, habitat, external and internal structure ofthallus, Reproduction- vegetative, asexual and sexual- Structure of sex organs, fertilization, structure of mature sporophyte, structure of spore, systematic position with reasons.
5.5: Utilization: Bryophytes as ecological indicators, agriculture, fuel, industryand medicine.

(Development of sex organs not expected for all the above mentioned life cycles).

REFERENCES:

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3. Gangulee, Das and Dutta (2002). College Botany. Vol. I, New Central Book Agency (P) Ltd.
4. Dube, H.C. (1990). An Introduction to Fungi. Vikas Publishing House Pvt. Ltd., Delhi.
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6. Parihar, N.S. (1980). Bryophyta, An Introduction of Embryophyta. Vol. I. CentralBook Distributors, Allahabad.
7. Puri, P. (1980). Bryophyta: Broad prospective. Atma Ram & Sons, Delhi.
8. Smith, G.M. (1971). Cryptogamic Botany. Vol. I: Algae & Fungi. Tata McGraw HillPublishing Co., New Delhi.
9. Smith, G.M. (1971). Cryptogamic Botany. Vol. II: Bryophytes & Pteridophytes. TataMcGraw Hill Publishing Co., New Delhi.
10. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students-Algae, S. Chand Publication.
11. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students-Fungi, S. Chand Publication.
12. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students-Bryophytes, S. Chand Publication.

SEMESTER-I: PAPER-II

BO-112: PLANT MORPHOLOGY AND ANATOMY (30 Lectures)

CREDIT-I **15 Lectures (15 hours)**

1. MORPHOLOGY: 2 L

1.1: Introduction, definition, descriptive and interpretative morphology.

1.2 : Importance in identification, nomenclature, classification, phylogeny and Plantbreeding.

2. MORPHOLOGY OF REPRODUCTIVE PARTS:

2.1: INFLORESCENCE: 3 L

2.1.1 Introduction and definition

2.1.2 Types:

a) Racemose -Raceme, Spike, Spadix, Corymb, Umbel, Catkin and Capitulum.

b) Cymose -Solitary, Monochasial- Helicoid and scorpiod; Dichasial andPolychasial.

c) Special types -Verticillaster, Cyathium and Hypanthodium.

2.1.3 Significance

2.2: FLOWER: 7 L

2.2.1 Introduction and definition

2.2.2 Parts of a typical flower: Bract, Pedicel, Thalamus- forms, Perianth- Calyx andCorolla, Androecium and Gynoecium.

2.2.3 Symmetry: Actinomorphic and zygomorphic, Sexuality- Unisexual ands bisexual, Insertion of floral whorls on thalamus- Hypogyny, Epigyny andperigyny, Merous condition-Trimerous, tetrmerous and pentamerous.

2.2.4 Floral whorls:

a) **Calyx:** Nature- Polysepalous, Gamosepalous; Aestivation- types, Modifications ofCalyx- Pappus, Petaloid and Spurred.

b) **Corolla:** Forms of Corolla-

i) Polypetalous- Cruciform and Papilionaceous.

ii) Gamopetalous- Infundibuliform, Bilabiate, Tubular and Campanulate.

iii) Aestivation- types and significance.

c) **Perianth:** Nature- Polytepalous, Gamotepalous.

d) **Androecium:** Structure of typical stamen, Variations- cohesion and adhesion.

e) **Gynoecium:** Structure of typical carpel, number, position, cohesion and adhesion;placentation- types and significance.

2.3: FRUITS: 3 L

2.3.1 Introduction and definition

2.3.2 Types of fruits:

a) **Simple:** Indehiscent - Achene, Cypsela, Nut and Caryopsis.Dehiscent - Legume, Follicle and Capsule,

b) **Fleshy:** Drupe, Berry, Hespiridium and Pepo.

c) **Aggregate:** Etaerio of Berries and Etaerio of Follicles.

d) **Multiple fruits:** Syconus and Sorosis.

CREDIT- II **15 Lectures (15 Hours)**

3. ANATOMY: 2 L

3.1 Introduction and definition

3.2 Importance in Taxonomy, Physiology, Ecological interpretations, Pharmacongnosyand Wood identification.

4. TYPES OF TISSUES: 8 L

Outline with brief description, simple and complex tissues.

4.1 : **Meristmatic tissues:** Meristem, characters and types based on origin, position andplane of division, functions.

4.2 : **Permanent tissues:** Simple tissues - parenchyma, collenchymas, chlorenchymaand sclerenchyma.

4.3 : **Complex/Vascular tissues:** Components of xylem and phloem, types of vascularbundles and functions.

4.4 : **Epidermal tissues:** Epidermis, structure of typical stomata, trichomes, motor cells;functions.

5. INTERNAL ORGANIZATION OF PRIMARY PLANT BODY: 5 L

5.1 : Internal structure of dicotyledon and monocotyledon root. 5.2: Internal structure of dicotyledon and monocotyledon stem. 5.3: Internal structure of dicotyledon and monocotyledon leaf.

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14. Sharma, O.P. (1993). Plant Taxonomy. 2nd Edition, McGraw Hill Education, NewDelhi.
15. Singh, Gurucharan (2005). Systematics- Theory and Practice. Oxford IBH.
16. Sutaria, R.N.A. Text Book of Systematic Botany.

17. Tayal, M.S. (2012). Plant Anatomy. Rastogi Publications.

BO 113: PRACTICALS BASED ON BO 111 & BO 112 (1.5 CREDITS)

1. Study of Life Cycle of *Spirogyra.* 1 P
2. Study of Life Cycle of *Agaricus.* 1 P
3. Study of Life Cycle of *Riccia* 1 P.
4. Study of forms of Lichens- Crustose, Foliose and fruticose. 1 P
5. Study of Mushroom Cultivation. 1 P
6. One day visit to study Algae, Fungi, Bryophytes and Lichens. 1 P
7. Study of Inflorescence. 2 P
   a. Racemose: Raceme, Spike, Spadix, Catkin, Corymb, Umbel and Capitulum
   b. Cymose: Solitary cyme, Uniparous cyme: helicoid and scorpiod, Biparous cymeand Multiparous cyme.
   c. Special type: Verticillaster, Hypanthodium and Cyathium.
8. Study of flower with respect to Calyx, Corolla and Perianth, Androecium and Gynoecium. 2 P
9. Study of fruits with suitable examples. 2 P
   a) Simple fruit: Dry: Achene, Cypsella and Legume; Fleshy: Berry and Drupe.
   b) Aggregate fruit: Etaerio of follicles and Etaerio of Berries.
   c) Multiple fruit: Syconus and Sorosis.
10. Study of internal primary structure of dicotyledonous root and stem e.g. Sunflower. 1 P
11. Study of internal primary structure of monocotyledonous root and stem e.g. Maize. 1 P
12. Study of internal primary structure of dicotyledonous and monocotyledonous leaf e.g. Sunflower and Maize. 1 P

SEMESTER-II: PAPER-I

BO-121: PLANT LIFE AND UTILIZATION-II (30 Lectures)

CREDIT-I **15 Lectures (15 hours)**

1. **INTRODUCTION:** Introduction to plant diversity- Pteridophytes, Gymnosperms and Angiosperms with reference to vascular plants. 3 L
2. **PTERIDOPHYTES:** General characters, Outline classification according to Sporne(1976) up to classes with reasons. Life cycle of *Nephrolepis* w.r.t. Habit, habitat, distribution, morphology, anatomy of stem and leaf, Reproduction – vegetative and sexual. 10 L
3. Utilization and economic importance of Pteridophytes. 2 L

CREDIT-II **15 Lectures (15 hours)**

1. **GYMNOSPERMS:** General characters, Outline classification according to Sporne (1977) up to classes with reasons. Life cycle of *Cycas* w.r.t. Habit, Habitat, Distribution, Morphology and Anatomy of Stem, leaf and reproductive organs- Malecone, Microsporophyll, microspores and megasporophyll, megaspore; structure of seed; Utilization and economic importance of gymnosperms. 8 L
2. **ANGIOSPERMS:** General characters, Outline of classification of Bentham and Hooker's system up to series, comparative account of monocotyledons and dicotyledons. 4L
3. Utilization and economic importance of Angiosperms: In food, fodder, fibers, horticulture and medicines. 3L

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2. Chamberlain, C.J. (1934). Gymnosperms- Structure and Evolution. Chicago.
3. Coulter, J.M. and Chamberlain, C.J. (1917). Morphology of Gymnosperms.Chicago.
4. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperms taxonomy.Oliver and Boyd Publ. London.
5. Dutta, S.C. (1988). Systematic Botany. Wiley Eastern Ltd., New Delhi.
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SEMESTER-II: PAPER-II

BO-122: PRINCIPLES OF PLANT SCIENCE (30 Lectures)

CREDIT-1: PLANT PHYSIOLOGY AND CELL BIOLOGY

15 Lectures (15 Hours)

1. Introduction, definition and scope of plant physiology. 1 L
2. Diffusion – definition, importance of diffusion in plants, imbibition as a special type of diffusion. 1 L
3. Osmosis – definition, types of solutions (hypotonic, isotonic, hypertonic), endosmosis, exo-osmosis, osmotic pressure, turgor pressure, wall pressure, importance of osmosis in plants. 2 L
4. Plasmolysis – definition, mechanism and significance. 1 L
5. Plant growth - introduction, phases of growth, factors affecting growth, 2 L
6. Structure of plant cell, differences between prokaryotic and eukaryotic cell. 2 L
7. Plant cell wall – components of primary cell wall, structure and functions. 1 L
8. Ultrastructure and functions of chloroplast 2 L
9. Cell cycle in plants- importance of cell cycle in plants, divisional stages of mitosisand meiosis. 3 L

CREDIT-II: MOLECULAR BIOLOGY (15 Lectures) 15 Hours

1. Introduction and scope of molecular biology, central dogma of molecular biology. 2 L
2. Structure of DNA, nucleoside and nucleotide 2 L
3. Watson Crick model of DNA and its characteristic features, types of DNA (A, B and Z DNA). 3 L
4. Types of chromosomes. 2 L
5. Structure and types of RNA. 3 L
6. DNA replication- Types of replication (conservative, semi-conservative and dispersive), enzymes involved, leading and lagging strands, Okazaki fragments. 3 L

REFERENCES:

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BO 123: PRACTICALS BASED ON BO 121 & BO 122 (1.5 CREDITS)

1. Study of life cycle of *Nephrolepis*. 1 P
2. Study of life cycle of *Cycas*. 1 P
3. Study of Bentham and Hooker's system of classification outline up to series with example 1 P
4. Study of comparative account of Dicotyledonous and Monocotyledonous plants w.r.t to external morphological characters. 1 P
5. Study of utilization and economic importance of Angiosperms- food, fodder, fibers, horticulture and medicines. 1 P
6. One day visit to study diversity of vegetation. 2 P
7. To observe characteristic features of prokaryotic and eukaryotic plant cell. 1 P
8. Staining of suitable nuclear material by Basic Fuchsin 1 P
9. Study of mitosis- preparation of slides using onion root tips to observe divisional stages. 1 P
10. Study of meiosis- preparation of slides using *Tradescantia/ Rhoeo/* Maize / Onion flower buds to observe divisional stages. 2 P
11. Estimation of chlorophyll-a and chlorophyll-b by using suitable plant material. 1 P
12. Plasmolysis- endosmosis, exosmosis, incipient plasmolysis using *Rhoeo* leaf peeling and Demonstration of Osmosis- curling experiment. 1 P
13. Study of DPD by using suitable plant sample 1 P

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Geography

(Faculty of Science & Technology)

F.Y.B.Sc. (Geography)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: B.Sc. Geography

Preamble of the syllabus

i. To introduce the students to the basic concepts in Geomorphology.

ii To acquaint the students with the utility and applications of Geomorphology indifferent areas and environment.

iii. To make the students aware of the need of protection and conservation of different landforms.

Introduction: Pattern – CBCS: Semester (15marks internal and 35marks University)

Structure of the course **Course code for choice based credit system**

Year	Semester	Course Type	Course code	Course Name	Credit
1	1	Compulsory Course	GG 111	Introduction to Physical Geography–I(Geomorphology)	2
			GG 112	Introduction to Physical Geography -II(Ggeography of Atmosphere and Hydrosphere)	2
			GG 113	Practicals in Physical Geography	1.5
	2	Compulsory Course	GG 121	Introduction to Human Geography	2
			GG 122	Population and Settlement Geography	2
			GG 123	Practicals in Human Geography	1.5
2	3	Compulsory Course	GG 231	Environmental Geography -I	2
			GG 232	Geography of Maharashtra(Physical)-I	2
			GG 233	Surveying- I	2
	4	Compulsory Course	GG 241	Environmental Geography -II	2
			GG 242	Geography of Maharashtra (Human) -II	2
			GG 243	Surveying - II	2
3	5	Discipline Specific Elective	GG 351	Regional Geography of India (Physical)- I	2
			GG 352	Geography of Economic Activities-I	2
			GG 353	Fundamentals of Tourism - I	2
			GG 354	Pedology	2
			GG 355	Management of Natural Disasters	2
			GG 356	Geoinformatics-I	2
			GG 357	Techniques in Quantitative Analysis	2
			GG 358	Field Techniques in Mapping	2
			GG 359	Techniques in Geomorphology	2
		Skill Enhancement Course	GG 3510	Skill Enhancement Course in Geography - I	2
			GG 3511	Skill Enhancement Course in Geography -II	2
	6	Discipline Specific Elective	GG 361	Regional Geography of India (Human) -II	2
			GG 362	Geography of Economic Activities-II	2
			GG 363	Tourism Activities and Management -II	2
			GG 364	Weathering	2
			GG 365	Management of Manmade Disasters	2
			GG 366	Geoinformatics-II	2
			GG 367	GIS Based Project Report	2
			GG 368	Maps and Mapping Techniques	2
			GG 368	Soil and Sediment Analysis	2
		Skill	GG 3610	Skill Enhancement Course in Geography - III	2

		Enhancement Course	3611GG	Skill Enhancement Course in Geography - IV	2

Class- F.Y.B.Sc. GEOGRAPHY		
Paper- CC	Semester - I	Semester - II
I	GG 111 -Introduction to PhysicalGeography - I (Geomorphology)	GG 121-Introduction to HumanGeography
II	GG 112 - Introduction to Physical Geography - II (Ggeography ofAtmosphere and Hydrosphere)	GG 122- Population and SettlementGeography
III- Practical	GG 113- Practicals in PhysicalGeography	GG 123- Practical in HumanGeography
Class- S.Y.B.Sc.- CC		
IV	GG 231- Environmental Geography -I	GG 241- Environmental Geography -II
V	GG 232- Geography of Maharashtra(Physical) - I	GG 242- Geography of Maharashtra(Human) – II
VI- Practical	GG 233- Surveying - I	GG- 243- Surveying –II
Class- T.Y.B.Sc.- DSEC		
VII	GG 351- Regional Geography of India(Physical) I	GG 361- Regional Geography of India(Human) – II
VIII	GG 352- Geography of Economicactivities - I	GG 362- Geography of EconomicActivities–II
IX	GG 353- Fundamentals of Tourism - I	GG 363- Tourism Activities andManagement– II
X	GG 354-Pedology	GG 364- Weathering
XI	GG 355- Management of NaturalDisasters	GG 365- Management of ManmadeDisasters
XII	GG 356-Geoinformatics-I	GG 366-Geoinformatics–II
XIII- Practical	GG 357- Techniques in QuantitativeAnalysis	GG 367- GIS Based Project Report
XIV- Practical	GG 358- Field Techniques in Mapping	GG 368- Maps and MappingTechniques
XV- Practical	GG 359-Techniques inGeomorphology	GG 369- Soil and Sediment Analysis
	SEC	
X	GG 3610- Skill Enhancement Course in Geography - I	GG 3610- Skill Enhancement Course in Geography - III
XI	GG 3611- Skill EnhancementCourse in Geography -II	GG 3611- Skill EnhancementCourse in Geography - IV

Equivalence of Syllabus in Geography (F.Y.B.Sc.) effective from June 2019

Old Syllabus June 2013		New Syllabus June 2019	
Gg 110	Physical Geography (Paper I)	Gg 110	Introduction to Physical Geography–I (Geomorphology)
Gg 120	Geography of Atmosphere and Hydrosphere (Paper II)	Gg120	Introduction to Physical Geography - II (Geography of Atmosphere and Hydrosphere
Gg 101	Techniques in Physical Geography(Paper III)	Gg 101	Practicals in Physical Geography

Semester I Paper I

Introduction to Physical Geography–I (Geomorphology)

Course No :Gg111 Total no. of Credits: 02No. of hours:30

Sr. No	Unit	Sub-Units	No. of Hours
1	Introduction of Geomorphology	a. Introduction to Physical Geography and its branches b. Geomorphology – Definition, Nature and Scope c. Components of Earth systems. d. Geological time scale. e. Applied Geomorphology	08
2	The Earth system	a. Interior of the Earth – based on seismic evidences. B. Theory of Isostacy. c. Wegener's Continental Drift Theory. D. Crustal movements: Folding and faulting and their types.	07
3.	Plate Tectonics	a. Theory of Plate tectonics. b. Plates and boundaries and associated landforms. c. Earthquakes and volcanoes, their types, causes and effects.	07
4.	Geomorphic Processes	a. Rocks and Minerals: Meanings, differences and classification of rocks. b. Weathering: Definition and types c. Mass movement: Meaning and types	08

		d.Fluvial cycle of erosion : Theory by Davis	

Reference books:

1. **Conserva H. T.** 2004: Illustrated Dictionary of Physical Geography, Author House,USA.
2. **Christopherson, R.W.** 2000, Geo-systems, Prentice Hall, INC. USA. Hamblin, W.K., 1989. TheEarth's Dynamic Systems, Macmillan Publishing Company, NewYork.
3. **Gabler,R.E.,Peterson,J.F.**andTrapasso,L.M.,2007:EssentialsofPhysicalGeography(8th Edition), Thomson, Brooks/Cole, USA.
4. **Garrette, N.**, 2000: Advance Geography, Oxford UniversityPress.
5. **Goudie, A.**, 1984: The Nature of Environment: An Advanced Physical Geography, BasilBlackwell Publishers,Oxford
6. **Husain, M.**, 2001. Fundamentals of Physical Geography, Rawat Publication, Jaipur.
7. Kale,V.S.andGupta,A.,2001.IntroductiontoGeomorphology,Orient Longman,Calcutta.
8. **Monkhouse, F.J.**, 1996. Principles of Physical Geography, Hodder andStoughton, London.
9. **Robinson, H.**, 1969. Morphology and Landscape, University Tutorial Press Ltd, London. 10.**Siddhartha, K.**, 2001. The Earth's Dynamic Surface, Kisalaya Publications Pvt. Ltd, NewDelhi.11.**Strahler, A.A. and Strahler, A. N.**, 2002. Physical Geography: Science and Systems of the Human Environment, John Wiley & Sons, NewYork.

Semester IPaper II

Introduction to Physical Geography II (Geography of Atmosphere and Hydrosphere)

Course No :Gg112 No. of Credits: 2No. of hours:30

Unit No.	Unit	Sub Unit	No. ofHours
1.	Introduction to the Atmospher e	a) Definition andevolution b) Composition of theatmosphere c) Structure of theatmosphere d) Weather and climate, elements of weather andclimate	07
2.	Insolation	a) Definition and mechanisms of heat transfer:conduction, convection andradiation b) Heat budget of theEarth c) Factors affecting on horizontal distribution of temperature d) Vertical distribution of temperature- lapse rate andinversion oftemperature	08
3.	Atmospheri cPressure and WindSyste	a) Meaning and measurement of the atmosphericpressure b) Vertical and horizontal distribution of pressure-pressure belts	08

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		c) Concept of pressure gradient and its relation with winds d) Type of winds- planetary winds, periodic winds (monsoon winds), local winds (land and sea breezes, mountain and valleywinds).	
4.	Introduction tothe Hydrosphere	a) Definition, hydrologicalcycle b) General structure of oceanfloor c) Movements of oceanwater i. Waves- characteristics of seawaves ii. Ocean currents- meaning, causes and types iii. Tides- meaning, causes andtypes	07

Reference books:

Conserva H.T., 2004. Illustrated dictionary of Physical Geography, Author House, USA.

Critchfield, H.J., 1997. General Climatology, Prentice Hall of India Pvt. Ltd, New Delhi. Dasgupta, A. andKapoor, A.N., Principles of Physical Geography. Grald, S., General Oceanography.

Gabler R.E., Petersen J.F. and Trapasso L.M., 2007. Essentials of Physical Geography (8th edition),Thompson, Brooks/Cole, USA.

Garrett N. 2000. Advanced Geography, Oxford University Press.

Goudie A., 1984. The nature of the enviromnentl: an advanced physical geography, Basil BlackwellPublishers, Oxford.

Hamblin W.K., 1995. Earth's Dynamic System, Prentice Hall, N J.

Hussain M., 2002. Fundamentals of Physical Geography, Ravat Publication, Jaipur.

Lutgens, F.K. and Tarbuck, E.J., 2007. The Atmosphere, Pearson Prentice Hall, New Jersey. Pirie,R.G., Oceanography (Contemporary).

Monkhouse F.J. 2009. Principals of Physical Geogeaphy, Platinum Publishers, Kolkatta.

Ross, D.A., 1988. Introduction to Oceanography. Prentice Hall, New Jersey. Sharma, R.C. and Vatel. M., Oceanography for Geographers.

Strahler, A.A. and Strahler, A. N., 2002. Physical Geography: Science and Systems of the Human Environment, John Wiley and Sons, INC. Strahler, A.H. and Strahler, A. N., 1992. Modern Physical Geography, John Wiley and Sons, INC. Strahler, A.N., 1965. Introduction to PhysicalGeography, John Wiley and Sons,

Strahler A.N., Strahler A.H. 2008. Mpdern Physical Geography. John Wiley and Sons, New York.

Ttrewartha, G., Introduction to Weather and Climate. King, C.A.M., Oceanography forGeographers. Lake, P., Physical Geography.

Semester IPaper III

Practicals in Physical Geography

Course No. Gg. 113No. ofCredits:1.5 **No. of Practicals:15**

Batch of 15 students each

Unit No.	Unit	Sub Unit	No. of Practicals (3 hours/Practical)
1.	Maps	a) Definition, Elements of maps (scale, direction, map projection, conventional signs and symbols,legend),Types of maps, Uses of maps	02
2.	Map Scales	a) Definition, Types- Verbal Scale (VS), RepresentativeFraction (RF), Graphical Scale b) Conversion of scale- VS into RF and RF into VS (Minimum 2exampleseach), Exercise on simple graphical scale (Minimum 2exercises) c) Reading distances on amap	03
3.	Map Projections	a) Definition of mapprojection b) Classification of mapprojection c) Construction and study of the followingprojections I. Zenithalprojections- Zenithal polar gnomonic projection II. Conical projections- Simple conical projection with two standard parallel III. Cylindrical projections- Cylindrical equal area projection (Note:-construction of above map projections with properties and uses, for relevant group one examplefrom each hemisphere) d) Choice of map projections	05
4.	Representation of data	Thematic Maps a) Symbol method b) Dot method c) Choropleth method d) Isopleth method e) Flow diagram (Representation and Interpretation of thematic maps)	03
5.	Field Visit	a) Reading of maps in the field b) Collection of data and its representation	02

Reference books:

Dent B.D., 1999. Cartography: Thematic Map Design, (Vol. 1), McGraw Hill.

Gupta K.K and Tyagi V.C., 1992. Working with Maps, Survey of India, DST, New Delhi.Mishra R.P. and Ramesh A., 1989. Fundamentals of Cartography, Concept Publishing.

Monkhouse, F.J. and Wilkinson, H.R., 1971. Maps and Diagrams. Methuen and Co. Ltd., London. K.Singh, R.L., 2005. Elements of Practical Geography. Kalyani Publishers, New Delhi. India.

Ramamurthy, K., 1982. Map Interpretation, Rex Printers, Madras.Robinson A.
,1953. Elements of Cartography, John Wiley.

Sharma J. P., 2010.Prayogic Bhugol, Rastogi Publishers.

Singh R.L. and Singh R.P.B., 1999. Elements of Practical Geography, Kalyani Publishers.Singh R.L., 1998. ProyogicBhugolRooprekha, Kalyani Publication.

Singh, G., 2005. Map work and practical geography. Vikas Publishing House Pvt. Ltd., New DelhiSingh, L.R. and Singh, R., 1973. Map work and practical geography, Central Book Allahabad Siddhartha, K., 2006. Geography through maps, Kisalaya Publications Pvt. Ltd, Delhi

Singh, R.L., and Dutt, P.K., 1968. Elements of practical geography, Students' Friends, Allahabad

Steers, J.A., 1970. An Introduction to Study of Map Projections. University of London Press Ltd.,London.

Semester II

Paper No-IV Introduction to Human Geography

Course no :Gg121 No. ofCredits:2 No. of Periods:30

Sr. No	Unit	Sub-Units	No. of Periods
1	Introduction of Human Geography	a) Definition and meaning of HumanGeography b) Branches of Human Geography c) Nature and scope of Human Geography d) Importance of Human Geography	06
2	Human Evolutionand Races	a) Stages of human evolution. b) Meaning and definition of human race c) Bases of human race d) Griffith Taylor's theory of human race e) Pure and Mixed Races	08
3.	Man and Environment	**a)** Human life in cold region-**ESKIMO** i) Location ii) Geographical environment iii) Physical traits iv) Food & clothing v) Economic activity **b)** Human life in hot region - **PYGMY** i) Location ii) Geographical environment iii) Physical traits iv) Food & clothing v) Economic activity	08
4.	Economic activitiesof Man	a) **Primary activities**: Hunting, Fishing, gathering, farming, Lumbering, Pasturing andMining. b) **Secondary activities**: manufacturing, Processing ,construction and infrastructure industry c) **Tertiary activities**: Trade, Transportation, Communication, Banking, Entertainment andTourism d) **Quaternary activities**: Information and technology, Scientific research, High-techsoftware based activities e) **Quinary activities**: Government decisions	08

References:

Bergwan, Edward E: Human Geography: Culture, Connections and Landscape, Prentice-Hall, New

Jersey.1995.

Carr, M.: Patterns, Process and change in Human Geography. MacMillan Education,London,1987.**Fellman, J.L**.: Human Geography—Landscapes of Human Activities. Brown andBenchman Pub., U.S.A., 1997.

DeBlij H.J.: Human Geography, Culture, Society and Space John Wiley, New York,1996.

Johnston, R.J. (editor).: Dictionary of Human Geography Blackwell, Oxford, 1994:

Mc Bride, P.J.: Human Geography Systems, Patterns and Change, Nelson, U.K. andCanada,1996.

Michael, Can: New Patterns: Process and Change in Human Geography Nelson,1997

Rubenstein, J.H. and Bacon R.S.: The Cultural Landscape — an Introduction toHuman Geography.Prenice Hall, India, New Delhi,1990.

Singh, K.N. :People of India, An introduction Seagull Books, 1992

Spate O.H.K. and Learmonth A.T.A. : India and Pakistan Methuen, London.1968.

U. V. Jagdale& P. G. Saptarshi: Human Geography (2007), Diamond Publication (Marathi)Johnson R. Gregory D, Pratt G. et al. (2008) The dictionary of Human

Semester IIPaper V

Population and Settlement Geography

Course no : Gg 122 No. of Credits: 2 No. of Periods:30

Sr. No	Unit	Sub-Units	No. of Periods
1	Introduction	a) Definitions, nature and scope ofPopulationGeography b) Sources of Population Data:Census,NationalSample Survey and other Sources	07
2	Population Dynamic	a) Determinates of Distribution and DensityofPopulation b) Distribution of Population -World c) Population Growth- Global & IndianTrend d) Demographic Transition Theory(DTM) e) Demographic Composition: Age, GenderandLiteracy	09
3.	Settlements	a) Definition, Nature and Scope ofSettlementGeography b) Types and Pattern of RuralSettlement	06
4.	Classification of Urban Settlements	a) Classification of Urbansettlements b) Concept ofUrbanization c) Trends and Patterns of Worldurbanization	08

References:

Beaujeu-Garnier, J. : Geography of Population (Translated by Beaver, S.H.) Longmans,London,**Census of India 2011 Series-I** India Provisional Population Totals. Published by Registrar General &Census Commissioner, India, 2011.

Census of India, 2011India : A State Profile Published by office of the Registrar Generalof India,Census Operations, New Delhi.

Chandna, R.C. : Geography of Population: Concepts, Determinants and Patterns, KalyaniPublishers,New Delhi, 2000.

Chandna, R.C. Population GeographyKalyani Publishers, New Delhi, 2010

Clark J.1: Population Geography, Permagon Press, New York, 1965.

Sundram K.V. &NangiaSudesh, (editors): Population Geography, Heritage Publishers,Delhi, 1986.**Peters: G.L**. and Larkim R.P: Population Geography: Problems, Concepts and ProspectsKendele- Hunt Iowa, 1979.

Srinivasan K. and M. Vlassoff Population Development nexus in India: challenges for thenew millennium. Tata McGraw Hill Publishing Co. Ltd., New Delhi 2001.

Trewartha, G.T. : A Geography of Population : World Patterns, John Wiley & Sons, Inc.,New York,1969.

Trewartha, G.T. : The More Developed Realm: A Geography of its Population, PergamonPress,Oxford, 1978.

Trewartha, G.T.: The Less Developed Realm - A Population Geography, McGraw-Hill,New York,1972.

UNDP: Human Development Report, Oxford University Press 2001.

Zelinsky, W. : A Prologue to Population Geography, Prentice-Hall, Englewood Cliffs,1966.

Carter H.: The Study of Urban Geography, Edward Arnold, London, 1972.

Chisholm, M.: Rural Settlement and Land Use, Hutchinson, London,1970. **Clout, R.D**. :Rural Geography, Pergamon Press, London,1970.

Deshpande, C.D.: Shehre, Continental Prakashan, Pune, 1983 (Marathi).

Dickinson, R.E. City, Region and Regionalism, Kegan Paul, Trench, Trubner&Co.,London, 1947.

Misra, H.N.(ed.) : Rural Geography, Heritage Publishers, New Delhi,1987.

Money, D.C. : Patterns of Settlements, Evan Brothers, London, 1972. **Mukerji, R.K**. : Man and His Habitation, Popular Books, Bombay, 1968.**Nangia S**.: Delhi Metropolitan Region, Rajesh Publications, 1976.

Perpillou, A.: Human Geography, Longmans, London, 1966.

Singh, R.L.: Readings in Rural Settlement Geography, Banaras Hindu University,Department of Geography, Varanasi, 1972.

Semester IIPaper VI

Practicals in Human Geography

CourseNo.Gg:123 **Total no. ofCredits:1.5** **No. of Practicals:15**

Unit no.	Unit	Subunit	Learning points	Practicals (3hours)
1	Population Geography Computer application	Population Indices	1. Age-sexpyramid 2. Child-womanratio 3. Dependencyratio 4. Infant mortalityratio 5. Age-specificmortality 6. Population growthrate Data analysis and presentation using computer	04 03
2	Settlement Geography	Methods for calculation Urban data	1. Rank Size Rule 2. Gravity Model.	03
3	Agriculture Geography	a. Crop Combination b.Agricultural Efficiency	1. Weaver' method 2. Bhatia 'smethod	03
4	Village survey/ Urban survey/Tour report/		Visit to different places andreport writing	02

Reference Books:

Carter Harold (1977): The study of Urban Geography**Hans Raj** (1978): Fundamentals of Demography

Hudson F.S. (1976): Geography of Settlements **Michael E. and E. Hurse**: Transportation Geography

Pollard A. H. and FarhatYusu: Demographic Techniques

Singh, R. L. Reading in Rural Settlement Geography

Yeats, M. H. (1974). An introduction to Quantitative Analysis in Human Geography

Singh, J. and Dhillon (1984): Agricultural Geography.

Liendsor, J. M. (1997): Techniques in Human Geography, Routledge.

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Physics

(Faculty of Science & Technology)

F.Y.B.Sc. (Physics)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: B.Sc. (Physics)

Preamble:

The curriculum for the B. Sc. (Physics) programme is designed to cater to the requirement of Choice Based Credit System following the University Grants Commission (UGC) guidelines. In the proposed structure, due consideration is given to Core and Elective Courses (Discipline specific - Physics), along with Ability Enhancement (Compulsory and Skill based) Courses. Furthermore, continuous assessment is an integral part of the CBCS, which will facilitate systematic and thorough learning towards better understanding of the subject. The systematic and planned curricula from first year to the third year (comprised of six semesters) shall motivate the student for pursuing higher studies in Physics and inculcate enough skills for becoming an entrepreneur.

Objectives:

- To foster scientific attitude, provide in-depth knowledge of scientific and technologicalconcepts of Physics.
- To enrich knowledge through problem solving, minor/major projects, seminars, tutorials,review of research articles/papers, participation in scientific events, study visits, etc.
- To familiarize with recent scientific and technological developments.
- To create foundation for research and development in Physics.
- To help students to learn various experimental and computational tools thereby developinganalytical abilities to address real world problems.
- To train studentsin skills related to research, education, industry, and market.
- To help students to build-up a progressive and successful career in Physics.

Structure of the Course:

Subject Name	Year	Semester	Course Type	Course Code	Course Name	Credit
Physics	1	I	Compulsory Course	PHY-111	Mechanics and Properties of Matter	2
				PHY-112	Physics Principles and Applications	2
				PHY-113	Physics Laboratory-IA	1.5
		II	Compulsory Course	PHY-121	Heat and Thermodynamics	2
				PHY-122	Electricity and Magnetism	2
				PHY-123	Physics Laboratory-IB	1.5
	2	III	Compulsory Course	PHY-231	Mathematical Methods in Physics I	2
				PHY-232	Electronics I /Instrumentation	2
				PHY-233	Physics Laboratory-2A	2
			Ability Enhancement Compulsory Course	PHY-2310	Environment -I	2
				PHY-2311	Language-I	2
		IV	Compulsory Course	PHY-241	Oscillations, Waves and Sound	2
				PHY-242	Optics	2
				PHY-243	Physics Laboratory-2B	2
			Ability Enhancement Compulsory Course	PHY-2410	Environment –II	2
				PHY-2411	Language-II	2
	3	V	Discipline Specific Elective Course	PHY- 351	Mathematical Methods in Physics II	2
				PHY- 352	Electrodynamics	2
				PHY- 353	Classical Mechanics	2
				PHY- 354	Atomic and Molecular Physics	2
				PHY- 355	Computational Physics	2
				PHY- 356	Elective I (Select any One)	2
				PHY- 357	Physics Laboratory-3A	2
				PHY- 358	Physics Laboratory-3B	2
				PHY- 359	Physics Laboratory-3C	2
			Skill Enhanceme	PHY-3510	Maintenance and Repairing of Laboratory equipment – I	2

			ntCourse	PHY- 3511	Household Electrification, Maintenance and repairing - I	2

		VI	Discipline Specific Elective Course	PHY- 361	Solid State Physics	2
				PHY- 362	Quantum Mechanics	2
				PHY- 363	Thermodynamics and Statistical Physics	2
				PHY- 364	Nuclear Physics	2
				PHY- 365	Electronics II /Advanced Electronics	2
				PHY- 366	Elective II (Select any One)	2
				PHY- 367	Physics Laboratory-4A	2
				PHY- 368	Physics Laboratory-4B	2
				PHY- 369	Project	2
			Skill Enhancement Course	PHY-3610	Maintenance and Repairing of Laboratory Equipment – II	2
				PHY- 3611	Household Electrification, Maintenance and Repairing- II	2

SEMISTER-I

Course code and title: PHY-111 Mechanics and Properties of Matter

Lectures: 36 **(Credits-02)**

1. Motion: **(9 Lectures)**

Introduction to motion, Types of motion, Displacement, Velocity, Acceleration, Inertia, Newton's laws of motion with their explanations, Various types of forces in nature, Frames of reference (Inertial and Non inertial), Laws of motion and it's real life applications, Problems.

2. Work and Energy: **(7 Lectures)**

Kinetic energy, Work Energy Theorem, Work done with constant force, Work done withvarying force (spring force), Conservative and Non conservative forces, Potential energy, Law of energy conservation, Gravitational potential energy, Problems.

3. Fluid Mechanics: **(8 Lectures)**

Concept of viscous force and viscosity, Coefficient of viscosity, Steady and Turbulent flow, Reynolds number, Equation of continuity, Bernoulli's Principle, Applications of Bernoulli's Principle (Ventury Meter, PitotTube), Applications of viscous fluids, Problems.

4. Properties of Matter: **(12 Lectures)**

Surface tension, Angle of contact, Factors affecting surface tension, Jaeger's method for determination of surface tension, Applications of surface tension.

Stress and Strain, Hook's law and Coefficient of elasticity, Young's modulus, Bulk modulus, Modulus of rigidity, Work done during longitudinal strain, Volume strain, Shearing strain, Poisson's ratio, Relation between three elastic moduli, (Y, η, K), Applications of elasticity, Problems.

Reference Books

1. Physics: Resnick, Halliday& Walker 9/e, Wiley.
2. University Physics : Sears and Zeemansky, XIth/XIIth Edition, Pearson Education.
3. Mechanics: D. S. Mathur, S. Chand and Company, New Delhi.
4. Elements of Properties of Matter : D. S. Mathur, S. Chand, New Delhi.
5. Concepts of Physics: H. C. Verma, BharatiBhavan Publisher.
6. Problems in Physics: P. K. Srivastava, Wiley Eastern Ltd.
7. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir VI Edition. PearsonEducation/Prentice Hall International, New Delhi.
8. Fundamentals of Mechanics: J C Upadhyaya, Himalaya Publishing House.
9. Mechanics: D. S. Mathur, Revised by P. S. Hemne, S. Chand and Company, New Delhi.
10.

Course code and title: PHY-112 Physics Principles and Applications

Lectures: 36 **(Credits-02)**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1. To understand the general structure of atom, spectrum of hydrogen atom.
2. To understand the atomic excitation and LASER principles.
3. To understand the bonding mechanism and its different types.
4. To demonstrate an understanding of electromagnetic waves and its spectrum.
5. Understand the types and sources of electromagnetic waves and applications.
6. To demonstrate quantitative problem solving skills in all the topics covered.

1. Physics of Atoms **(08-Lectures)**

1.1 Introduction to Atom
1.2 Atomic Models:
- 1.2.1 Thomson's Atomic Model
- 1.2.2 Rutherford's Atomic Model
- 1.2.3 Bohr's Atomic Model

1.3 Atomic Spectra:
- 1.3.1 Emission line Spectrum
- 1.3.2 Absorption line spectrum
- 1.3.3 Uses of Atomic Spectra

1.4 Classical planetary model of Hydrogen Atom
1.5 The Bohr Theory of the Hydrogen Atom
1.6 The Hydrogen Spectrum
1.7 Frank-Hertz experimentProblems

2. LASERS and Its Applications **(07-Lectures)**

2.1 Introduction to LASERS
2.2 Basic Principle of Lasers: Three Processes
2.3 Characteristics of Lasers: brief explanation
2.4 Boltzmann Distribution Law
2.5 Population Inversion and Pumping
2.6 Types of Lasers:
- 2.5.1 He-Ne Laser
- 2.5.2 Ruby Laser

2.7 Applications of LasersProblems

3. Physics of Molecules **(08-Lectures)**

3.1 Introduction to Bonding Mechanisms
3.2 Forces between Atoms
3.3 Types of Bonding:
- 3.3.1 Ionic Bonds
- 3.3.2 Covalent Bonds
- 3.3.3 van der Waal's Bonds
- 3.3.4 Hydrogen Bond
- 3.3.5 Metallic Bond

3.4 Rotation energy levels of a diatomic molecule
3.5 Vibration energy levels of a diatomic moleculeProblems

4. Sources of Electromagnetic Waves (06-Lectures)

4.1 Introduction to Electromagnetic Waves: Historical Perspective
4.2 General properties of Electromagnetic radiations
4.3 Electromagnetic spectrums and its sources
4.4 Production of electromagnetic waves: Hertz experiment
4.5 Plank's hypothesis of Photons
4.6 Applications of various waves in electromagnetic spectrum

5. Applications of Electromagnetic Waves (07-Lectures)

5.1 Microwave oven
5.2 RADAR
5.3 Pyroelectric thermometer
5.4 X-ray radiography
5.5 CT Scan
5.6 Solar cell and its typesProblems

Books/References

1. Concepts of Modern Physics: A Beiser (6th ed., McGraw Hill, 2003
2. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer
3. Sears and Zemansky's University Physics: H.D. Young R. A. Freedman, Sandin (11th Ed.Pearson Education)
4. LASERS: M. N. Avdhanulu, S. Chand Publications.

Course code and title: PHY-113 Physics Laboratory 1A

Practical: 10 (Credits-1.5)

Section I- Mechanics and Properties of Matter

Sr. No	Title of the experiment
1	Study and use of various measuring Instruments. 1. Vernier caliper 2. Micrometer Screw Gauge 3. Travelling Microscope
2	Study of Modulus of Rigidity of wire using Torsional Oscillations
3	Determination of coefficient of Viscosity by Poiseuille's method
4	Determination of "Y" and "η" by flat spiral spring
5	Determination of "Y" by bending method.
6	Study of surface tension by Jaeger's method
7	Study of Poisson's ratio of rubber using rubber tube /rubber chord
8	Study of surface tension of liquid using Fergusson Method

Section II-Physics Principles and Applications

Sr. No	Title of the experiment
1	Study of Spectrometer and determination of angle of prism
2	Study of Spectrometer calibration and determination of refractive indices of different colors
3	Study of divergence of LASER beam
4	Study of total internal reflection using LASER
5	Determination of Plank's constant
6	Determination of wavelength of LASER light by plane diffraction grating
7	Study of I-V characteristics of solar cell

Note: Any four experiments from each section be conducted during the semester, with a total of 10 experiments.

SEMISTER-II

Course code and title: PHY-121 Heat and Thermodynamics

Lectures: 36 **(Credits-02)**

1. Fundamentals of Thermodynamics (10 Lectures) Concept of thermodynamic state, Equation of state, Van der Waal's equation of state, Thermal equilibrium, Zeroth law of thermodynamics, Thermodynamic processes: Adiabatic,Isothermal, Isobaric and Isochoric changes, Indicator diagram, Work done during isothermalchange, Adiabatic relations, Work done during adiabatic change, Internal energy, Internalenergy as state function, First law of thermodynamics, Reversible and Irreversible changes,

Problems.

2. Applied Thermodynamics: (9 Lectures)

Conversion of heat into work and it's converse, Second law of thermodynamics, Concept of entropy, Temperature - entropy diagram, T-dS equations, Clausius - Clapeyron latentheat equations, Problems.

3. Heat Transfer Mechanisms (9 Lectures)

Carnot's cycle and Carnot's heat engine and its efficiency, Heat Engines: Otto cycle &its efficiency, Diesel cycle & its efficiency, Refrigerators: General principle and coefficient of performance of refrigerator, Simple structure of Vapour compression refrigerator, Air Conditioning: Principle and it's applications, Problems.

4. Thermometry: (8 Lectures)

Concept of heat & temperature, Principle of thermometry, Temperature scales & inter-conversions, Principle, Construction and Working: (Liquid thermometers, Liquid filled thermometers, Gas filled thermometers, Bimetallic thermometers, Platinum resistancethermometer, Thermocouple), Problems.

Reference Books:

1. Concept of Physics: H. C. Verma, BharatiBhavan Publisher.
2. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand and Company Ltd.
3. Heat and Thermodynamics: Mark W. Zemansky, Richard H. Dittman, 7th Edition, Mc-GrawHill International Edition.
4. Thermodynamics and Statistical Physics: J. K. Sharma, K. K. Sarkar, Himalaya PublishingHouse.
5. Thermal Physics (Heat and Thermodynamics): A. B. Gupta, H. P. Roy books and Allied (P)Ltd. Calcutta.
6. Instrumentation:Devices & Systems, Rangan, Mani, and Sarma.

Course code and title: PHY-122 Electricity and Magnetism

Lectures: 36 **(Credits-02)**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1) To understand the concept of the electric force, electric field and electric potential forstationary charges.
2) Able to calculate electrostatic field and potential of charge distributions using Coulomb'slaw and Gauss's law.
3) To understand the dielectric phenomenon and effect of electric field on dielectric.
4) To Study magnetic field for steady currents using Biot-Savart and Ampere's Circuitallaws.
5) To study magnetic materials and its properties.
6) Demonstrate quantitative problem solving skills in all the topics covered.

1. Electrostatics **(08-Lectures)**

1.1 Revision of Coulomb's law:
- 1.1.1 Statement
- 1.1.2 Variation of forces with distances

1.2 Superposition principle:
- 1.2.1 Statement
- 1.2.2 Explanation with illustration

1.3 Energy of system of charges

1.4 Concept of electric field
- 1.4.1 Due to point charge
- 1.4.2 Due to group charges

1.5 Concept of electric flex

1.6 Gauss's law in electrostaticsProblems

2. Dielectrics **(08-Lectures)**

2.1 Introduction to dielectric materials

2.2 Electric Dipole
- 2.2.1 Electric dipole
- 2.2.2 Dipole moment

2.3 Electric potential and intensity at any point due to dipole

2.4 Torque on a dipole placed in an electric field

2.5 Polar and non-polar molecules

2.6 Electric polarization of dielectric material

2.7 Gauss' law in dielectric

2.8 Electric vectors and its relationProblems

3. Magnetization **(07-Lectures)**

3.1 Introduction to Magnetization

3.2 Magnetic materials

3.3 Types of Magnetic Materials
- 3.3.1 Diamagnetic materials
- 3.3.2 Paramgnetic materials
- 3.3.3 Ferromagnetic materials
- 3.3.4 Antiferromagnetic materials

3.4 Bohr magnetron
Problems

4. Magnetostatics **(07-Lectures)**

4.1 Introduction to magnetization,
4.2 Magnetic Induction and Intensity of magnetization
4.3 Biot-Savart's law:
- 4.3.1 Statement
- 4.3.2 Long straight conductor
- 4.3.3 Circular Coil

4.4 Ampere's circuital law:
- 4.4.1 Statement
- 4.4.2 Field of Solenoid
- 4.4.3 Field of Toroid

4.5 Gauss law for magnetismProblems

5. Magnetic Properties of Materials **(06-Lectures)**

5.1 Definition
- 5.1.1 Magnetization (M),
- 5.1.2 Magnetic Intensity (H),
- 5.1.3 Magnetic Induction (B),
- 5.1.4 Magnetic Susceptibility
- 5.1.5 Magnetic Permeability

5.2 Relation between B, M and H
5.3 Hysteresis and Hysteresis Curve
5.4 Ferrite materials and its ApplicationsProblems

References:

1. Fundamentals of Physics: HallidayResnik and Walkar, 8th Edition.
2. Electromagnetics: B. B. Laud.
3. Foundations of Electromagnetic theory: Reitz,Milford, Christey.
4. Electricity and Electronics: D.C.Tayal, Himalaya Publishing House, Mumbai.
5. Introduction to Electrodynamics: D.G. Griffith.
6. Electricity and Magnetism: BrijLal, Subramanyan, RatanPrakashan (Revised edition, 1997).
7. Electricity and Magnetism: Khare, Shrivastav (Revised edition, 1997).

Course code and title: PHY-123 Physics Laboratory 1B Practical: 08

(Credits-1.5)

Section I- Heat and Thermodynamics

Sr No	Title of the experiment
1	Interpretation of Isothermal and Adiabatic curve on P-V diagram and theoretical study of Carnot's cycle by drawing graphs of Isothermal and Adiabatic curves
2	Study of temperature coefficient of Thermistor.
3	Study of Thermocouple and determination of inversion temperature
4	Study of thermal conductivity by Lee's method
5	Study of specific heat of Graphite
6	Study of Solar constant
7	Determination of calorific values of different fuels

Section II- Electricity and Magnetism

Sr No	Title of the experiment
1	Study of charging and discharging of capacitor
2	Study of LR circuit
3	Study of LCR circuit
4	Study of Kirchhoff's Laws
5	Study of Diode characteristics
6	Study of Voltmeter, Ammeter and Multimeter (AC, DC, ranges and least count)
7	Determination of frequency of AC mains
8	Comparison of capacitor using DeSauty's method

Note: Any four experiments from each section be conducted during the semester.

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Zoology(Faculty of Science & Technology)

F.Y.B.Sc. Zoology

Choice Based Credit System Syllabus

to be implemented from

Academic Year 2019-2020

Preamble:

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animalbiology. It includes an interesting range of highly diverse topics. A zoology student needs to gain understanding of many areas of the subject to keep pace with advancements in LifeSciences.

This under-graduate degree program has been designed by the Board of Studies in Zoologyof Savitribai Phule Pune University with a substantial component of what is needed from zoologists as a skilled career and what zoologists need to pursue for post-graduation and further academic studies. It follows the guidelines laid down by the University Grants Commission, New Delhi. This newly designed curriculum is a perfect blend of the classicalaspects in Zoology and the advanced and more specialized areas.

This degree offers Discipline Specific Core Courses **[CC]** in Animal Systematics, Animal Ecology, Animal Cell biology, Applied Zoology, Pest Management, Histology, Biological Chemistry, Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Animal Physiology, Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology.

In addition to the Core Courses, Ability Enhancement Compulsory Courses **[AECC]** have been added in the second year i.e. Semester III and Semester IV of the undergraduate course.In the third year i.e. Semester V and Semester VI, Discipline specific Elective Courses **[DSEC]** and Skill Enhancement Courses **[SEC**] have been offered. The students, therefore,have an opportunity to take courses in Environment Awareness, Language communication: English/Marathi, Aquarium Management, Poultry Management and Environmental ImpactAssessment. In Semester VI the students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspective of the subject as he progresses towards completion of the degree program. Fieldtrips, Educational visits and the Project work have been included for the student toexperience the applications of the theory learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciate:animal diversity, few applications of Zoology, the structure, functions and life processes atcellular, tissue, organ and system level, significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and field work through the practical course, field work and the project.

While presenting this new syllabus to the teachers and students of F.Y.B.Sc. Zoology, I amextremely happy to state that efforts have been made to seek inputs of all the stake holders to make it more relevant.

The new course that will be effective from the academic year 2019- 2020 and will follow the Choice Based Credit System in a Semester mode. It has been primed keeping in view the distinctive requirements of B.Sc. Zoology students. The contents have been drawn-up to accommodate the widening prospects of the discipline of Life Sciences. They reflect thechanging prerequisites of the students. This program has been introduced with 132 credits for the subject group while 08 credits to earn from any of the 08 groups offering a range ofcurricular, cocuricular and extracurricular activities. This pattern has been specially aimed towards the overall development of the students'. The calculation of credits and CGPA will

be as per the guidelines of the University. The B.Sc. Zoology program provides anappropriate blend of classical and applied aspects of the subject. This newly designed curriculum will allow students to acquire the skill in handling scientific instrumentsplanning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills. The Syllabus has been revised with the following aims

- To foster curiosity in the students for Zoology
- To create awareness amongst students for the basic and applied areas of Zoology
- To orient students about the importance of abiotic and biotic factors of environmentand their conservation.
- To provide an insight to the aspects of animal diversity.
- To inculcate good laboratory practices in students and to train them about proper
- handling of lab instruments.

1. Course Structure:

Course Structure with Credit Distribution of the Undergraduate Science Program inZoology

Course	Course Code and Name of the Course		Credits
F.Y.B.Sc.	**SEMESTER I**	**SEMESTER II**	
CC	ZO-111 Animal Diversity I	ZO-121 Animal Diversity II	2+2
CC	ZO-112 Animal Ecology	ZO-122 Cell Biology	2+2
CC	ZO-113 Zoology Practical Paper	ZO-123 Zoology Practical Paper	1.5 +1.5
S.Y.B.Sc.	**SEMESTER III**	**SEMESTER IV**	
CC	ZO-231 Animal Diversity III	ZO-241 Animal Diversity IV	2+2
CC	ZO-232 Applied Zoology I	ZO-242 Applied Zoology II	2+2
CC	ZO-233 Zoology Practical Paper	ZO-243 Zoology Practical Paper	2+2
AECC	EVS 231-Environment Awareness	EVA 241-Environment Awareness	2+2
AECC	LA 231-English/Marathi	LA 241- English /Marathi	2+2
T.Y.B.Sc.	**SEMESTER V**	**SEMESTER VI**	
DSEC	ZO-351 Pest Management	ZO-361 Medical & Forensic Zoology	2+2
DSEC	ZO-352 Histology	ZO-362 Animal Physiology	2+2
DSEC	ZO-353 Biological Chemistry	ZO-363 Molecular Biology	2+2
DSEC	ZO-354 Genetics	ZO-364 Entomology	2+2
DSEC	ZO-355 Developmental Biology	ZO-365 Techniques in Biology	2+2
DSEC	ZO-356 Parasitology	ZO-366 Evolutionary Biology	2+2
DSEC	ZO-357 Zoology Practical Paper 1	ZO-367 Zoology Practical Paper 1	2+2
DSEC	ZO-358 Zoology Practical Paper 2	ZO-368 Zoology Practical Paper 2	2+2
DSEC	ZO-359 Zoology Practical Paper 3	ZO-369 Zoology Practical Paper 3	2+2
SEC	ZO-3510 Aquarium Management	ZO-3610 Environmental Impact Assessment	2+2
SEC	ZO- 3511 Poultry Management	ZO-3611 Project	2+2

Detailed Syllabus of F.Y.B.Sc.

Paper	Semester I Course Code& Course	Credits	No of Lectures	Marks (Internal + University)		SemesterII Course Code& Course	Credits	No of Lectures	Marks (Internal + University)
I	ZO-111 Animal Diversity I	02	30	15+ 35= 50		ZO-121 Animal Diversity II	02	30	15+ 35 = 50
II	ZO-112 Animal Ecology	02	30	15+ 35 = 50		ZO-122 Cell Biology	02	30	15+ 35 = 50
III	ZO-113 Zoology Practical Paper	01	15 practical	15+ 35 = 50		ZO-123 Zoology Practical Paper	01	15 Practical	15+ 35 = 50

Course No.	Course Title	Total Number of lectures/practical per Term	Standard of passing		
			Internal marks	**Universitymarks**	**Total marks**
ZO-111 (First term)	Animal Diversity–I	Three lectures/Week (Total 30 lectures perterm)	15	35	50
ZO-121 (Second term)	Animal Diversity-II	Three lectures/Week (Total 30 lectures perterm)	15	35	50
ZO-112 (First term)	Animal Ecology	Three lectures/Week (Total 30 lectures perterm)	15	35	50
ZO-122 (Second Term)	Cell Biology	Three lectures/Week (Total 30 lectures perterm)	15	35	50
ZO-113 (First term)	Zoology Practical Paper	Practical session of 3hours. 15 Practicals	15	35	50
ZO-123 (Second Term)	Zoology Practical Paper	Practical session of 3hours. 15 Practicals	15	35	50

Animal Diversity I & II

Objectives:

1. To understand the Animal diversity around us.
2. To understand the underlying principles of classification of animals.
3. To understand the terminology needed in classification.
4. To understand the differences and similarities in the various aspects ofclassification.
5. To classify invertebrates and to be able to understand the possible group of theinvertebrate observed in nature.to understand our role as a caretaker and promoter of life.

Learning outcomes for the course:

1. The student will be able to understand classify and identify the diversity ofanimals.
2. The student understands the importance of classification of animals andclassifies them effectively using the six levels of classification.
3. The student knows his role in nature as a protector, preserver and promoter oflife which he has achieved by learning, observing and understanding life.

Course Title: Animal Diversity –ICourse

Code-ZO-111

Semester I **(2 credits-30 lectures)**

No.	Title & Contents	Number of lectures
1.	**Principles of Classification:**	**(05)**

Taxonomy & Systematics

1.1 Taxonomy: Basic terminology and Introuction

- Alpha, Beta and Gamma levels of taxonomy, Micro-taxonomy
- Macro taxonomy: Phenetics (numerical taxonomy, Cladistics(Phylogenetic systematics), Evolutionary taxonomy (evolutionary systematics)
- Classical taxonomy and experimental or neo taxonomy(biochemical taxonomy and Cytotaxonomy)
- Significance of Taxonomy

1.2 Systematics: definition introduction

1.3 Linnaean system of classification (Six level classification: Phylum,class, order, family, genus, species)

1.4 Concept of Species: Biological & Evolutionary

1.5 Introduction to Binomial Nomenclature.

1.6 Introduction to Five kingdom system.

2. **General Features of kingdom Animalia** **(02)**

2.1 General characters of Kingdom Animalia, Grades of organization

2.2 Symmetry.

3. **Kingdom Protista (Phylum: Protozoa)** **(07)**

3.1 Introduction to Phylum Protozoa

3.2 Salient features of Phylum Protozoa

3.3 Classification of Phylum Protozoa up to classes with two examplesof each class (names only).

Class Rhizopoda (e.g :*Entamoeba histolytica, Arcella*),

Class Mastigophora (e.g: *Euglena viridis, Trypanosoma gambiense*),Class Ciliata (e.g *Paramoecium caudatum, Opalina ranarum*),

Class Sporozoa (e.g *Plasmodium vivax*, *Toxoplasma gondii*)

3.4 Locomotion in Protozoa: Amoeboid, Ciliary and Flagellar withsuitable examples

3.5 Type Study: ***Paramecium caudatum***: Classification, Habit andHabitat, External morphology, Feeding and digestion, Excretion, Reproduction (binary fission and conjugation)

3.6. Economic importance of Protozoa (three harmful and one usefulprotozoan)

3.6.1-**Harmful Protozoa**:

Plasmodium vivax (malarial parasite),

Entamoeba histolytica (Amoebic dysentery),

Trypanosoma gambiense (Gambian sleeping sickness).3.6.2- **Useful Protozoa**:

Trichonympha

4. **Origin of Metazoa** **(01)**

4.1 Introduction Origin and importance of Metazoa

5. **Phylum Porifera** **(06)**

5.1. Introduction to Phylum Porifera

5.2 Classification of Phylum Porifera up to classes with two examplesof each class (names only, no description of specimens).

Class Calcarea (e.g.: *Leucosolenia, Sycon (Scypha)*

Class Hexactinellida (e.g: *Euplectella* (venus flower basket), *Hyalonema* (glass sponge))

Class Demospongiae (e.g: *Chalina* (Mermaid's gloves, *Spongilla* (freshwater sponge))

5.3 Canal system in sponges: Ascon, Leucon and Rhagon type.

5.4 Skeleton in sponges: Spicules, its

types:Microscleres & Megascleres,

Monoaxon – monactinal, diactinal, Amphidiscs, Triaxon,

Polyaxon,Spongin fibres.

5.5 Regeneration in sponges.

5.6 Economic importance of Phylum Porifera.

6. **Phylum: Cnidaria** **(05)**

6.1 Introduction to Phylum Cnidaria

6.2 Salient features of Phylum Cnidaria

6.3 Classification of Phylum Cnidaria up to class level with

givenexamples each class (names of examples only)

Class Hydrozoa e.g.: Hydra, *Physalia* (Portuguese man of war)

Class Scyphozoa e.g: *Aurelia* (Jelly fish), *Leucernaria* (trumpet shapedJellyfish)

Class Anthozoa: e.g; Metridium (Common sea anemone0

6.4 Polymorphism in Hydrozoa: Polyps & Medusa (polyp types:gastrozooids, dactylozooids, gonozooids) and functions

6.5 Economic importance of Cnidarians with reference to Corals andCoral reefs.

7. **Phylum Platyhelminthes** **(04)**

7.1 Introduction to Phylum Platyhelminthes

7.2 Salient features of Phylum Platyhelminthes

7.3 Classification of Phylum Platyhelminthes up to classes with twoexamples each class (names of examples only).

Class: Turbellaria (e.g: *Dugesia, Bipallium*)

Class: Trematoda (e.g*: Fasciola hepatica, Schistosoma haematobium*)Class Cestoda: (*Taenia solium* (pork tape worm),*Echinococcus granulosus* (dog tapeworm)

7.4 Parasitic adaptations in Platyhelminthes: structural and physiological.

7.5 Economic importance of Platyhelminthes

Course Title: Animal EcologyCourse

Code: ZO 112

Semester I **(2 Credits-30 Lectures)**

Learning outcomes for the course:

- The learners will be able to identify and critically evaluate their own beliefs, values andactions in relation to professional and societal standards of ethics and its impact on ecosystem and biosphere due to the dynamics in population.
- To understand anticipate, analyse and evaluate natural resource issues and act on alifestyle that conserves nature.
- The Learner understands and appreciates the diversity of ecosystems and applies beyondthe syllabi to understand the local lifestyle and problems of the community.
- The learner will be able to link the intricacies of food chains, food webs and link it withhuman life for its betterment and for non-exploitation of the biotic and abiotic components.
- The working in nature to save environment will help development of leadership skills topromote betterment of environment.

ZO 112: Animal Ecology **(2 Credits-30 Lectures)**

No.	Topic & Content	Number of lectures
1.	**Introduction to Ecology**	**(02)**
	1.1 Concepts of Ecology, Environment, Population, Community,Ecosystem, Biosphere, Autecology and synecology.	
2.	**Ecosystem**	**(08)**
	2.1 Types of ecosystems: Aquatic (Freshwater, estuarine, Marine andterrestrial (Forest, Grassland and Desert)	
	2.2 Structure and Composition of Ecosystem (Abiotic components and biotic components.	
	2.3 Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem, Ecological pyramids: Number, Biomass,and Energy.	
	2.4 concept of Eutrophication in lakes and rivers.	
3	**Population**	**(08)**
	3.1 Characteristic of population: Density, Natality, Mortality, Fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion.	
	3.2 Exponential and logistic growth,	
	3.3 Population regulation – density-dependent and independentfactors.	
	Population interactions, Gause's Principle with laboratory and field interactions,	
	3.4 Quadrate, line and belt transect methods.	
4.	**Community**	**(07)**
	4.1Community characteristics: species richness, dominance,	
	diversity,abundance, vertical stratification, Eco tone and edge	
	effect; Ecological	
	succession with one example.	

5. **Animal interactions** **(05)**

5.1 Introduction to Animal interactions

5.2 Types of Animal interactions with at least to suitable examples ofeach

5.2.1-Competition: Interspecific and intraspecific

5.2.2- Beneficial Associations:

Commensalism (remora fish on shark, Cattle egrets on livestock),

Mutualism (Termite and *Trichonympha*, bees and flowers, cleaning symbiosis in fish by prawns.

5.3 Antagonistic associations: Parasitism (*Ascaris* and man, lice andhumans), Prey predation (Lion and deer).

Course Title: Zoology Practical PaperCourse

Code: ZO113

Semester I **(1.5 Credits-45 Hours)**

Animal Diversity –I

1. Museum Study of phylum Protozoa: Euglena, Paramecium, Amoeba, Plasmodium sp.
2. Museum study of Phylum Porifera: *Sycon*, *Euplectella, Chalina*, Spongilla.
3. Museum study of phylum Cnidaria: *Hydra, Physalia, Aurelia, Metridium*.
4 Museum Study of phylum Platyhelminthes: *Planeria, Faciola hepatica, Taenia solium*
5. Study of Paramecium: Culture, External morphology, Conjugation and Binary fission.
6. Study of permanent slides: Spicules and Gemmules in Sponges, T.S. of *Sycon*, T.S. ofHydra, Taeniasolium: Scolex, Gravid proglottid.
7. Identification of any three museum specimen with help of taxonomic identification key.
8. Visit to Zoological survey of India/ Museum/National Park.

Animal Ecology:

1. Estimation of Dissolved oxygen from given water sample.
2. Estimation of Water Alkalinity from given water sample.
3. Study of animal community structure by quadrate method (Field or Simulation).
4. Determination of density, frequency and abundance of species by quadrat method.
5. Study of microscopic fauna of freshwater ecosystem (from pond).
6. Estimation of water holding capacity of given soil sample.
7. Estimation of dissolved and free carbon dioxide from water sample.
8. Study of Eutrophication in lake/river.

Course Title: Animal Diversity –IICourse

Code: ZO-121:

Semester II **(2 credits-30 lectures)**

No.	Title & Contents	Number of lectures
1.	**Phylum Aschelminthes**	**(04)**
	1.1 Introduction to phylum Aschelminthes 1.2 Salient features of Phylum Aschelminthes 1.3 Classification of Phylum Aschelminthes (Class Nematoda only with two examples – *Ascaris lumbricoides* (common round worm),*Wuchereria bancrofti* (Elephantiasis)). 1.4 Economic importance of class Nematoda.	
2.	**Phylum Annelida**	**(06)**
	2.1 Introduction to Phylum Annelida 2.2 Salient features of Phylum Annelida. 2.3 Classification of Phylum Annelida up to classes with examples offollowing classes (names of examples only). Class Polychaeta (e.g: *Nereis pelagica (neries/* sand worm, *Aphrodita aculeata* (=Aphrodite/ seamouse) Class Oligochaeta (e.g.: *Pheritima posthuma* (earthworm), Class Hirudinea (e.g: *Hirudinaria granulosa* common cattle leech) 2.4 Economic importance of Annelida with reference to earthwormsas friends of farmers and in their role in vermicomposting.	
3.	**Phylum Arthropoda**	**(06)**
	3.1 Introduction to Phylum Arthropoda 3.2 Salient features of Phylum Arthropoda 3.3 Classification of Phylum Arthropoda with specific classes andmentioned examples (names only) Class:Crustacea*:Palaemon palaemon* (Prawn) *Brachyura* spp. crabs)Class: Chilopoda: *Scolopendra* sp. (centipede) Class: Diplopoda: *Julus* sp. (millipede)	

Class Insecta*: Periplaneta americana* (American Cockroach),

Anopheles stephensii (mosquito).

Class: Arachnida- Spiders, *Buthus sp (*scorpion)

3.4 mouth parts in insects: Mandibulate (cockroach),

Piercing andsucking (female Anopheles mosquito),

chewing and lapping type (honey bee)

3.5 Economic importance of Arthropoda

Useful Insects: Honey bee, Lac insect, Silkworm.

Harmful insects: Female Anopheles mosquito, Red cotton bug, Riceweevil

4. **Phylum Mollusca** **(06)**

4.1 Introduction to Phylum Mollusca

4.2 Salient features of Phylum Mollusca

4.3 Classification of Phylum Mollusca with specific

classes andmentioned examples (names only)

Class Gastropoda e.g *Pila globosa* (apple snail)

Class Pelecypoda e.g *Lamellidens*

marginalis(Bivalve)Class Polyplacophora e.g

Chiton

Class: Cephalopodae.g: *Octopus vulgaris* (common

octopus), *Sepiaofficinalis* (common Cuttle fish)

4.4 Economic importance of Mollusca.

5. **Study of Phylum Echinodermata** **(08)**

5.1 Introduction to Phylum Echinodermata

5.2 Salient features of Phylum Echinodermata.

5.3 Classification of Phylum Echinodermata with specific

classes andmentioned examples (names only)

Class Asteroidea (*Asterias rubens* sea stars or

starfish)Class: Holothuroidea. *Holothuria sp*. sea

cucumbers)

Class: Echinoidea *(Echinus esculentis* common sea urchins)

Class: Crinoidea (sea lilies or feather stars)

5.4 **Type study: *Asteriasrubens* (Sea Star):**

Classification, HabitHabitat, External Morphology,

Digestive system, Water vascular System and autotomy

and regeneration

5.5 Pedicillaria in Echinodermata: straight, crossed, valvate,tridactylous, globigerous.

5.6 Economic importance of Echinidermata.

Course Title: Cell biology

Course Code: ZO122:

Semester II **(2 credits-30 lectures)**

Learning outcomes for Cell Biology

- The learner will understand the importance of cell as a structural and functionalunit of life.
- The learner understands and compares between the prokaryotic and eukaryoticsystem and extrapolates the life to the aspect of development.
- The dynamism of bio membranes indicates the dynamism of life. Its workingmechanism and precision are responsible for our performance in life.
- The cellular mechanisms and its functioning depends on endo-membranes andstructures. They are best studied with microscopy.

ZO122: Cell biology **(2 credits-30 lectures)**

No.	Title & Contents	Number of lectures

1. **Introduction:** **(04)**

1.1 Introduction cell biology,

1.2 Cell as basic unit of life.

1.3 Importance of Cell Biology and its applications in industry.

Overview of Cells

1.3 Introduction to Prokaryotic and Eukaryotic cells.

1.4 Structure and function of Prokaryotic *(E. coli)*

1.5 Structure and function of Eukaryotic cells (Animal and Plant Cell)

2	**Techniques in Cell Biology:**	**(04)**
	3.1 Introduction	
	3.2 Microscopy: Basic Principle, Simple, Compound and applications ofElectron Microscope.	
	3.3 Stains and dyes: Types of Stain: Acidic, basic and neutral.	
	Dye (Preparation and chemistry of dyes not expected)	
	3.4 Micrometry.	
3	**Plasma Membrane:**	**(06)**
	4.1 Introduction	
	4.2 Structure of plasma membrane: Fluid mosaic model.	
	4.3Transport across membranes: Active and Passive transport, Facilitated transport, exocytosis, endocytosis, phagocytosis – vesiclesand their importance in transport.	
	4.4 Other functions of Cell membrane in brief Protection, cellrecognition, shape, storage, cell signalling.	
	4.5 Cell Junctions: Tight junctions, gap junctions, Desmosomes.	
4	**Nucleus: Structure and function**	**(04)**
	5.1 Introduction to Nucleus	
	5.2 Structure of Nucleus: Nuclear envelope, Nuclear pore complex,Nucleoplasm, Nucleolus	
	5.3 Chromatin: Eu-chromatin and Hetro-chromatin, nature anddifferences.	
	5.4 Functions of nucleus	
5.	**Endomembrane System**	**(04)**
	6.1 Introduction	
	6.2 Structure, location and Functions: Endoplasmic Reticulum, Golgiapparatus, Lysosomes and vacuoles.	
7.	**Mitochondria and Peroxisomes**	**(03)**
	7.1 Introduction	
	7.2 Mitochondria: ultrastructure and function of mitochondrion.	

7.3 Peroxisomes

Cell Division **(05)**

7.1 Introduction

7.2 Cell cycle (G1, S, G2, M phases),

7.3 Mitosis.

7.4 Meiosis.

Course Title: Zoology Practical PaperCourse

Code: ZO123

Semester II **(1.5 Credits-45 Hours)**

Animal Diversity –II

1. Museum study of Phylum Aschelminthes: *Ascaris lumbricoides*,
2. Museum study of phylum Annelida: *Neries*, Earthworm, Leech.
3. Museum study of phylum Arthropoda: Prawn, Cockroach, Centipede, Millipede, Crab
4. Museum study of phylum Mollusca: *Pila*, *Chiton*, Bivalve, Octopus.
5. Museum study of phylum Echinodermata: Sea Star, Sea urchin, Brittle Star, seacucumber.
6. Study of permanent slides: Mouthparts of Insects -Mandibulate, Piercing and sucking,Chewing and Lapping.
7. Types of Shells in Mollusca. *Pila*, Bivalve, Chiton, Sepia.
8. Economic importance of honey bees, Lac insects silk worms, red cotton bug,Anopheles mosquito
9. Earthworm: vermicomposting bin preparation and maintenance.
10. Visit to a vermicomposting unit/ field for insect pest collection and its identification

Cell Biology

1. Study of Microscope: Simple and Compound
2. Micrometry: Measurement of microscopic objects
3. Study of cell: Preparation of temporary mount of human buccal epithelial cells.
4. Preparation of blood smears to observe the blood cells
5. Temporary preparation of mitotic cell from onion roots
6. Study of Cell organelles (any three) by using microphotographs

Recommended Reference Books

Animal Diversity – I and II

1. Anderson, D.T (Ed) 1988: Invertebrate Zoology, Oxford University Press.
2. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders InternationalEdition.
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). TheInvertebrates: A New Synthesis, III Edition, Blackwell Science
4. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S.and Nelson
5. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students.Asia Publishing Home.
6. Brusca, R.C andBrusca, G. J (2003): Invertebrate (2nd ed.) Sinauer Associates Inc.,Publishers Sunderland.
7. Hadzi, J (1963): The Evolution of Metazoa, Macmillan Newyork.
8. Hyman, L. H (1940): Invertebrates Vol I, Protozoa through ctenophore.
9. Hyman. L. H (1955): The Invertebrates Vol: IV, Echinodermata, the coelomatebilateria, Mcgraw Hill, Newyork.
10. Modern Text-Book of zoology, Vertebrates. By Kotpal, RL., Rastogi and Co., Meerut.
11. Nigam H.C., Zoology of Chordates, Vishal Publication, Jalandhar-144008.
12. Phylum Protozoa to Echinodermata (series) by Kotpal, RL. Rastogi and Co., Meerut
13. Parker T.J and W.A Haswell (1972): A text book of Zoology, Vol –I (7th edition byMarshall and Williams) Mcmillan Press ltd.
14. Jordan, E.L. and P.s.Verma Invertebrate Zoology, S. Chand and Co., Ltd. RamNagar, New Delhi.
15. Russel Hunter: - A Biology of higher invertebrates, MacMillon Co. Ltd. London

Animal Ecology

1. Colinvaux, P. A. (1993). Introduction to Ecology. II Edition. Wiley, John and Sons,Inc.
2. Krebs, C. J. (2001). Ecology: The Experimental Analysis of Distribution and Abundance, 6th Edition, ©2009, Pearson
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
6. Sharma P.D. (2002) Ecology and Environment, Himalaya Publication

Cell Biology

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI EditionJohn Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIIEdition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition.ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of theCell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James(2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London
6. Inside the Cell (2005); US Department of Health Sciences, National Institute of Health,Natinal institute of General Medicine Sciences.
7. Lodish, H., D. Baltimore, A. Berk, L. Zipursky, M. Matsudaira and J. Darnell. (2010).
8. Molecular Cell Biology, Eds. 3, Scientific American & W. H. Freeman. New York.
9. Powar C B.: Cell Biology, Himalaya Publication, Meerut

Note: Latest editions of the recommended books may be referred.

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Electronic Science(Faculty of Science & Technology)

F.Y.B.Sc. (Electronic Science)

Choice Based Credit System (CBCS) Syllabus To be implemented from Academic Year 2019-2020

Title of the Course: B. Sc (Electronic Science)

Preamble:

Electronics technology has revolutionized various fields including communication, consumer appliances, medical, defense and so on. The advances in technology are making systems smaller, smarter and powerful. Electronics is an important branch of Science devoted to design implementation and analysis of circuits and systems. Knowledge of Electronics is based on fundamental laws of Physics and though new chips/SOC's are fabricated every day, basic principles remain the same.

The goal of the three-year course is to instill in students a confidence that they can get a grip of the subject andapply it for designing, testing and analyzing systems. The course will also make use of problem-solving approach wherein the students will be trained to apply the acquired knowledge to design and analyze circuits for specific applications. The students will be familiarized with programming languages, various developmenttools, modeling and simulation tools through lab sessions.

The syllabus has been designed such that basic fundamental concepts, knowledge and specific practical skills of the students are developed. The students will be first introduced to various components, devices and their applications, Network theorems and applications of electronics in day to day life. Digital Electronics fundamentals, Operational amplifier circuits, and its applications will be covered in the second semester. In theSecond year the students will be taught the basic principles of communication, Analog and digital circuit designand Microcontrollers. In the third year the students will be given an insight to concepts of Embedded System Design, VLSI Technology, Communication systems and various discipline specific courses with a Project in the final semester.

Titles of Papers and Scheme of Study Evaluation

F. Y. B. Sc. Electronic Science

Sem	Paper Code	Paper	Paper title	Credits	Lectures/Week Th	Tut	Pr.	Evaluation CA	UE	Total
I	EL- 111	I	Basics of Applied Electronics	2	3			15	35	50
	EL- 112	II	Electronic Devicesand Circuits	2	3			15	35	50
	EL-113	III	Electronics Lab IA	1.5			3.15	15	35	50
II	EL-121	I	Fundamentals of Digital Electronics	2	3			15	35	50
	EL-122	II	Analog and Digitaldevice Applications	2	3			15	35	50
	EL-123	III	Electronics Lab IB	1.5			3.15	15	35	50

S. Y. B. Sc. Electronic Science

Sem	Paper Code	Paper	Paper title	Credits	Lectures/Week Th	Tut	Pr.	Evaluation CA	UE	Total
III	EL-231	I	Analog Communication	2	4			15	35	50
	EL- 232	II	Digital System Design	2	4			15	35	50
	EL-233	III	Electronics Lab IIA	2			4	15	35	50
IV	EL-241	I	Analog Circuit Design	2	4			15	35	50
	EL-242	II	Microcontroller	2	4			15	35	50
	EL-243	III	Electronics Lab IIB	2			4	15	35	50

T. Y. B. Sc. Electronic Science

Sem		Paper Code	Paper	Paper title	Credits
V	Discipline Specific Elective Course	EL-351	I	Theory Paper 1	2
		EL-352	II	Theory Paper 2	2
		EL-353	III	Theory Paper 3	2
		EL-354	IV	Theory Paper 4	2
		EL-355	V	Theory Paper 5	2
		EL-356	VI	Theory Paper 6	2
		EL-357	VII	Electronics Lab IIIA	2
		EL-358	VIII	Electronics Lab IIIB	2
		EL-359	IX	Electronics Lab IIIC	2
	Skill EnhancementCourse	EL-3510	X	Theory Paper 7	2
		EL-3511	XI	Theory Paper 8	2
VI	Discipline Specific Elective Course	EL-361	I	Theory Paper 1	2
		EL-362	II	Theory Paper 2	2
		EL-363	III	Theory Paper 3	2
		EL-364	IV	Theory Paper 4	2
		EL-365	V	Theory Paper 5	2
		EL-366	VI	Theory Paper 6	2
		EL-367	VII	Lab IVA: Project	2
		EL-368	VIII	Lab IVB: Project	2
		EL-369	IX	Lab IVC: Project	2
	Skill EnhancementCourse	EL-3610	X	Theory Paper 7	2
		EL-3611	XI	Theory Paper 8	2

Semester I

Paper I: EL- 111: Basics of Applied Electronics (2 Credits, 36 lectures)Semester 1 Theory Lectures: 36

Objective

1. *To understand importance of Electronics in day today life*
2. *To understand basics of electronic circuits*
3. *To make the students learn through problem solving*
4. *To understand few electronic systems*

Learning outcomes:

After completion of this course student will be able:

1. *To identify different parameters/functions/specifications of components used inelectronic circuits*
2. *To solve problems based on network theorems.*
3. *To perform simulations using simulator for analyzing network performance*

Unit 1: Fundamentals of Electronics (14 L)

Introduction to Electronics, applications of Electronics

Electronic Components: Resistors, Capacitors, Inductors, Relays, Batteries, Switches, cablesand connectors, fuses (Only basic concept, working, Specifications and application is expected)

Series and parallel combination of resistors, capacitors and inductors

Voltage and Current Sources: Input and output impedance of AC and DC voltage and/or current sourcesVariable and constant voltage and current sources

Unit 2: Network Theorems (10L)

Kirchoff's Voltage Law and Kirchoff's Current Law, Thevenin, Norton , superposition andmaximum power transfer theorems

DC and AC analysis of network

Numerical problems based on these network theorems

Unit 3: Introduction to electronic systems (12 L)

Building blocks, working principle and features of Smart Phone System, Security systems: Surveillance Camera System CCTV, Public Address System and thermostat

TEXT BOOKS AND REFERENCE BOOKS:

1. Electronic Principles by Malvino
2. Consumer Electronics by J. S. Chitode Technical Publications, Jan-2007
3. Mobile Cellular Telecommunications Analog and Digital System-By Lee.

Paper II: EL- 112: Electronic Devices and Circuits (2 Credits, 36 lectures)

Objectives:

Semester 1 **Theory lectures:36**

1. *To know about basics of Semiconductor Devices and its parameters*
2. *To know about the details of diode, transistors, FET and MOSFETS*
3. *To build and understand application circuits of electronic devices.*
4. *To encourage the students for making use of simulation software for testing the circuitsbefore experimentation.*

Learning outcomes:

After completion of this course student will be able:

1. *To analyze performance parameters based on study of characteristics of electronicdevices like diode, transistors etc*
2. *To choose proper electronic devices as per the need of application*
3. *To perform simulations for designing and analyzing diode/transistor circuits*
4. *To build and test the circuitslike street light controller using electronic devices*

Unit 1: PN Junction Diodes (14L)

Junction Diode, Construction, working and V-I characteristics, Depletion region, BarrierPotential, Forward and Reverse bias condition – Junction capacitance.

Diode current equation–Effect of temperature on reverse saturation currentTypes of diodes: rectifier diodes, Zener diode

Applications: Voltage regulator using Zener diode, Rectifiers: Half wave, full wave and bridge rectifiersripple factor, Use of diode in mobile charger and power supply (includes transformer, diodes, C- filter, regulator IC(78XX or78XXseries))

Unit 2: BJT, FET and MOSFET Basics and Applications(12L)

BJT: Symbol, terminals, types, basic operation, configurations and characteristics (Showing different regions)

Applications: Transistor as switch, Transistor as amplifier Transistor as impedance matching networkFET: Terminals, Symbol, Basic operation and FET as Voltage Variable Resistance

MOSFET: Terminals, Symbol, Basic operation, characteristics and MOSFET as switch

Unit 3: Photo Electric Devices:(10L)

Light-Emitting Diodes (LEDs): Symbol and its use in circuit, IR transmitter and receiver applications ,Photo diode circuit , Photo transistors, LDR and its use in street light controller and Opto-Isolators (MCT2E) and its use in isolation

TEXT BOOKS:

1. Electronic Devices and Circuit Theory --- Robert L. Boylestad & Louis Nashelsky.
2. Electronic Devices and Circuits I – T.L.Floyd- PHI Fifth Edition

REFERENCE BOOKS:

1. Integrated Electronics –Millmam & Halkias.
2. Electronic Devices & Circuits – Bogart.
3. Sedha R.S., A Text Book Of Applied Electronics, S.Chand & Company Ltd

Semester I

EL- 113: ELECTRONICS LAB IA (1.5 Credits)

Number of Practicals:10

Objectives:

1. *To teach students how to draw different symbols and circuit diagrams*
2. *To develop skill of circuit connections*
3. *To familiarize the student with different components and devices used in thelaboratory and the device manuals*
4. *To familiarize students with laboratory instruments like Ammeter, voltmeter, DMM, Signal Generator, Function Generator, CRO and tools like cutter, stripperetc.*
5. *To train them to design and analyze the circuits for specific purpose*
6. *To teach the students how to analyze the results and calculate performance parameters*
7. *To motivate them to work on different mini projects*

Learning outcomes:

After completion of this course student will be able

1. *To identify different components and devices as well as their types*
2. *To understand basic parameters associated with each device*
3. *To know operation of different instruments used in the laboratory*
4. *To connect circuit and do required performance analysis*
5. *To compare simulated and actual results of given particular experiment*

Section A: List of Experiments(Any 05)

1. Assignment type experiment: finding values of Electronic components like resistors from color code, capacitors, inductors and their types, know the components like cables, fuses, wires and toolslike stripper, cutter, soldering gun etc
2. Know your laboratory instruments: Signal Generators and CRO,DMM
3. To verify Kirchhoff's Voltage and current laws
4. To verify Thevenin's Theorem
5. .To verify Norton'sTheorem
6. .To verify Maximum Power Transfer Theorem

7. To verify Superposition theorem
8. To study application circuit of LED
9. How it works: GSM, GPS and Bluetooth(Assignment experiment)
10. Simulation experiment using pSpice (any of the above experiment)

Section B: List of Experiments(Any 05)

1. To study forward and reverse characteristics of Diode characteristics
2. To study diode rectifier circuits
3. To design Zener voltage regulator
4. To design Transistor as a switch(LEDON/OFF)5.To Study of three terminal voltage regulators
7. To study MOSFET as a Switch
8. Simulation experiment using pSpice (any of the above experiment)

Semester II

Paper I: EL-121: Fundamentals of Digital Electronics (2 Credits, 36 lectures)Semester II Theory lectures: 36

Objectives:

1. *To know about different number systems and codes*
2. *To understand logic gates and truth tables*
3. *To understand combinational logical circuits*
4. *To understand sequential logical circuits*
5. *To encourage the students for making use of simulation software for testing andbuilding the circuits before experimentation.*

Learning outcomes:

After completion of this course student will be able

1. *To solve problems based on interconversion of number systems*
2. *To reduce the expression using Boolean theorems*
3. *To reduce expressions using K maps in SOP and POS forms*
4. *To understand how to use flip flops to build modulus counter*
5. *To familiarize with applications of counters like ring counter or event counter*

Unit 1 : Basics of Digital Electronics(16L)

Number Systems: Decimal, Binary, Hexadecimal, BCD, Gray code and their inter-conversions, ASCII, Complements (1's, 2's), Rules of binary Addition, Subtraction.

Logic gates: positive and negative logic, AND, OR, NOT, EX-OR, NAND, NOR, EX-NORand truth tables, NAND and NOR universal gates

Boolean Algebra and Theorems: Boolean Theorems, De-Morgan's laws. Digital logic gates, Multi levelNAND & NOR gates. Standard representation of logic functions (SOP and POS), Minimization Techniques (Karnaugh Map Method: 3 variables),don't care condition.

Basic concept of Arithmetic and logical unit (ALU)

Unit-2 Combinational Logic Circuits (10 L)

Adders-Half & full adder, Subtractor-Half and full subtractors, Parallel binary adder, Magnitude Comparator, Digital lock using magnitude comparator Multiplexers (2:1,4:1)) and Demultiplexers(1:2,4:1), Encoder (8-line-to-3-line) and Decoder (3-line-to-8-line). Parity generator and checker

Unit 3: Sequential Logic Circuits (10 L)

Flip Flops and truth tables: S-R FF , J-K FF, T and D type FFs, Master-Slave FFs, Flip flop asmemory device

Shift Registers and their types, serial to parallel and parallel to serial converters using shift registers Counters : Asynchronous-Mod16, Mod-10, Mod-8, up down counter, Synchronous-Ring counter, Event counter

TEXT BOOKS:

1. M.Morris Mano, “Digital Design “ 3rd Edition, PHI,New Delhi.
2. Ronald J. Tocci. “Digital Systems-Principles and Applications” 6/e. PHI.New Delhi. 1999.(UNITS I to IV)
3. G.K.Kharate :Digital electronics-Oxford University Press
4. S.Salivahana &S. Arivazhagan-Digital circuits and design
5. Fundamentals of Digital Circuits byAnandKumar

Reference Books :

1. Herbert Taub and Donald Schilling. “Digital Integrated Electronics” . McGrawHill.1985.
2. Malvino and Leach. “ Digital Principles and Applications”. TMGHill Edition.

Paper II: EL- 122: Analog and Digital Device applications (2 Credits, 36 lectures)Semester II Total lectures: 36

Objectives:

1. *To know basics of operational amplifier*
2. *To compare performance parameters of opamp ICs available in market*
3. *To understand basic application circuits of opamp.*
4. *To basics of timer IC 555 and its applications*
5. *To understand data converters and their performance parameters*

Learning outcomes:

After completion of this course student will be able

1. *To compare different opamps as per specifications or performance parameters*
2. *To understand opamp circuits and its usefulness in different applications*
3. *To know operating principle of IC 555 in different configurations*
4. *To understand different types of DAC and their performance parameters*
5. *To study different types of ADC and their performance parameters*

Unit 1 : Operational Amplifiers(10 L)

Definition, Basic op-amp Ideal op-amp, Block diagram of op-amp, ideal and practicalcharacteristics of inverting, non inverting configuration, virtual ground

Introduction of OPAMP ICs(comparative study)

Unit 2: Applications of Opamp and IC 555 (14 L)

Wave shaping circuits using integrator and differentiator, ON-OFF controller using comparatoror Schmitt trigger, Function generator, Audio amplifier, V to I converter, PWM generation

IC-555 –functional block diagram , formula of output frequency, duty cycle, pin diagram,astable, monostable and bistable operation

Application circuits: Moisture detector circuit, PWM generation, FSK generator, 50% duty cyclecircuit using diode

Unit 3: Data Converters (12 L)

D/A converter: R-2R Ladder network, Binary Weighted DAC

A/D converter:-Counter type ADC, Successive Approximation ADCBasic operation and block diagram: Digital thermometer

TEXT BOOKS:

1. G.K.Kharate-Digital electronics-oxford university press
2. M.Morris Mano, " Digital Design " 3rdEdition, PHI, New Delhi.
3. Op Amp and Linear Integrated Circuits By Ramakant Gaykwad
4. Linear Integrated Circuits By Roy Choudary

REFERENCE BOOKS :

1. Jacob Millan,MicroElectronics,McGrawHill.
2. Mithal G K, Electronic Devices and Circuits, ThanaPublishers.
3. Allan Mottershead ,Electronic Devices and Circuits – An Introduction-PrenticeHall

Semester II

EL- 123: ELECTRONICS LAB IB (1.5 Credits)

Number of Practicals:10

Objectives:

1. *To build opamp configurations and study its performance*
2. *To build application circuits of opamp and study its performance*
3. *To build application circuits of IC555*
4. *To understand types of ADC and DAC and its performance parameters likeaccuracy, resolution etc*
5. *To teach the students how to analyze the results and calculate performance parameters*
6. *To understand features of laboratory instruments like Ammeter, voltmeter,DMM, Signal Generator, Function Generator, CRO*

Learning outcomes:

After completion of this course student will be able

1. *To connect opamp circuits and analyze the output*
2. *To build application circuits of opamp*
3. *To design the output frequency of IC 555 as astable/monostable multivibrator*
4. *To compare simulated and actual results of given circuit*

Section A: List of Experiments (Any 05)

1. Op-Amp as inverting and non-inverting
2. Op-Amp as integrator and differentiator
3. Op-Amp as adder &subtractor
4. Op-Amp as voltage to current converter
5. Op-Amp as sine wave generator (Wien bridge oscillator)
6. Op-Amp as function generator
7. Astable multivibrator determination of frequency(usingIC-555)
8. Schmitt trigger usingIC-555timer
9. Smoke detector circuit
10. Simulation experiment using pSpice (any of the above experiment)

Section B: List of Experiments(Any 05)

1. Study of logic families (assignment type practical)
2. Verification of IC-logic gates
3. Realization of basic gates using discrete components (resistor, diodes & transistor)
4. Realization of basic gates using Universal gates (NAND & NOR gates)
5. Verify Half adder and full adder using gates
6. Verify Half subtractor and full subtractor using gates.
7. Verify the truth table of RS , JK, T-F/F using NAND gates
8. 4-bit binary parallel adder and subtractor using IC7483
9. BCD to Seven Segment Decoder using IC-7447/7448
10. Simulation experiment using pSpice (any of the above experiment)

Savitribai Phule Pune University [SPPU]

B.Sc. (Chemistry)

(Three Years Integrated Degree Program)

Choice Based Credit System [CBCS]

2019 Pattern

Second Year Bachelors of Science

(S. Y. B. Sc.)

From Academic Year2020-21

Board of Studies in Chemistry

Savitribai Phule Pune University

[SPPU]Pune-411007

Structure of S. Y. B. Sc. Chemistry

(According to CBCS – 2019 Pattern of SPPU)

Semester	Course	Discipline Specific Core (DSCC)*
III	Theory	**CH-301** : Physical and Analytical Chemistry (2 credit, 36 L)
	Theory	**CH-302** : Inorganic and Organic Chemistry (2 credit, 36 L)
	Practical	**CH-303** : Chemistry Practical - III (2 credit, 72 L)
IV	Theory	**CH-401** : Physical and Analytical Chemistry (2 credit, 36 L)
	Theory	**CH-402** : Inorganic and Organic Chemistry (2 credit, 36 L)
	Practical	**CH-403** : Chemistry Practical - IV (2 credit, 72 L)

***Important Notice:**

i. Each lecture (L) will be of 50 minutes.

ii. Each practical of 4 hours and 12 practical sessions per semester

iii. 12 weeks for teaching 03 weeks for evaluation of students (theory as well as practical).

iv. For details refer UG rules and regulations (CBCS for Science program under Science & Technology) published on SPPU website.

Evaluation Pattern (As per CBCS rules, SPPU 2019 Pattern)

1. Each theory and practical course carry 50 marks equivalent to 2 credits.
2. Each course will be evaluated with Continuous Assessment (CA) and University Assessment (UA) mechanism.
3. Continuous assessment shall be of 15 marks (30%) while university Evaluation shall be of 35 marks (70%).
4. To pass each course, a student has to secure 40% mark in continuous assessment as well asuniversity assessment i.e. 6 marks in continuous assessment and 14 marks in university assessment for the respective course.
5. For Continuous Assessment (internal assessment) minimum two tests per paper must be organized, of which one must be written test of 10 marks.
6. Method of assessment for internal exams: Viva-Voce, Project, survey, field visits, tutorials,assignments, group discussion, etc. (on approval of the head of centre).

Theory - University Assessment Question Paper Pattern

(According to CBCS - 2019 Pattern of SPPU)

Note that in theory question paper weightage will be given to each topics equivalent tonumber of lectures assigned in the syllabus.

Total Marks: 35		**Duration: 2 Hours**		
Note: i) Question -1 will be compulsory (5 marks). ii) Solve any three questions from question 2- 5. iii) Questions 2 to 5 carry equal marks (10 each).				
Q-1		Solve any five of the following (a) (b) (c) (d) (e) (f)	a) four tricky questions and b)two question on problem type (if applicable).	5 marks
Q-2	(A) (B)	Describe type of question(s) i) ii) Short question, but tricky		6 mark 4 mark
Q-3	(A) (B)	Explain type of question(s) i) ii) Problem based question if applicable. Justification type of question		6 mark 4 mark
Q-4	(A) (B)	Discuss type of question(s) i) ii) Problem based question if applicable. Justification type of question		6 mark 4 mark
Q-5	 (A) (B) (C)	Attempt any two of the following Questions A, B, C, - will be Explain, Derivation, Discuss, Notes, etc. type of long questions		10 mark

S. Y. B. Sc. Chemistry Syllabus

(CBCS - 2019 Semester Pattern)

From Academic Year 2020-21

Equivalence with Previous Syllabus (2013 Pattern)

New Course (2019 Pattern)	Old Course (2013 Pattern)
CH-301 : Physical and Analytical Chemistry	**CH-211** : Physical and Analytical Chemistry
CH-302 : Inorganic and Organic Chemistry	**CH-212** : Organic and Inorganic Chemistry
CH-303 : Chemistry Practical - III	**CH-223** : Chemistry Practical
CH-401 : Physical and Analytical Chemistry	**CH-221** : Physical and Analytical Chemistry
CH-402 : Inorganic and Organic Chemistry	**CH-222** : Organic and Inorganic Chemistry
CH-403 : Chemistry Practical - IV	**CH-223** : Chemistry Practical

Preamble:

The syllabus of Chemistry for second year has been redesigned for Choice based Credit System (CBCS: 2019 pattern) to be implemented form 2020-21.

In CBCS pattern semester system has been adopted for FY, SY and TY whichincludes Discipline Specific Core Course (DSCC) at F Y level, Ability Enhancement Compulsory Course (AECC), Discipline Specific Elective Course (DSEC) and Skill Enhancement Course (SEC). A DSCC course has been introduced at FY level and AECC courses at SY level along with DSEC. At TY level DSEC and SEC courses has beenintroduced.

Syllabus for Specific Core Courses of Chemistry (2 Theory and 1 Practical) subjectfor F. Y. B. Sc. is to be implemented from the year 2019-20. Syllabus for S. Y. and T. Y. B. Sc. will be implemented from the year 2020-21 and 2021-22 respectively as per structure approved.

Learning Outcome:

1. To understand basic concept/principles of Physical, Analytical, Organic and Inorganicchemistry.
2. To impart practical skills and learn basics behind experiments.
3. To prepare background for advanced and applied studies in chemistry.

Overall Syllabus

SEMESTER-III			
Sr. No.	**Course Code**	**Course Name**	**Credits and No of Lect.**
1	CH-301	Physical and Analytical Chemistry	Credit -2, 36 L
2	CH-302	Inorganic and organic Chemistry	Credit -2, 36 L
3	CH-303	Practical Chemistry-III	Credit -2, 72 L
SEMESTER-IV			
4	CH-401	Physical and Analytical Chemistry	Credit -2, 36 L
5	CH-402	Inorganic and organic Chemistry	Credit -2, 36 L
6	CH-403	Practical Chemistry-IV	Credit -2, 72 L

The detailed Semester and Course wise of Syllabus is as follows:

SEMESTER-III

CH-301: Physical and Analytical Chemistry [Credit -2, 36 L]

Chapter No.	Chapter	No of Lectures
1	Chemical Kinetics	12
2	Surface Chemistry	06
3	Errors in Quantitative Analysis	05
4	Volumetric analysis	13

1. Chemical Kinetics: [12 L]

Introduction to kinetics, the rates of chemical reactions – definition of rates, rate laws and rate constants, reaction order and molecularity, determination of rate law, factors affecting reaction rates, integrated rate laws – zeroth-order reactions, first-order reactions, second-order reactions (with equal and unequal initial concentration of reactants), half-life period, methods for determination order of a reactions, Arrhenius equation- temperature dependence of reaction rates, interpretation of Arrhenius parameters, reaction dynamics - collision theory and transition-state theory of bimolecular reactions, comparison of the two theories, Problems.

*(**Ref. No: 1**- 725-728, 731-733, 741-742, 780-784, 792-794, **Ref. No: 2**- 1033- 1067)*

Learning Outcome:

After studying the Chemical Kinetics student will able to-

1. Define / Explain concept of kinetics, terms used, rate laws, molecularity, order.
2. Explain factors affecting rate of reaction.
3. Explain / discuss / derive integrated rate laws, characteristics, expression for half-lifeand examples of zero order, first order, and second order reactions.
4. Determination of order of reaction by integrated rate equation method, graphicalmethod, half-life method and differential method.
5. Explain / discuss the term energy of activation with the help of energy diagram.
6. Explanation for temperature coefficient and effect of temperature on rate constant k.
7. Derivation of Arrhenius equation and evaluation of energy of activation graphically.
8. Derivations of collision theory and transition state theory of bimolecular reaction andcomparison.
9. Solve / discuss the problem based applying theory and equations.

2. Surface Chemistry [6L]

Introduction to surface chemistry - some basic terms related to surface chemistry adsorption, adsorption materials, factors affecting adsorption, characteristics of adsorption, types of adsorption, classification of adsorption isotherms, Langmuir adsorption isotherm, Freundlich's adsorption isotherm, BET theory (only introduction), application of adsorption, problems. *(**Ref. No:1**- 824-826, 832-837, **Ref. No: 2-** 1251-1264; **Ref. No: 3**- 932-938)*

Learning Outcomes

- Define / explain adsorption, classification of given processes into physical and chemicaladsorption.
- Discuss factors influencing adsorption, its characteristics, differentiates types as physisorption and Chemisorption
- Classification of Adsorption Isotherms, to derive isotherms.
- Explanation of adsorption results in the light of Langmuir adsorption isotherm,Freundlich's adsorption Isotherm and BET theory.
- Apply adsorption process to real life problem.
- Solve / discuss problems using theory.

Reference Books (Physical Chemistry)

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
2. Principles of physical chemistry by B.R. Puri, L.R. Sharma**,** M.S. Pathania
3. Essentials of Physical chemistry by BahlTuli-Revised Multicolour Edition 2009, S. Chand andCompany Ltd.
4. Physical-Chemistry-4th Edition - Gilbert W. CastellanNarosa (2004).
5. Principles of ChemicalKinetics-2rdEdition- James E. House
6. Barrow, G.M. Physical Chemistry Tata McGraw- Hill (2007).
7. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
8. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.:New Delhi (2009).
9. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
10. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co. New York, 1985).
11. Physical Chemistry by Thomas Engel, Philip Reid, Warren Hehre.

3. Errors in Quantitative Analysis [5 L]

Introduction to errors, limitations of analytical methods, classifications of errors,accuracy, precision, minimization of errors, significant figures and computation, methods of

expressing accuracy and precision: mean and standard deviations, reliability of results andnumerical. ***(Ref-1:*** *127-138, supplementary references-* ***Ref-2:*** *62-75,* ***Ref-3:*** *82-121)* **Learning Outcomes**

- Define, explain and compare meaning of accuracy and precision.
- Apply the methods of expressing the errors in analysis from results.
- Explain / discuss different terms related to errors in quantitative analysis.
- Apply statistical methods to express his / her analytical results in laboratory.
- Solve problems applying equations.

4. Volumetric Analysis [13 L]

Introduction to volumetric analysis, classification of reactions in volumetric analysis, standard solutions, equivalents, normalities, and oxidation numbers, preparation of standard solutions, primary and secondary standards. **Types of Volumetric Analysis methods:**

1. Neutralization titrations: Theory of indicators, neutralization curves for strong acid strong base, weak acid strong base, weak base strong acid. Preparation of approximate 0.1 M HCl and standardization against anhydrous sodium carbonate, determination of Na_2CO_3content in washing soda. **2. Complexometric Titrations:** Definition of complexing agent and complexometric titration, EDTA-as complexing agent (structure of EDTA and metal ion-EDTA complex), Types of EDTA titration (direct and back titration), pH adjustment and amount of indicator in EDTA titration, metal ion indicators (general properties, solochrome black – T, Patton and Reeder's indicator only), standard EDTA solution, determination of Ca(II) and Mg(II), total hardness of water. **3. Redox Titrations:** Definition of oxidizing agent, reducing agent, redox titration, $K_2Cr_2O_7$ and $KMnO_4$ as oxidizing agents, 1,10- phenanthroline as indicator in reduction titration, diphenyl amine as oxidation indicator, $KMnO_4$ as self-indicator, Standard $KMnO_4$ solution and standardization with sodium oxalate, Determination of H_2O_2. **4. Precipitation titrations:** precipitation reactions, determination of end point (formation of coloured ppt, formation of soluble coloured compound, adsorption indicator), standard $AgNO_3$ soln., standardization of $AgNO_3$ soln. – potassium chromate indicator- Mohr's titration, determination of chloride and bromide, determination of iodide. Problems based on analysis.

(Ref-1: *Pages-257-275, 286, 295, 309 -322, 328-332, 340-351, 364-372.; supplementary*

reference ***Ref-2:*** *382-302, 322-334, 366-374, 437-452)*

Learning Outcome:

After studying the Volumetric Analysis student will able to-

1. Explain / define different terms in volumetric analysis such as units of concentration, indicator, equivalence point, end point, standard solutions, primary and secondary standards, complexing agent, precipitating agent, oxidizing agent, reducing agent, redox indicators, acid base indicators, metallochome indicators, etc.
2. Perform calculations involved in volumetric analysis.
3. Explain why indicator show colour change and pH range of colour change.
4. To prepare standard solution and **b.** perform standardization of solutions.
5. To construct acid – base titration curves and performs choice of indicator for particulartitration.
6. Explain / discuss acid-base titrations, complexometric titration / precipitation titration /redox titration.
7. Apply volumetric methods of analysis to real problem in analytical chemistry / industry.

Reference Books: (Analytical Chemistry)

1. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham,

   R. C. Denney, Longman Scientific and Technical, 1989.
2. Analytical Chemistry, G. D. Christian, P. K. Dasgupta, K. A. Schug, 7th Ed, Wily, 2004.
3. Fundamentals of Analytical Chemistry- Skoog, west, Holler, Crouch, 9th Ed. Brooks / Cole,2014/2004.
4. Basic Concept of Analytical Chemistry- S. M. Khopkar
5. Instrumental methods of chemical analysis- Chatwal Anand
6. Analytical Chemistry, G.R. Chatwal, Sham Anand.

CH-302: Inorganic and Organic Chemistry [2Credit, 36 L]

Chapter No.	Chapter	No of Lectures
1	Molecular Orbital Theory of Covalent Bonding	13
2	Introduction to Coordination chemistry	05
3	Aromatic hydrocarbons	05
4	Alkyl and Aryl Halides	07
5	Alcohols, Phenols and Ethers	06

1. Molecular Orbital Theory of Covalent Bonding [13 L]

Introduction to Molecular Orbital Method (MOT) and postulates of MO theory, LCAO approximation, s-s combination of orbitals, s-p combination of orbitals, p-p combination of orbitals, p-d combination of orbitals, d-d combination of orbitals, non-bonding combination of orbitals, Rules for linear combination of atomic orbitals, example of molecular orbital treatment for homonuclear diatomic molecules: Explain following molecules with respect to MO energy level diagram, bond order and magnetism: *H_2^+ molecule ion, H_2 molecule, He_2^+ molecule ion, He_2 molecule, Li_2 molecule, Be_2 molecule, B_2 molecule, C_2 molecule, N_2 molecule, O_2 molecule, O_2^- and O_2^{2-} ion, F_2 molecule,* Heteronuclear diatomic molecules: *NO, CO, HF.*

(***Ref.-1:****89-112,* ***Ref-4:*** *278-292,* ***Ref-5:*** *33-38)*

Learning Outcome:

After studying the Molecular Orbital Theory student will able to-

1. Define terms related to molecular orbital theory (AO, MO, sigma bond, pi bond, bondorder, magnetic property of molecules, etc).
2. Explain and apply LCAO principle for the formation of MO's from AO's.
3. Explain formation of different types of MO's from AO's.
4. Distinguish between atomic and molecular orbitals, bonding, anti-bonding and non-bonding molecular orbitals.
5. Draw and explain MO energy level diagrams for homo and hetero diatomic molecules.Explain bond order and magnetic property of molecule.
6. Explain formation and stability of molecule on the basis of bond order.
7. Apply MOT to explain bonding in diatomic molecules other than explained in syllabus.

2. Introduction to Coordination Compounds [5 L]

Double salt and coordination compound, basic definitions: *coordinate bond, ligand, types of ligands, chelate, central metal ion, charge on complex ion, calculation of oxidation state of central metal ion, metal ligand ratio*; Werner's work and theory, Effective atomic number, equilibrium constant *(**Ref-6: 138-140**), chelate effect, IUPAC nomenclature.*

*(**Ref.-1:** 194-200, 222-224; **Ref-4:** 483-492)*

Learning Outcome:

After studying the Introduction to Coordination Compounds student will able to-

1. Define different terms related to the coordination chemistry (double salt, coordination compounds, coordinate bond, ligand, central metal ion, complex ion, coordination number, magnetic moment, crystal field stabilization energy, types of ligand, chelate effect, etc.)
2. Explain Werner's theory of coordination compounds. Differentiate between primary and secondary valency. Correlate coordination number and structure of complex ion.
3. Apply IUPAC nomenclature to coordination compound.

Reference Books: (Inorganic Chemistry)

1. Concise Inorganic Chemistry, J. D. Lee, 5th Ed (1996) Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.
4. Principles of Inorganic Chemistry, Brian W. Pfennig, Wiley (2015)
5. Inorganic Chemistry, Catherine Housecroft, Alan G. Sharpe, Pearson Prentis Hall, 2008.
6. Basics Inorganic Chemistry, Cotton and Wilkinson

3. Aromatic Hydrocarbons: [5 L]

Introduction and IUPAC nomenclature, preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions* (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkylbenzenes (up to 4 carbons on benzene).

*(**Ref-1:** 493-513)*

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Identify and draw the structures aromatic hydrocarbons from their names or from structure name can be assigned.

2. Explain / discuss synthesis of aromatic hydrocarbons.
3. Give the mechanism of reactions involved.
4. Explain /Discuss important reactions of aromatic hydrocarbon.
5. To correlate reagent and reactions.

4. Alkyl and Aryl Halides: [7 L]

Alkyl Halides (up to 5 Carbons): Introduction and IUPAC nomenclature, Types of Nucleophilic Substitution (SN^1, SN^2 and SNi) reactions. *Preparation:* from alkenes *and* alcohols. *Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation.Williamson's ether synthesis: Elimination vs. substitution.

Aryl Halides: Introduction and IUPAC nomenclature, *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer and Gattermann reactions. *Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides**.**

***(Ref.-1:** 165-211 and 943-967)*

Learning Outcome:

After studying the Alkyl and Aryl Halides student will able to-

1. Identify and draw the structures alkyl / aryl halides from their names or from structurename can be assigned.
2. Explain / discuss synthesis of alkyl / aryl halides.
3. Write / discuss the mechanism of Nucleophilic Substitution (SN^1, SN^2 and SNi) reactions.
4. Explain /Discuss important reactions of alkyl / aryl halides.
5. To correlate reagent and reactions.
6. Give synthesis of expected alkyl / aryl halides.

5. Alcohols, Phenols and Ethers (Up to 5 Carbons): [6 L]

Alcohols: Introduction and IUPAC nomenclature, *Preparation:* Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions:* with sodium, HX (Lucas test), esterification, oxidation (with PCC, alc. KMnO4, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols (Phenol case): Introduction and IUPAC nomenclature, *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann Reaction, Houben– Hoesch Condensation, Schotten–Baumann Reaction. **Ethers (aliphatic and aromatic):** Cleavage of ethers with HI.

(***Ref-1:*** *213-244 and 889-912)*

Learning Outcome:

After studying the Alcohols and Phenols student will able to-

1. Identify and draw the structures alcohols / phenols from their names or from structurename can be assigned.
2. Able to differentiate between alcohols and phenols
3. Explain / discuss synthesis of alcohols / phenols.
4. Write / discuss the mechanism of various reactions involved.
5. Explain /Discuss important reactions of alcohols / phenols.
6. To correlate reagent and reactions of alcohols / phenols
7. Give synthesis of expected alcohols / phenols.

References: (Organic Chemistry)

1. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Prentice Hall of India, Sixth Edition, **2002**, 283-308.

Other Reference Books for All Chapters:

2. Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers *Organic Chemistry* -Oxford University Press, USA, 2nd Ed.

3. Bahl, A. and Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, **2010**.

4. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley andSons (2014).

5. Mc Murry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning IndiaEdition, 2013.

6. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi(1988).

7. Finar, I. L. *Organic Chemistry* (Vol. I and II), E.L.B.S.

CH-303: Practical Chemistry-III [2 credit, 72* L]

* 72 L distributed as 58 L for performing practicals and 14 L for internal evaluation.

For practicals, see the manual prepared by BOS of Chemistry. The examination will be heldaccording to this manual.

Instructions

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. Use optimum concentrations and volumes
3. **Two burette method should be used for volumetric analysis (Homogeneousmixtures)**
4. Use of Microscale technique is recommended wherever possible

A. Chemical Kinetics: (Any Three)

1. To Study the Acid catalysed hydrolysis of an ester (methyl Acetate) and determine therate constant (k). (first order reaction)
2. To study the kinetics of saponification reaction between sodium hydroxide and ethylacetate.
3. To compare the relative strength of HCl and H_2SO_4 or HNO_3 by studying the kineticsof hydrolysis of methyl acetate.
4. Energy of activation of the reaction between $K_2S_2O_8$ and KI with unequal initial concentration.

   OR

4. To determine the order of the reaction with respect to $K_2S_2O_8$ by fractional life methodfollowing the kinetics of per sulphate-iodide reaction.

References:

i) Systematic experimental physical chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjalipublication.

ii) Practical Physical Chemistry, Vishwanathan and Raghwan , Viva book.

iii) Practical Chemistry, O. P. Pandey, D. N. Bajpai Dr. S. Giri, S Chand Publication

iv) Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publication.

B. Inorganic quantitative / qualitative analysis (Any two)

1. Estimation of Fe(III) from given solution by converting it to Fe(II) using Zn metal andthen by titrating with standard solution of $K_2Cr_2O_7$-A Green Approach (Ref.-1,3).

2. Determination of $BaCO_3$ content in a given sample by precise determination of volume of CO_2 (Ref-2).
3. Separation and Identification of metal ions by Paper Chromatography (Ref.,4,5)

References:

1. Iron Analysis by Redox Titration A General Chemistry Experiment, ***Journal of ChemicalEducation***, Volume 65, Number 2, February 1988.183.
2. A Precise Method for Determining the CO_2 Content of Carbonate Materials, ***Journal of ChemicalEducation***, Vol. 75, No. 12, December 1998.
3. Vogel's Textbook Quantitative Chemical Analysis, 3rd and 6th Ed.
4. Advanced Practical Chemistry, Jagdamba Sing et al, Pragati Prakashan, Merrut.
5. Practical Chemistry, Panday, Bajpai, Giri, S.Chand and Co.

C. Organic Qualitative Analysis (Two mixtures: solid-solid type)

1. **Separation of Two Components** from given binary mixture of organic compounds containing mono-functional group (Ex. - carboxylic acid, phenols, amines, amide, nitro, etc.) and systematic identification of each component qualitatively.

D. Organic Preparations (Any two)

1. Preparation of benzoic acid from ethyl benzoate (Identification and confirmatory Testof –COOH group, M.P and purity by TLC)
2. Acetylation of primary amine (Green approach)
3. Base catalyzed Aldol condensation (Green approach)
4. Preparation of Quinone from hydroquinone (Confirm the conversion by absence ofphenolic –OH group in product, M.P and purity by TLC)

E. pH Metry (Compulsory)

4. To determine equivalence point of neutralisation of acetic acid by pH-metric titrationwith NaOH and to find best indicator for the titration.

F. Volumetric Analysis (Any two)

1. Estimation of Aspirin from a given tablet and find errors in quantitative analysis. (***Standardization of acid must be performed with standard Na2CO3 solution, prepared from dried anhydrous AR grade Na_2CO_3***)
2. Determination of acetic acid in commercial vinegar by titrating with standard NaOH. Express your results as average ± standard deviation. (***Standardization of base must be performed with standard KHP***)

3. Determination of Hardness of water from given sample by complexometric titration (Using E.D.T.A.) method and total dissolve solids by conductometry. Express your results as average ± standard deviation. (***Standardization of Na_2EDTA must be performed with standard Zn(II) solution***)

Reference:

1. Vogel's Textbook Quantitative Chemical Analysis, 3rd and 5th Ed.
2. Experiments in chemistry, D. V. Jahagirdar, Himalaya Publication.

Examination Pattern: At the time of examination student will have to perform one experiment. In case of organic qualitative analysis, after separation of binary mixture any onecomponent has to be analysed according to OQA scheme. Distribution of 35 marks: 30 marksfor experimental performance and 5 mark for oral.

To cope up with NACC criterion and to motivate and inculcate research culture among the students, interested students can be assigned mini-scale project. Project should be based either on applications of chemistry in day to day life or application or novel / applied synthesis / demonstrating principles of chemistry. The project work is equivalent to three experiments. ***Student performing project can be exempted from 3 experiments from two semester. (*from three different sections of two semester) and project will be evaluated by external examiner. Project being choice based activity; student will not get any exemption in external examination***. Systematic project report (Name page, certificate, introduction/theory, importance of project, learning outcome, requirements, safety precautions, procedure, observations, calculations, results and conclusions) be submittedseparately in binding form duly certified by mentor teacher and HOD.

Illustrative list of some projects is given below for your perusal.

1. Synthesis of soap from different types of oils with respect to i) percent yield ii cost of obtaining 50 g soap (students will learn saponification or alkaline hydrolysis of oils – a chemical reaction for the synthesis of day to day life product, which oil is better for soap making).
2. Synthesis of biodegradable plastic (Principles demonstrated: Chemical reactions for mores safe products and to mitigate environmental pollution).
3. Synthesis of azo dyes and effect substituents of benzene ring on colour of azo dye (Principle demonstrated -Inductive effect a visible demonstration, strategy to charge the colour of dye, chemical reactions for industries).

4. Quality of Consumer products: identification reactions and Purity of $NaHCO_3$ (eating soda) of different brands by thermal decomposition. (Application of analytical chemistry and simple decomposition reaction for the determination of purity of consumer product)
5. Determination pH, surface tension, CMC and washing action of detergent of different brands for comparing their quality. (Application of chemistry principles in determination of quality of consumer product)
6. Removal of dyes / nitrophenols / by Fenton's process or by adsorption on activated charcoal. (Applications of principles of chemistry in mitigation of environmental pollution, an industrial application of chemistry).
7. Study of deionization water using cation and anion exchange resins / zeolites. Amount of zeolites / resin required for the softening of water. (Day to day life application of chemistry, student can apply their knowledge and can construct their own deionizer).
8. Preparation shampoo. Ingredients required, their proportion, mixing and testing.
9. Eudiometer: Determination of oxidation state, equivalent wt. and determine stoichiometry of the reaction between i) iron metal and HCl. Fe can have oxidation state +2 or +3. ii) Znand HCl iii) Al and HCl. What happens with HNO_3? Why similar method cannot used to investigate reaction between HNO_3 and these metals?
10. Study stoichiometry of simple chemical reactions thereby determination of equivalent wt. of one of the reactant: i) $FeSO_4 7H_2O$ and $KMnO_4$ (determine equivalent wt. of $KMnO_4$)

    ii) Mn(II) and $KMnO_4$ (determine equivalent wt. of $KMnO_4$).Explain the concept of variable oxidation state and variable equivalent wt. for same substance i.e. mol. wt. is constant. (Known Fe^{2+} oxidizes to Fe^{3+} only).
11. Synthesis /isolation of essences, purity by TLC/ B.P. (at least two).
12. Synthesis and estimation of purity of aspirin (medicinal compound) by green chemistryroute.
13. Compare the paracetamol content in tablet of different brands (at least three differentbrands).
14. Compare the vitamin-c content in tablet of different brands. (at least three differentbrands).
15. Determination of Avagdro Number (N) by various technics such as Brownian Moment,Electrodeposition, number of molecules in monolayer etc.
16. Hess Law verification

17 Determination of Farday constant and Avagadro number

18 To determine thermodynamic values of various compounds

19 To determine density of various substances

20 Preparation of Nylon and study its properties

21 Microscale techniques in Chemistry

References:

1. A laboratory manual for general, organic and biological chemistry, 3rd Ed. Pearson.
2. Safety-Scale Laboratory Experiments for Chemistry for Today: General, Organic and BiochemistrySeventh Edition, Spencer L. Seager, Michael R. Slabaugh, Cengage Learning, 2010
3. Laboratory Manual for Principles of General Chemistry, Bearen, 8th Ed. Wiley.
4. Green Chemistry Laboratory Manual for General Chemistry, Sally A. Henrie, CRC Press Taylor &Francis Group, and Informa Business. 2015
5. Experiments in General Chemistry, G. S. Weiss T. G. Greco L. H. Rickard, Ninth Edition, PearsonEducation Limited, 2014.
6. Mini-scale and micro-scale organic chemistry laboratory experiments 7th Ed. Schoffstall, Gaddis,Mc-Graw-Hill Higher Education, 2004.
7. Journal of Chemical Education, ACS, (search relevant topics).

II. Students short activity (for both semesters)

These are the extra-time activities for the students which can be performed with the permission of mentor. Mentor can arrange a demonstration on these activities to explain basic principles of chemistry. **Teacher can design many such activities to explain theory that you taught in the class.** Systematic report of activity performed be written in journal. Sample list of small activities is given below. These short activities can be considered for internal evaluation. Some activities are given below.

1. Amphoteric nature of $Al(OH)_3$ (Principle demonstrated-demonstration of amphotericnature substance and why $Al(OH)_3$ is used in antacid preparations)
2. Enzyme deactivation by Hg^{2+} (Principle demonstrated–catalyst deactivation and toxicityeffect of Hg^{2+})
3. Adsorption of dyes on activated charcoal (Principle demonstrated and application-surfaceadsorption for removal of dyes from effluents)
4. Detection of adulteration in milk / chilli powder / turmeric power / food colours
5. Use of EXCEL in drawing of graphs and calculations.
6. Catalysis by Mn(II) in $KMnO_4$–Oxalic acid titration. (Principle, demonstrated - Homogeneous catalysis)

7. Identification of type of salt (strong acid – strong base, strong acid – weak base, weak acid

   – strong base) by hydrolysis reactions and indicators. (Principle demonstrated – hydrolysisreaction of salts, it really takes place)
8. Identification of inorganic ions in soft drinks / tooth paste, form of iodide in table salt / waste water / bore well water.
9. Spectrochemical series using $CuSO_4$ solution and i) NaCl, ii) KBr, iii) Ammonia, iv) ethylene diamine, v) salicylic acid [correlate colour with wavelength and predict ligand strength]
10. Green Chemistry principles in Organic Chemistry.

References: Journal of Chemical Education, ACS, (search relevant topics).

Learning Outcome- Practical Chemistry-III

1. Verify theoretical principles experimentally.
2. Interpret the experimental data on the basis of theoretical principles.
3. Correlate theory to experiments. Understand/verify theoretical principles by experimentobservations; explain practical output / data with the help of theory.
4. Understand systematic methods of identification of substance by chemical methods.
5. Write balanced equation for the chemical reactions performed in the laboratory.
6. Perform organic and inorganic synthesis and is able to follow the progress of the chemicalreaction by suitable method (colour change, ppt. formation, TLC).
7. Set up the apparatus / prepare the solutions - properly for the designed experiments.
8. Perform the quantitative chemical analysis of substances explain principles behind it.
9. Systematic working skill in laboratory will be imparted in student.

Important Notes:

i) Wherever feasible develop and practice micro or semi-micro methods from known / recommended procedures and the reference books. This is to i) minimize the cost of experiment, ii) reduce wastage of chemicals iii) reduce environmental pollution.

ii) Mentor should promote students to ***complete the Journal on the same day before leavingof the lab***. Ensure that the original data is retained and used by the candidate. Students may adjust the data from their lab work to reach close to theoretical values. If journal is completed before leaving the lab it will not encourage students to "adjust" the facts from their lab work. (**Ref-Journal of Chemical Education, Min J. Yang and George F. Atkinson, Designing New Undergraduate Experiments, Vol. 75, No. 7, July 1998**).

Internal Evaluation Strategy for practical (Both semester):

During start of the practical course methodology of internal evaluation should be discussed with students. Internal evaluation is a continuous assessment (CA). Hence during each practical, internal evaluation must be done with different tools. **Guidelines for internalevaluation:** To each practical 15 marks can be assigned which can be distributed as follows:

Overall performanceand timely arrival	**Interactio n**	**Accuracy of results**	**Journal /Lab report**	**Post laboratory quiz /assignment / oral**
4	2	2	5	2

At the end of semester, average of 12 experiments can be assigned as internal marks out of 15. Systematic record of internal evaluation must be maintained which is duly sign by mentor and student. If student is absent with prior-intimation her/his absentee will be considered but student will have to complete the experiment in the same week or in with the permission of mentor. Mentor or practical in-charge should arrange the practical for such students. Students performing projects (one mini project equivalent to three practical session)
/ student activities (4 to 6 activities equivalent to three practical session) can be assigned upto 3 marks out of 15.

SEMSER-IV

CH-401: Physical and Analytical Chemistry [Credit: 2, 36 L]

Chapter No	Chapter	No of Lectures
1	Phase Equilibrium	09
2	Ideal and Real Solutions	09
3	Conductometry	06
4	Colorimetry	06
5	Column Chromatography	06

1. Phase equilibrium [9L]

Introduction; definitions of phase, components and degrees of freedom of a system; stability of phases, criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, phase diagrams of one- component systems- water, carbon dioxide and sulphur systems, problems. *(**Ref. No: 1**, Page No- 119 - 126, **Ref. No: 2**, Page No – 661-675,**Ref. No:4,** Page No 344- 354).*

Learning Outcomes

- Define the terms in phase equilibria such as- system, phase in system, components insystem, degree of freedom, one / two component system, phase rule, etc.
- Explain meaning and Types of equilibrium such as true or static, metastable and unstableequilibrium.
- Discuss meaning of phase, component and degree of freedom.
- Derive of phase rule.
- Explain of one component system with respect to: Description of the curve, Phase rule relationship and typical features for i) Water system ii) Carbon dioxide system iii) Sulphur system
- **Reference Books (Physical Chemistry)**

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
2. Principles of Physical chemistry by B.R. **Puri**, L.R. **Sharma**, M.S. Pathania
3. Essentials of Physical chemistry by Bahl Tuli-Revised Multicolour Edition 2009, S. Chand andCompany Ltd.
4. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
5. Physical-Chemistry-4th Edition - Gilbert W. Castellan Narosa (2004).
6. Principles of Chemical Kinetics- 2rdEdition- James E. House.

7. Barrow, G.M. Physical Chemistry Tata McGraw- Hill (2007).
8. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.:New Delhi (2009).
9. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
10. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
11. Physical Chemistry by Thomas Engel**,** Philip Reid, Warren Hehre.

2. Ideal and real solutions [9L]

Introduction, chemical potential of liquids - ideal solutions, ideal dilute solutions -Raoult's and Henry's Law, liquid mixtures, phase diagram of binary systems : liquids - vapour pressure diagrams, temperature composition diagrams, liquid-liquid phase diagrams, solubility of partially miscible liquids-critical solution temperature, effect of impurity on partially miscible liquids, Problems. (***Ref. No:*** *1, Page Nos- 150-153, 155-157, 166 – 175,*

Ref. No: 2*, Page No. - 750-775, 696-705****Ref. No:4****, Page No. 261-292, 298- 302).*

Learning Outcomes

- Define various terms, laws, differentiate ideal and no-ideal solutions.
- Discuss / explain thermodynamic aspects of Ideal solutions-Gibbs free energy change,Volume change, Enthalpy change and entropy change of mixing of Ideal solution.
- Differentiate between ideal and non-ideal solutions and can apply Raoult's law.
- Interpretation of i) vapour pressure–composition diagram ii) temperature-compositiondiagram.
- Explain distillation of liquid solutions from temperature – composition diagram.
- Explain / discuss azeotropes, Lever rule, Henrys law and its application.
- Discuss / explain solubility of partially miscible liquids- systems with upper **c**ritical. Solution temperature, lower critical solution temperature and having both UCST and LCST.
- Explain / discuss concept of distribution of solute amongst pair of immiscible solvents.
- Derive distribution law and its thermodynamic proof.
- Apply solvent extraction to separate the components of from mixture interest.
- Solve problem by applying theory.

3. Conductometry [6 L]

Introduction, Electrolytic Conductance, Resistance, conductance, Ohm's law, cellconstant, specific and equivalent conductance, molar conductance, variation of equivalent and specific conductance with concentrations, Kohlrausch's law and its applications, conductivity cell, conductivity meter, Whetstone Bridge, determination of cell constant,

conductometric titrations (strong acid-strong base, strong acid-weak base, weak acid strong base) and Numericals. ***Ref-1:*** *398-402, 414-423, 433-434,* ***Ref-2:*** *519-527,* ***SupplementaryRef-3:*** *746-756,* ***Ref-4:*** *528-532.*

Learning Outcomes

- Explain / define different terms in conductometry such as electrolytic conductance, resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, Kohlrausch's law, etc.
- Discuss / explain Kohlrausch's law and its Applications, Conductivity Cell, Conductivity Meter, Whetstone Bridge.
- Explain / discuss conductometric titrations.
- Apply conductometric methods of analysis to real problem in analytical laboratory.
- Solve problems based on theory / equations.
- Correlate different terms with each other and derive equations for their correlations.

4. Colorimetry: [6 L]

Introduction, interaction of electromagnetic radiation with matter, essential terms: radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, Lambert-Beer's Law, molar absorptivity, deviations from Beer's Law, Colorimeter**:** *Principle, Construction and components, Working*. Applications–unknown conc. By calibration curve method, Determination of unknown concentration of Fe(III) by thiocynate method, Numericals. (***Ref- 2:*** *645-651, 658-661, 690,* ***Ref-3:*** *97, 100, 159-172,* ***Ref-4:*** *144-153, 157-160,* ***Ref-6-****Relevent pages).*

Learning Outcomes

- Explain / define different terms in Colorimetry such as radiant power, transmittance,absorbance, molar, Lamberts Law, Beer's Law, molar absorptivity
- Discuss / explain / derive Beer's law of absorptivity.
- Explain construction and working of colorimeter.
- Apply colorimetric methods of analysis to real problem in analytical laboratory.
- Solve problems based on theory / equations.
- Correlate different terms with each other and derive equations for their correlations.

5. Column Chromatography [6 L]

Introduction, Principle of Column Chromatography, **Ion Exchange Chromatography:** Ion exchange resins, action of ion exchange resin (Ion exchange equilibria, Ion exchange capacity), Experimental technique, Application: i) Separation of

Metal ions / non-metal ions on Ion Exchange Chromatography (*Zn(II) and Mg(II)*, *Cl^- and Br^-),* ii) Purification of water, (***Ref-2:*** *186-192, 205-209*) **Adsorption Chromatography – Liquid solid chromatography**: Introduction, the technique of conventional chromatography, column packing materials, Selection of solvent for adsorption chromatography, Adsorption column preparation and loading, Application – Purification of anthracene (***Ref-5:*** *209-215, 221*), Size Exclusion Chromatography*(Supplementary -* ***Ref-4:*** *pages 111-153, 212-215,* ***Ref-6-****Relevent pages)*

Learning Outcomes

- Explain / define different terms in column chromatography such as stationary phase,mobile phase, elution, adsorption, ion exchange resin, adsorbate, etc.
- Explain properties of adsorbents, ion exchange resins, etc.
- Discuss / explain separation of ionic substances using resins.
- Discuss / explain separation of substances using silica gel / alumina.
- Apply column chromatographic process for real analysis in analytical laboratory.

References (Analytical Chemistry)

1. Principles of Physical Chemistry, S.H. Marron and C. F. Pruton4th ed., Oxford and IBH publishingcompany / CBS, new Delhi.
2. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham,

   R. C. Denney, Longman Scientific and Technical, 1989.
4. Basic Concept of Analytical Chemistry- S. M. Khopkar
5. Vogel's Text Book of Practical Organic Chemistry, Furniss, Hannaford, Smith, Tatchel, 5th Ed.,Longman Scientific and Technical, 2004.
6. Analytical Chemistry, G.R. Chatwal, Sham Anand.

CH-402: Inorganic and Organic Chemistry [2 credit, 36L]

Chapter No.	Chapter	No of Lectures
1	Isomerism in coordination complexes	02
2	Valance Bond Theory of Coordination Compounds	04
3	Crystal field Theory	12
4	Aldehydes and ketones	05
5	Carboxylic acids and their derivatives	05
6	Amines and Diazonium Salts	04
7	Stereochemistry of Cyclohexane	04

1. Isomerism in coordination complexes [2 L]

Introduction, polymerization isomerism, ionization isomerism, hydrates isomerism, linkage isomerism, coordination isomerism, coordination position isomerism, geometric isomerism, optical isomerism.

***(Ref-1:** 232-236)*

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Isomerism in coordination complexes
2. Explain different types of isomerism in coordination complexes.

2. Valance Bond Theory of Coordination Compounds [4 L]

Aspects and assumptions of VBT, applications of VBT on the basis of hybridizationto explain the structure and bonding in $[Ag(NH_3)_2]^+$, $[Ni(Cl_4)]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Cr(H_2O_6)]^{3+}$,$[Fe(CN)_6]^{3-}$ (Inner orbital complex) and $[FeF_6]^{3-}$(outer orbital complex). Use of observedmagnetic moment in deciding the geometry in complexes with C.N.4, limitations of VBT. (**Ref-2:** 592-597, **Ref-3:**350-351).

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Apply principles of VBT to explain bonding in coordination compound of differentgeometries.
2. Correlate no of unpaired electrons and orbitals used for bonding.
2. Identify / explain / discuss inner and outer orbital complexes.
4. Explain / discuss limitation of VBT.

3. Crystal Field Theory [12 L]

Shapes of d-orbitals, Crystal field Theory (CFT): Assumptions, Application of CFT to

i) Octahedral complexes (*splitting of 'd' orbitals in Oh ligand field, effect of weak and strong ligand fields, colour absorbed and spectrochemical series, crystal splitting energy, Crystal field stabilization energy and factors affecting it, tetragonal distortion in Cu(II) complexes*)

ii) Square planar complexes and iii) Tetrahedral complexes; spin only magnetic moment of Oh and Td complexes.

(Ref-1:*194-225).*

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Explain principle of CFT.
2. Apply crystal field theory to different type of complexes (Td, Oh, Sq. Pl complexes)
3. Explain: i) strong field and weak field ligand approach in Oh complexes ii) Magnetic properties of coordination compounds on the basis of weak and strong ligand field ligand concept. iii) Origin of colour of coordination complex.
4. Calculate field stabilization energy and magnetic moment for various complexes.
5. To identify Td and Sq. Pl complexes on the basis of magnetic properties / unpaired electrons.
6. Explain spectrochemical series, tetragonal distortion / Jahn-Teller effect in Cu(II) Oh complexes only.

Reference Books: (Inorganic Chemistry)

1. Concise inorganic chemistry, J. D. Lee, 5th Ed (1996), Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.

4. Aldehydes and Ketones (aliphatic and aromatic) [5 L]

(Formaldehyde, acetaldehyde, acetone and benzaldehyde)

Introduction and IUPAC nomenclature, *Preparation:* from acid chlorides and from nitriles. *Reactions* – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test, Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemenson reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction. (***Ref-1:*** *657-700 and 797-816*)

Learning Outcome:

After studying the aldehydes and ketones student will able to-

1. Identify and draw the structures aldehydes and ketones from their names or fromstructure name can be assigned.
2. Explain / discuss synthesis of aldehydes and ketones.
3. Write / discuss the mechanism reactions aldehydes and ketones.
4. Explain /Discuss important reactions of aldehydes and ketones.
5. To correlate reagent and reactions of aldehydes and ketones
6. Give synthesis of expected aldehydes and ketones.
7. Perform inter conversion of functional groups.

5. **Carboxylic acids and their derivatives** **[5 L]**

Carboxylic acids (aliphatic and aromatic): Introduction and IUPAC nomenclature,

Preparation: Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell–Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (up to 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their inter conversion. Reaction: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. *(**Ref-1:** 713-745 and 753-785).*

Learning Outcome:

After studying the carboxylic acids and their derivatives student will able to-

1. Identify and draw the structures carboxylic acids and their derivatives from their names or from structure name can be assigned.
2. Explain / discuss synthesis of carboxylic acids and their derivatives.
3. Write / discuss the mechanism reactions carboxylic acids and their derivatives.
4. Explain /Discuss important reactions of carboxylic acids and their derivatives.
5. Correlate reagent and reactions of carboxylic acids and their derivatives
6. Give synthesis of expected carboxylic acids and their derivatives.
7. Perform inter conversion of functional groups.

6. Amines and Diazonium Salts: [4 L]

Amines (Aliphatic and Aromatic): Introduction and IUPAC nomenclature, *Preparation* from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Electrophilic substitution (Case Aniline): nitration, bromination, sulphonation.

Diazonium salts: Preparation from aromatic amines. (***Ref-1:** 821-877)*

Learning Outcome:

After studying the amines and diazonium Salts student will able to-

1. Identify and draw the structures amines from their names or from structure name can beassigned.
2. Explain / discuss synthesis of carboxylic amines.
3. Write / discuss the mechanism reactions carboxylic amines.
4. Explain /Discuss important reactions of carboxylic amines.
5. To correlate reagent and reactions of carboxylic amines.
6. Give synthesis diazonium salt from amines and reactions of diazonium salt.
7. Perform inter conversion of functional groups.

7. Stereochemistry of Cyclohexane: [4 L]

Bayer's strain theory, heat of combustion of cycloalkanes, structure of cyclohexane, axial and equatorial H atoms, conformations of cycloalkane, stability of conformations of cyclohexane, methyl and t-butyl monosubstituted cyclohexane, 1,1 and 1,2 dimethyl cyclohexane and their stability.

***(Ref-1:** 283-308*).

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Draw the structures of different conformations of cyclohexane.
2. Define terms such as axial hydrogen, equatorial hydrogen, confirmation, substitutedcyclohexane, etc.
3. Convert one conformation of cyclohexane to another conformation and should able toidentify governing structural changes.
4. Explain / discuss stability with respect to potential energy of different conformations ofcyclohexane.
5. Draw structures of different conformations of methyl / t-butyl monosubstitutedcyclohexane (axial, equatorial) and 1, 2 dimethyl cyclohexane.
6. Identify cis- and trans-isomers of 1, 2 dimethyl substituted cyclohexane and able tocompare their stability.

Reference Books: (Organic Chemistry)

1. Morrison, R.T. and Boyd, R.N. *Organic Chemistry*, Prentice Hall of India, Sixth Edition,2002, 283-308.

Other Reference Books for all chapters:

2. Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers, ***Organic Chemistry***-Oxford University Press, USA, 2nd Ed.

3. Bahl, A. and Bahl, B.S. *Advanced Organic Chemistry,* S. Chand**,** 2010**.**

4. Graham Solomon, T. W., Fryhle, C. B. and Dnyder, S. A. ***Organic Chemistry****,* John Wileyand Sons (2014).

5. Mc Murry, J.E. ***Fundamentals of Organic Chemistry***, 7th Ed. Cengage Learning IndiaEdition, 2013.

6. Sykes, P. ***A Guidebook to Mechanism in Organic Chemistry****,* Orient Longman, NewDelhi (1988).

7. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.

CH-403: Practical Chemistry-IV [2 credit, 72* L]

* 72 L will be distributed as 58 L performing practical and 14 L for internal evaluation.

Instructions:

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. Use optimum concentrations and volumes
3. **Two burette method should be used for volumetric analysis (HomogeneousMixtures)**
4. Use of Microscale technique is recommended wherever possible.

A. Conductometry (Compulsory)

a) To determine the cell constant of the given cell using 0.01 M KCl solution and determine dissociation constant of a given monobasic weak acid.

b) To investigate the conductometric titration of any one of the following a) Strong acid against strong base b) Strong base against weak acid. (***standardization of base must be performed with KHP***)

B. Chromatography (compulsory)

1. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose (any one mixture) (Co + Al, Cu + Mg, Zn+Mg). Separation of cations must be confirmed by qualitative test

References:

i. Vogel's Textbook Quantitative Chemical Analysis, 3rd, 6th Ed.

ii) Experiments in chemistry, D. V. Jahagirdar, Himalaya publication.

C. Ideal and Real solutions (Any two)

1. To study the variation of mutual solubility temperature with % concentration for the phenol - water system
2. To study the effect of added electrolyte on the critical solution temperature of phenol- water system and to determine the concentration of the given solution of electrolyte.
3. To obtain the temperature-composition phase diagram for a two component liquid system with maximum (or minimum) boiling point and to determine the maximum (orminimum) boiling point and composition.

D. Adsorption (Compulsory)

1. To verify the Freundlich and Langmuir adsorption isotherm for adsorption of aceticacid on activated charcoal.

References:

i) Systematic experimental physical chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjalipublication.

ii) Practical Physical Chemistry, Vishwanathan and Raghwan , Viva book.

iii) Practical Chemistry, O. P. Pandey, D. N. Bajpai Dr. S. Giri, S Chand Publication

E. Synthesis of Coordination compounds (any two)

1. Synthesis of sodium cobaltinitrite (a laboratory chemical) from Co(II) salt and $NaNO_2$ salts. Comment on colour and magnetic properties of the complex. (Ref.-1, 2)
2. Synthesis of potassium Tris(oxalate)aluminium(III) using Al metal powder(Scrap aluminium). Comment on colour and magnetic properties of the complex. (Ref-2, 3, 4)
3. Synthesis of Tris(acetylacetone)iron(III) by green chemistry method by reaction between $Fe(OH)_3$ and acac. Comment on colour and magnetic properties of the complex. (Ref.- 5,6).
4. Synthesis of Tris(ethylenediamine)nickel(II) from Ni(II) salt, ethylediamine and sodium thiosulfate. Comment on colour and magnetic properties of the complex. (Ref.-7)

F. Inorganic colorimetric investigations (Any two)

1. Prepare standard solutions of $KMnO_4$ / $CuSO_4$, record their absorbance and Verify Beer's Law and determine unknown concentration. **(Compulsory)**
2. Prepare solution of Fe(III) and SCN^- of in different molar proportion, record their absorbance and calculate equilibrium constant of $[Fe(SCN)]^{2+}$ complex (Ref.-9,10)
3. Prepare solution of Fe(III)/Cu(II) and salicylic acid in different molar proportion and determine metal ligand ratio in Fe(III) or Cu(II)–Salicylic acid complex. (Ref.-11, 12, 13)

References

1. Handbook of Preparative Inorganic Chemistry, Volume 2, Second Edition, Edited By Georg BraueR, Academic Press, New York, London, 1965. (Page-1541)
2. Practical Chemistry, Panday, Bjpai, Giri, S.Chand and Co.
3. McNeese, T.J.; Wierda, D.A. Synthesis of Potassium Tris(oxalato)aluminate(III) Trihydrate.

   Journal of Chemical Education,1983, 60(11), 1001.
4. Inorganic Syntheses Vol -1 by H S Booth. First Ed, 1939. (page-36).
5. Novel Synthesis of Tris(acetylacetonato)-iron(III), ***Journal of Chem. Soc. Dalton Trans.*** 1983

6. Metal Acetylacetonate Synthesis Experiments: Which Is Greener?, ***Journal of Chemical Education,*** 2011, 88, 947–953, dx.doi.org/10.1021/ed100174f

7. Experimental Inorganic/Physical Chemistry: An Investigative, Integrated Approach to Practical Project Work, Mounir A. Malati, Woodhead Publishing Limited, 1999.
8. Vogel's Textbook Quantitative Chemical Analysis, 6th Ed.
9. Colorimetric Determination of the Iron(III)-Thiocyanate Reaction Equilibrium Constant with Calibration and Equilibrium Solutions Prepared in a Cuvette by Sequential Additions of One Reagent to the Other, ***Journal of Chemical Education***, Vol.88 No.3 March 2011.
10. Experiments in chemistry, D. V. Jahagirdar, Himalaya publication.
11. A spectrophotometric study of complex formation between Fe(III) and salicylic acid, Kinya Ogawa, Nobuko Tobe, Bulletin of chemical society of Japan, 39, 227-232, 1966.
12. Salicylate determination by complexation with Fe(III) and optical absorbance spectroscopy
13. Determination of Equilibrium Constants of Metal Complexes from Spectrophotometric Measurements: An Undergraduate Laboratory Experiment, ***Journal of Chemical Education***, Vol.76, No. 9, September 1999.

G. Organic Estimations (any two)

1. **Determination of molecular weight:** Determination of molecular weight of organicacid by titration against standardized NaOH - a) monobasic acid or b) dibasic acid
2. **Estimation of amides:** Determine the amount of acetamide in given solution byvolumetric method. (Standardization of acid must be performed)
3. **Estimation of Ethyl benzoate:** To determine the amount of ethyl benzoate in givensolution volumetrically. (Standardization of acid must be performed).

References:

i) Vogel's textbook of practical organic chemistry
ii) Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal

Examination Pattern: At the time of examination student has to perform one experiment either from inorganic sections or organic section. 50% students must be assigned inorganic chemistry and 50% organic chemistry experiment. In case of organic qualitative analysis, after separation of binary mixture any one compound has to be analysed. Distribution of or 35 marks: 30 marks for experimental performance and 5 mark for oral.

Section - C: Industrial Visit

Visit any Chemical / Pharmaceutical / Polymer / Research Institutes / Sugar Factories / wastewater treatment plant, etc. and submit report.

Learning Outcomes

1. Verify theoretical principles experimentally

2. Interpret the experimental data on the basis of theoretical principles.
3. Correlate the theory to the experiments. Understand / verify theoretical principles byexperiment or explain practical output with the help of theory.
4. Understand systematic methods of identification of substance by chemical methods.
5. Write balanced equation for all the chemical reactions performed in the laboratory.
6. Perform organic and inorganic synthesis and able to follow the progress of the chemicalreaction.
7. Set up the apparatus properly for the designed experiments.
8. Perform the quantitative chemical analysis of substances and able to explain principlesbehind it.

Savitribai Phule Pune University [SPPU]

B.Sc. (Chemistry)

(Three Years Integrated Degree Program)

Choice Based Credit System [CBCS]

2019 Pattern

Second Year Bachelors of Science

(S. Y. B. Sc.)

From Academic Year2020-21

Board of Studies in Chemistry

Savitribai Phule Pune University

[SPPU]Pune-411007

Structure of S. Y. B. Sc. Chemistry

(According to CBCS – 2019 Pattern of SPPU)

Semester	Course	Discipline Specific Core (DSCC)*
III	Theory	**CH-301** : Physical and Analytical Chemistry (2 credit, 36 L)
	Theory	**CH-302** : Inorganic and Organic Chemistry (2 credit, 36 L)
	Practical	**CH-303** : Chemistry Practical - III (2 credit, 72 L)
IV	Theory	**CH-401** : Physical and Analytical Chemistry (2 credit, 36 L)
	Theory	**CH-402** : Inorganic and Organic Chemistry (2 credit, 36 L)
	Practical	**CH-403** : Chemistry Practical - IV (2 credit, 72 L)

***Important Notice:**

v. Each lecture (L) will be of 50 minutes.

vi. Each practical of 4 hours and 12 practical sessions per semester

vii. 12 weeks for teaching 03 weeks for evaluation of students (theory as well as practical).

viii. For details refer UG rules and regulations (CBCS for Science program under Science & Technology) published on SPPU website.

Evaluation Pattern (As per CBCS rules, SPPU 2019 Pattern)

7. Each theory and practical course carry 50 marks equivalent to 2 credits.
8. Each course will be evaluated with Continuous Assessment (CA) and University Assessment (UA) mechanism.
9. Continuous assessment shall be of 15 marks (30%) while university Evaluation shall be of 35 marks (70%).
10. To pass each course, a student has to secure 40% mark in continuous assessment as well asuniversity assessment i.e. 6 marks in continuous assessment and 14 marks in university assessment for the respective course.
11. For Continuous Assessment (internal assessment) minimum two tests per paper must be organized, of which one must be written test of 10 marks.
12. Method of assessment for internal exams: Viva-Voce, Project, survey, field visits, tutorials,assignments, group discussion, etc. (on approval of the head of centre).

Theory - University Assessment Question Paper Pattern

(According to CBCS - 2019 Pattern of SPPU)

Note that in theory question paper weightage will be given to each topics equivalent tonumber of lectures assigned in the syllabus.

Total Marks: 35			**Duration: 2 Hours**	
Note: i) Question -1 will be compulsory (5 marks). iv) Solve any three questions from question 2- 5. v) Questions 2 to 5 carry equal marks (10 each).				
Q-1		Solve any five of the following (a) (b) (c) (d) (e) (f)	a) four tricky questions and b)two question on problem type (if applicable).	5 marks
Q-2	(A) (B)	Describe type of question(s) i) ii) Short question, but tricky		6 mark 4 mark
Q-3	(A) (B)	Explain type of question(s) i) ii) Problem based question if applicable. Justification type of question		6 mark 4 mark
Q-4	(A) (B)	Discuss type of question(s) i) ii) Problem based question if applicable. Justification type of question		6 mark 4 mark
Q-5	 (A) (B) (C)	Attempt any two of the following Questions A, B, C, - will be Explain, Derivation, Discuss, Notes, etc. type of long questions		10 mark

S. Y. B. Sc. Chemistry Syllabus

(CBCS - 2019 Semester Pattern)

From Academic Year 2020-21

Equivalence with Previous Syllabus (2013 Pattern)

New Course (2019 Pattern)	Old Course (2013 Pattern)
CH-301 : Physical and Analytical Chemistry	**CH-211** : Physical and Analytical Chemistry
CH-302 : Inorganic and Organic Chemistry	**CH-212** : Organic and Inorganic Chemistry
CH-303 : Chemistry Practical - III	**CH-223** : Chemistry Practical
CH-401 : Physical and Analytical Chemistry	**CH-221** : Physical and Analytical Chemistry
CH-402 : Inorganic and Organic Chemistry	**CH-222** : Organic and Inorganic Chemistry
CH-403 : Chemistry Practical - IV	**CH-223** : Chemistry Practical

Preamble:

The syllabus of Chemistry for second year has been redesigned for Choice based Credit System (CBCS: 2019 pattern) to be implemented form 2020-21.

In CBCS pattern semester system has been adopted for FY, SY and TY whichincludes Discipline Specific Core Course (DSCC) at F Y level, Ability Enhancement Compulsory Course (AECC), Discipline Specific Elective Course (DSEC) and Skill Enhancement Course (SEC). A DSCC course has been introduced at FY level and AECC courses at SY level along with DSEC. At TY level DSEC and SEC courses has beenintroduced.

Syllabus for Specific Core Courses of Chemistry (2 Theory and 1 Practical) subjectfor F. Y. B. Sc. is to be implemented from the year 2019-20. Syllabus for S. Y. and T. Y. B. Sc. will be implemented from the year 2020-21 and 2021-22 respectively as per structure approved.

Learning Outcome:

4. To understand basic concept/principles of Physical, Analytical, Organic and Inorganicchemistry.
5. To impart practical skills and learn basics behind experiments.
6. To prepare background for advanced and applied studies in chemistry.

Overall Syllabus

SEMESTER-III			
Sr. No.	**Course Code**	**Course Name**	**Credits and No of Lect.**
1	CH-301	Physical and Analytical Chemistry	Credit -2, 36 L
2	CH-302	Inorganic and organic Chemistry	Credit -2, 36 L
3	CH-303	Practical Chemistry-III	Credit -2, 72 L
SEMESTER-IV			
4	CH-401	Physical and Analytical Chemistry	Credit -2, 36 L
5	CH-402	Inorganic and organic Chemistry	Credit -2, 36 L
6	CH-403	Practical Chemistry-IV	Credit -2, 72 L

The detailed Semester and Course wise of Syllabus is as follows:

SEMESTER-III

CH-301: Physical and Analytical Chemistry [Credit -2, 36 L]

Chapter No.	Chapter	No of Lectures
1	Chemical Kinetics	12
2	Surface Chemistry	06
3	Errors in Quantitative Analysis	05
4	Volumetric analysis	13

3. Chemical Kinetics: [12 L]

Introduction to kinetics, the rates of chemical reactions – definition of rates, rate laws and rate constants, reaction order and molecularity, determination of rate law, factors affecting reaction rates, integrated rate laws – zeroth-order reactions, first-order reactions, second-order reactions (with equal and unequal initial concentration of reactants), half-life period, methods for determination order of a reactions, Arrhenius equation- temperature dependence of reaction rates, interpretation of Arrhenius parameters, reaction dynamics - collision theory and transition-state theory of bimolecular reactions, comparison of the two theories, Problems.

*(**Ref. No: 1**- 725-728, 731-733, 741-742, 780-784, 792-794, **Ref. No: 2**- 1033- 1067)*

Learning Outcome:

After studying the Chemical Kinetics student will able to-

1. Define / Explain concept of kinetics, terms used, rate laws, molecularity, order.
2. Explain factors affecting rate of reaction.
3. Explain / discuss / derive integrated rate laws, characteristics, expression for half-lifeand examples of zero order, first order, and second order reactions.
4. Determination of order of reaction by integrated rate equation method, graphicalmethod, half-life method and differential method.
5. Explain / discuss the term energy of activation with the help of energy diagram.
6. Explanation for temperature coefficient and effect of temperature on rate constant k.
7. Derivation of Arrhenius equation and evaluation of energy of activation graphically.
8. Derivations of collision theory and transition state theory of bimolecular reaction andcomparison.
9. Solve / discuss the problem based applying theory and equations.

4. Surface Chemistry [6L]

Introduction to surface chemistry - some basic terms related to surface chemistry adsorption, adsorption materials, factors affecting adsorption, characteristics of adsorption, types of adsorption, classification of adsorption isotherms, Langmuir adsorption isotherm, Freundlich's adsorption isotherm, BET theory (only introduction), application of adsorption, problems. *(**Ref. No:1**- 824-826, 832-837, **Ref. No: 2-** 1251-1264; **Ref. No: 3**- 932-938)*

Learning Outcomes

- Define / explain adsorption, classification of given processes into physical and chemicaladsorption.
- Discuss factors influencing adsorption, its characteristics, differentiates types as physisorption and Chemisorption
- Classification of Adsorption Isotherms, to derive isotherms.
- Explanation of adsorption results in the light of Langmuir adsorption isotherm,Freundlich's adsorption Isotherm and BET theory.
- Apply adsorption process to real life problem.
- Solve / discuss problems using theory.

Reference Books (Physical Chemistry)

12. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
13. Principles of physical chemistry by B.R. Puri, L.R. Sharma**,** M.S. Pathania
14. Essentials of Physical chemistry by BahlTuli-Revised Multicolour Edition 2009, S. Chand andCompany Ltd.
15. Physical-Chemistry-4th Edition - Gilbert W. CastellanNarosa (2004).
16. Principles of ChemicalKinetics-2rdEdition- James E. House
17. Barrow, G.M. Physical Chemistry Tata McGraw- Hill (2007).
18. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
19. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.:New Delhi (2009).
20. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
21. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co. New York, 1985).
22. Physical Chemistry by Thomas Engel, Philip Reid, Warren Hehre.

5. Errors in Quantitative Analysis [5 L]

Introduction to errors, limitations of analytical methods, classifications of errors,accuracy, precision, minimization of errors, significant figures and computation, methods of

expressing accuracy and precision: mean and standard deviations, reliability of results andnumerical. ***(Ref-1:*** *127-138, supplementary references-* ***Ref-2:*** *62-75,* ***Ref-3:*** *82-121)* **Learning Outcomes**

- Define, explain and compare meaning of accuracy and precision.
- Apply the methods of expressing the errors in analysis from results.
- Explain / discuss different terms related to errors in quantitative analysis.
- Apply statistical methods to express his / her analytical results in laboratory.
- Solve problems applying equations.

6. Volumetric Analysis [13 L]

Introduction to volumetric analysis, classification of reactions in volumetric analysis, standard solutions, equivalents, normalities, and oxidation numbers, preparation of standard solutions, primary and secondary standards. **Types of Volumetric Analysis methods:**

2. Neutralization titrations: Theory of indicators, neutralization curves for strong acid strong base, weak acid strong base, weak base strong acid. Preparation of approximate 0.1 M HCl and standardization against anhydrous sodium carbonate, determination of Na_2CO_3content in washing soda. **2. Complexometric Titrations:** Definition of complexing agent and complexometric titration, EDTA-as complexing agent (structure of EDTA and metal ion-EDTA complex), Types of EDTA titration (direct and back titration), pH adjustment and amount of indicator in EDTA titration, metal ion indicators (general properties, solochrome black – T, Patton and Reeder's indicator only), standard EDTA solution, determination of Ca(II) and Mg(II), total hardness of water. **3. Redox Titrations:** Definition of oxidizing agent, reducing agent, redox titration, $K_2Cr_2O_7$ and $KMnO_4$ as oxidizing agents, 1,10- phenanthroline as indicator in reduction titration, diphenyl amine as oxidation indicator, $KMnO_4$ as self-indicator, Standard $KMnO_4$ solution and standardization with sodium oxalate, Determination of H_2O_2. **4. Precipitation titrations:** precipitation reactions, determination of end point (formation of coloured ppt, formation of soluble coloured compound, adsorption indicator), standard $AgNO_3$ soln., standardization of $AgNO_3$ soln. – potassium chromate indicator- Mohr's titration, determination of chloride and bromide, determination of iodide. Problems based on analysis.

(Ref-1: *Pages-257-275, 286, 295, 309 -322, 328-332, 340-351, 364-372.; supplementary*

reference ***Ref-2:*** *382-302, 322-334, 366-374, 437-452)*

Learning Outcome:

After studying the Volumetric Analysis student will able to-

1. Explain / define different terms in volumetric analysis such as units of concentration, indicator, equivalence point, end point, standard solutions, primary and secondary standards, complexing agent, precipitating agent, oxidizing agent, reducing agent, redox indicators, acid base indicators, metallochome indicators, etc.
2. Perform calculations involved in volumetric analysis.
3. Explain why indicator show colour change and pH range of colour change.
4. To prepare standard solution and **b.** perform standardization of solutions.
5. To construct acid – base titration curves and performs choice of indicator for particulartitration.
6. Explain / discuss acid-base titrations, complexometric titration / precipitation titration /redox titration.
7. Apply volumetric methods of analysis to real problem in analytical chemistry / industry.

Reference Books: (Analytical Chemistry)

7. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham,

   R. C. Denney, Longman Scientific and Technical, 1989.
8. Analytical Chemistry, G. D. Christian, P. K. Dasgupta, K. A. Schug, 7th Ed, Wily, 2004.
9. Fundamentals of Analytical Chemistry- Skoog, west, Holler, Crouch, 9th Ed. Brooks / Cole,2014/2004.
10. Basic Concept of Analytical Chemistry- S. M. Khopkar
11. Instrumental methods of chemical analysis- Chatwal Anand
12. Analytical Chemistry, G.R. Chatwal, Sham Anand.

CH-302: Inorganic and Organic Chemistry [2Credit, 36 L]

Chapter No.	Chapter	No of Lectures
1	Molecular Orbital Theory of Covalent Bonding	13
2	Introduction to Coordination chemistry	05
3	Aromatic hydrocarbons	05
4	Alkyl and Aryl Halides	07
5	Alcohols, Phenols and Ethers	06

3. Molecular Orbital Theory of Covalent Bonding [13 L]

Introduction to Molecular Orbital Method (MOT) and postulates of MO theory, LCAO approximation, s-s combination of orbitals, s-p combination of orbitals, p-p combination of orbitals, p-d combination of orbitals, d-d combination of orbitals, non-bonding combination of orbitals, Rules for linear combination of atomic orbitals, example of molecular orbital treatment for homonuclear diatomic molecules: Explain following molecules with respect to MO energy level diagram, bond order and magnetism: *H_2^+ molecule ion, H_2 molecule, He_2^+ molecule ion, He_2 molecule, Li_2 molecule, Be_2 molecule, B_2 molecule, C_2 molecule, N_2 molecule, O_2 molecule, O_2^- and O_2^{2-} ion, F_2 molecule,* Heteronuclear diatomic molecules: *NO, CO, HF.*

(***Ref.-1:****89-112,* ***Ref-4:*** *278-292,* ***Ref-5:*** *33-38)*

Learning Outcome:

After studying the Molecular Orbital Theory student will able to-

1. Define terms related to molecular orbital theory (AO, MO, sigma bond, pi bond, bondorder, magnetic property of molecules, etc).
2. Explain and apply LCAO principle for the formation of MO's from AO's.
3. Explain formation of different types of MO's from AO's.
4. Distinguish between atomic and molecular orbitals, bonding, anti-bonding and non-bonding molecular orbitals.
5. Draw and explain MO energy level diagrams for homo and hetero diatomic molecules.Explain bond order and magnetic property of molecule.
6. Explain formation and stability of molecule on the basis of bond order.
7. Apply MOT to explain bonding in diatomic molecules other than explained in syllabus.

4. Introduction to Coordination Compounds [5 L]

Double salt and coordination compound, basic definitions: *coordinate bond, ligand, types of ligands, chelate, central metal ion, charge on complex ion, calculation of oxidation state of central metal ion, metal ligand ratio*; Werner's work and theory, Effective atomic number, equilibrium constant *(**Ref-6: 138-140**), chelate effect, IUPAC nomenclature.*

*(**Ref.-1:** 194-200, 222-224; **Ref-4:** 483-492)*

Learning Outcome:

After studying the Introduction to Coordination Compounds student will able to-

1. Define different terms related to the coordination chemistry (double salt, coordination compounds, coordinate bond, ligand, central metal ion, complex ion, coordination number, magnetic moment, crystal field stabilization energy, types of ligand, chelate effect, etc.)
2. Explain Werner's theory of coordination compounds. Differentiate between primary and secondary valency. Correlate coordination number and structure of complex ion.
3. Apply IUPAC nomenclature to coordination compound.

Reference Books: (Inorganic Chemistry)

7. Concise Inorganic Chemistry, J. D. Lee, 5th Ed (1996) Blackwell Science
8. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
9. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.
10. Principles of Inorganic Chemistry, Brian W. Pfennig, Wiley (2015)
11. Inorganic Chemistry, Catherine Housecroft, Alan G. Sharpe, Pearson Prentis Hall, 2008.
12. Basics Inorganic Chemistry, Cotton and Wilkinson

6. Aromatic Hydrocarbons: [5 L]

Introduction and IUPAC nomenclature, preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions* (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkylbenzenes (up to 4 carbons on benzene).

*(**Ref-1:** 493-513)*

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Identify and draw the structures aromatic hydrocarbons from their names or from structure name can be assigned.

2. Explain / discuss synthesis of aromatic hydrocarbons.
3. Give the mechanism of reactions involved.
4. Explain /Discuss important reactions of aromatic hydrocarbon.
5. To correlate reagent and reactions.

7. Alkyl and Aryl Halides: [7 L]

Alkyl Halides (up to 5 Carbons): Introduction and IUPAC nomenclature, Types of Nucleophilic Substitution (SN^1, SN^2 and SNi) reactions. *Preparation:* from alkenes *and* alcohols. *Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation.Williamson's ether synthesis: Elimination vs. substitution.

Aryl Halides: Introduction and IUPAC nomenclature, *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer and Gattermann reactions. *Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides**.**

***(Ref.-1:** 165-211 and 943-967)*

Learning Outcome:

After studying the Alkyl and Aryl Halides student will able to-

1. Identify and draw the structures alkyl / aryl halides from their names or from structurename can be assigned.
2. Explain / discuss synthesis of alkyl / aryl halides.
3. Write / discuss the mechanism of Nucleophilic Substitution (SN^1, SN^2 and SNi) reactions.
4. Explain /Discuss important reactions of alkyl / aryl halides.
5. To correlate reagent and reactions.
6. Give synthesis of expected alkyl / aryl halides.

8. Alcohols, Phenols and Ethers (Up to 5 Carbons): [6 L]

Alcohols: Introduction and IUPAC nomenclature, *Preparation:* Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions:* with sodium, HX (Lucas test), esterification, oxidation (with PCC, alc. KMnO4, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols (Phenol case): Introduction and IUPAC nomenclature, *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann Reaction, Houben– Hoesch Condensation, Schotten–Baumann Reaction. **Ethers (aliphatic and aromatic):** Cleavage of ethers with HI.

(***Ref-1:*** *213-244 and 889-912)*

Learning Outcome:

After studying the Alcohols and Phenols student will able to-

1. Identify and draw the structures alcohols / phenols from their names or from structurename can be assigned.
2. Able to differentiate between alcohols and phenols
3. Explain / discuss synthesis of alcohols / phenols.
4. Write / discuss the mechanism of various reactions involved.
5. Explain /Discuss important reactions of alcohols / phenols.
6. To correlate reagent and reactions of alcohols / phenols
7. Give synthesis of expected alcohols / phenols.

References: (Organic Chemistry)

8. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Prentice Hall of India, Sixth Edition, **2002**, 283-308.

Other Reference Books for All Chapters:

9. Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers *Organic Chemistry* -Oxford University Press, USA, 2nd Ed.

10. Bahl, A. and Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, **2010**.

11. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley andSons (2014).

12. Mc Murry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning IndiaEdition, 2013.

13. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi(1988).

14. Finar, I. L. *Organic Chemistry* (Vol. I and II), E.L.B.S.

CH-303: Practical Chemistry-III [2 credit, 72* L]

* 72 L distributed as 58 L for performing practicals and 14 L for internal evaluation.

For practicals, see the manual prepared by BOS of Chemistry. The examination will be heldaccording to this manual.

Instructions

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. Use optimum concentrations and volumes
3. **Two burette method should be used for volumetric analysis (Homogeneousmixtures)**
4. Use of Microscale technique is recommended wherever possible

G. Chemical Kinetics: (Any Three)

1. To Study the Acid catalysed hydrolysis of an ester (methyl Acetate) and determine therate constant (k). (first order reaction)
2. To study the kinetics of saponification reaction between sodium hydroxide and ethylacetate.
3. To compare the relative strength of HCl and H_2SO_4 or HNO_3 by studying the kineticsof hydrolysis of methyl acetate.
4. Energy of activation of the reaction between $K_2S_2O_8$ and KI with unequal initial concentration.

   OR

4. To determine the order of the reaction with respect to $K_2S_2O_8$ by fractional life methodfollowing the kinetics of per sulphate-iodide reaction.

References:

v) Systematic experimental physical chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjalipublication.

vi) Practical Physical Chemistry, Vishwanathan and Raghwan , Viva book.

vii) Practical Chemistry, O. P. Pandey, D. N. Bajpai Dr. S. Giri, S Chand Publication

viii) Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publication.

H. Inorganic quantitative / qualitative analysis (Any two)

1. Estimation of Fe(III) from given solution by converting it to Fe(II) using Zn metal andthen by titrating with standard solution of $K_2Cr_2O_7$-A Green Approach (Ref.-1,3).

2. Determination of $BaCO_3$ content in a given sample by precise determination of volume of CO_2 (Ref-2).
3. Separation and Identification of metal ions by Paper Chromatography (Ref.,4,5)

References:

6. Iron Analysis by Redox Titration A General Chemistry Experiment, ***Journal of ChemicalEducation***, Volume 65, Number 2, February 1988.183.
7. A Precise Method for Determining the CO_2 Content of Carbonate Materials, ***Journal of ChemicalEducation***, Vol. 75, No. 12, December 1998.
8. Vogel's Textbook Quantitative Chemical Analysis, 3rd and 6th Ed.
9. Advanced Practical Chemistry, Jagdamba Sing et al, Pragati Prakashan, Merrut.
10. Practical Chemistry, Panday, Bajpai, Giri, S.Chand and Co.

I. Organic Qualitative Analysis (Two mixtures: solid-solid type)

1. **Separation of Two Components** from given binary mixture of organic compounds containing mono-functional group (Ex. - carboxylic acid, phenols, amines, amide, nitro, etc.) and systematic identification of each component qualitatively.

J. Organic Preparations (Any two)

1. Preparation of benzoic acid from ethyl benzoate (Identification and confirmatory Testof –COOH group, M.P and purity by TLC)
2. Acetylation of primary amine (Green approach)
3. Base catalyzed Aldol condensation (Green approach)
4. Preparation of Quinone from hydroquinone (Confirm the conversion by absence ofphenolic –OH group in product, M.P and purity by TLC)

K. pH Metry (Compulsory)

4. To determine equivalence point of neutralisation of acetic acid by pH-metric titrationwith NaOH and to find best indicator for the titration.

L. Volumetric Analysis (Any two)

1. Estimation of Aspirin from a given tablet and find errors in quantitative analysis. (***Standardization of acid must be performed with standard Na2CO3 solution, prepared from dried anhydrous AR grade Na_2CO_3***)
2. Determination of acetic acid in commercial vinegar by titrating with standard NaOH. Express your results as average ± standard deviation. (***Standardization of base must be performed with standard KHP***)

3. Determination of Hardness of water from given sample by complexometric titration (Using E.D.T.A.) method and total dissolve solids by conductometry. Express your results as average ± standard deviation. (***Standardization of Na_2EDTA must be performed with standard Zn(II) solution***)

Reference:

3. Vogel's Textbook Quantitative Chemical Analysis, 3rd and 5th Ed.

4. Experiments in chemistry, D. V. Jahagirdar, Himalaya Publication.

Examination Pattern: At the time of examination student will have to perform one experiment. In case of organic qualitative analysis, after separation of binary mixture any onecomponent has to be analysed according to OQA scheme. Distribution of 35 marks: 30 marksfor experimental performance and 5 mark for oral.

To cope up with NACC criterion and to motivate and inculcate research culture among the students, interested students can be assigned mini-scale project. Project should be based either on applications of chemistry in day to day life or application or novel / applied synthesis / demonstrating principles of chemistry. The project work is equivalent to three experiments. ***Student performing project can be exempted from 3 experiments from two semester. (*from three different sections of two semester) and project will be evaluated by external examiner. Project being choice based activity; student will not get any exemption in external examination***. Systematic project report (Name page, certificate, introduction/theory, importance of project, learning outcome, requirements, safety precautions, procedure, observations, calculations, results and conclusions) be submittedseparately in binding form duly certified by mentor teacher and HOD.

Illustrative list of some projects is given below for your perusal.

17. Synthesis of soap from different types of oils with respect to i) percent yield ii cost of obtaining 50 g soap (students will learn saponification or alkaline hydrolysis of oils – a chemical reaction for the synthesis of day to day life product, which oil is better for soap making).
18. Synthesis of biodegradable plastic (Principles demonstrated: Chemical reactions for mores safe products and to mitigate environmental pollution).
19. Synthesis of azo dyes and effect substituents of benzene ring on colour of azo dye (Principle demonstrated -Inductive effect a visible demonstration, strategy to charge the colour of dye, chemical reactions for industries).

20. Quality of Consumer products: identification reactions and Purity of $NaHCO_3$ (eating soda) of different brands by thermal decomposition. (Application of analytical chemistry and simple decomposition reaction for the determination of purity of consumer product)
21. Determination pH, surface tension, CMC and washing action of detergent of different brands for comparing their quality. (Application of chemistry principles in determination of quality of consumer product)
22. Removal of dyes / nitrophenols / by Fenton's process or by adsorption on activated charcoal. (Applications of principles of chemistry in mitigation of environmental pollution, an industrial application of chemistry).
23. Study of deionization water using cation and anion exchange resins / zeolites. Amount of zeolites / resin required for the softening of water. (Day to day life application of chemistry, student can apply their knowledge and can construct their own deionizer).
24. Preparation shampoo. Ingredients required, their proportion, mixing and testing.
25. Eudiometer: Determination of oxidation state, equivalent wt. and determine stoichiometry of the reaction between i) iron metal and HCl. Fe can have oxidation state +2 or +3. ii) Znand HCl iii) Al and HCl. What happens with HNO_3? Why similar method cannot used to investigate reaction between HNO_3 and these metals?
26. Study stoichiometry of simple chemical reactions thereby determination of equivalent wt. of one of the reactant: i) $FeSO_4 7H_2O$ and $KMnO_4$ (determine equivalent wt. of $KMnO_4$)

    ii) Mn(II) and $KMnO_4$ (determine equivalent wt. of $KMnO_4$).Explain the concept of variable oxidation state and variable equivalent wt. for same substance i.e. mol. wt. is constant. (Known Fe^{2+} oxidizes to Fe^{3+} only).
27. Synthesis /isolation of essences, purity by TLC/ B.P. (at least two).
28. Synthesis and estimation of purity of aspirin (medicinal compound) by green chemistryroute.
29. Compare the paracetamol content in tablet of different brands (at least three differentbrands).
30. Compare the vitamin-c content in tablet of different brands. (at least three differentbrands).
31. Determination of Avagdro Number (N) by various technics such as Brownian Moment,Electrodeposition, number of molecules in monolayer etc.
32. Hess Law verification

22 Determination of Farday constant and Avagadro number

23 To determine thermodynamic values of various compounds

24 To determine density of various substances

25 Preparation of Nylon and study its properties

26 Microscale techniques in Chemistry

References:

8. A laboratory manual for general, organic and biological chemistry, 3rd Ed. Pearson.

9. Safety-Scale Laboratory Experiments for Chemistry for Today: General, Organic and BiochemistrySeventh Edition, Spencer L. Seager, Michael R. Slabaugh, Cengage Learning, 2010

10. Laboratory Manual for Principles of General Chemistry, Bearen, 8th Ed. Wiley.

11. Green Chemistry Laboratory Manual for General Chemistry, Sally A. Henrie, CRC Press Taylor &Francis Group, and Informa Business. 2015

12. Experiments in General Chemistry, G. S. Weiss T. G. Greco L. H. Rickard, Ninth Edition, PearsonEducation Limited, 2014.

13. Mini-scale and micro-scale organic chemistry laboratory experiments 7th Ed. Schoffstall, Gaddis,Mc-Graw-Hill Higher Education, 2004.

14. Journal of Chemical Education, ACS, (search relevant topics).

III. Students short activity (for both semesters)

These are the extra-time activities for the students which can be performed with the permission of mentor. Mentor can arrange a demonstration on these activities to explain basic principles of chemistry. **Teacher can design many such activities to explain theory that you taught in the class.** Systematic report of activity performed be written in journal. Sample list of small activities is given below. These short activities can be considered for internal evaluation. Some activities are given below.

1. Amphoteric nature of $Al(OH)_3$ (Principle demonstrated-demonstration of amphotericnature substance and why $Al(OH)_3$ is used in antacid preparations)
2. Enzyme deactivation by Hg^{2+} (Principle demonstrated–catalyst deactivation and toxicityeffect of Hg^{2+})
3. Adsorption of dyes on activated charcoal (Principle demonstrated and application-surfaceadsorption for removal of dyes from effluents)
4. Detection of adulteration in milk / chilli powder / turmeric power / food colours
5. Use of EXCEL in drawing of graphs and calculations.
6. Catalysis by Mn(II) in $KMnO_4$–Oxalic acid titration. (Principle, demonstrated - Homogeneous catalysis)

7. Identification of type of salt (strong acid – strong base, strong acid – weak base, weak acid

   – strong base) by hydrolysis reactions and indicators. (Principle demonstrated – hydrolysisreaction of salts, it really takes place)

8. Identification of inorganic ions in soft drinks / tooth paste, form of iodide in table salt / waste water / bore well water.
9. Spectrochemical series using $CuSO_4$ solution and i) NaCl, ii) KBr, iii) Ammonia, iv) ethylene diamine, v) salicylic acid [correlate colour with wavelength and predict ligand strength]
10. Green Chemistry principles in Organic Chemistry.

References: Journal of Chemical Education, ACS, (search relevant topics).

Learning Outcome- Practical Chemistry-III

10. Verify theoretical principles experimentally.
11. Interpret the experimental data on the basis of theoretical principles.
12. Correlate theory to experiments. Understand/verify theoretical principles by experimentobservations; explain practical output / data with the help of theory.
13. Understand systematic methods of identification of substance by chemical methods.
14. Write balanced equation for the chemical reactions performed in the laboratory.
15. Perform organic and inorganic synthesis and is able to follow the progress of the chemicalreaction by suitable method (colour change, ppt. formation, TLC).
16. Set up the apparatus / prepare the solutions - properly for the designed experiments.
17. Perform the quantitative chemical analysis of substances explain principles behind it.
18. Systematic working skill in laboratory will be imparted in student.

Important Notes:

iii) Wherever feasible develop and practice micro or semi-micro methods from known / recommended procedures and the reference books. This is to i) minimize the cost of experiment, ii) reduce wastage of chemicals iii) reduce environmental pollution.

iv) Mentor should promote students to ***complete the Journal on the same day before leavingof the lab***. Ensure that the original data is retained and used by the candidate. Students may adjust the data from their lab work to reach close to theoretical values. If journal is completed before leaving the lab it will not encourage students to "adjust" the facts from their lab work. (**Ref-Journal of Chemical Education, Min J. Yang and George F. Atkinson, Designing New Undergraduate Experiments, Vol. 75, No. 7, July 1998**).

Internal Evaluation Strategy for practical (Both semester):

During start of the practical course methodology of internal evaluation should be discussed with students. Internal evaluation is a continuous assessment (CA). Hence during each practical, internal evaluation must be done with different tools. **Guidelines for internalevaluation:** To each practical 15 marks can be assigned which can be distributed as follows:

Overall performanceand timely arrival	**Interactio n**	**Accuracy of results**	**Journal /Lab report**	**Post laboratory quiz /assignment / oral**
4	2	2	5	2

At the end of semester, average of 12 experiments can be assigned as internal marks out of 15. Systematic record of internal evaluation must be maintained which is duly sign by mentor and student. If student is absent with prior-intimation her/his absentee will be considered but student will have to complete the experiment in the same week or in with the permission of mentor. Mentor or practical in-charge should arrange the practical for such students. Students performing projects (one mini project equivalent to three practical session)
/ student activities (4 to 6 activities equivalent to three practical session) can be assigned upto 3 marks out of 15.

SEMSER-IV

CH-401: Physical and Analytical Chemistry [Credit: 2, 36 L]

Chapter No	Chapter	No of Lectures
1	Phase Equilibrium	09
2	Ideal and Real Solutions	09
3	Conductometry	06
4	Colorimetry	06
5	Column Chromatography	06

1. Phase equilibrium [9L]

Introduction; definitions of phase, components and degrees of freedom of a system; stability of phases, criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, phase diagrams of one- component systems- water, carbon dioxide and sulphur systems, problems. *(**Ref. No: 1**, Page No- 119 - 126, **Ref. No: 2**, Page No – 661-675,**Ref. No:4,** Page No 344- 354).*

Learning Outcomes

- Define the terms in phase equilibria such as- system, phase in system, components insystem, degree of freedom, one / two component system, phase rule, etc.
- Explain meaning and Types of equilibrium such as true or static, metastable and unstableequilibrium.
- Discuss meaning of phase, component and degree of freedom.
- Derive of phase rule.
- Explain of one component system with respect to: Description of the curve, Phase rule relationship and typical features for i) Water system ii) Carbon dioxide system iii) Sulphur system
- **Reference Books (Physical Chemistry)**

12. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
13. Principles of Physical chemistry by B.R. **Puri**, L.R. **Sharma**, M.S. Pathania
14. Essentials of Physical chemistry by Bahl Tuli-Revised Multicolour Edition 2009, S. Chand andCompany Ltd.
15. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
16. Physical-Chemistry-4th Edition - Gilbert W. Castellan Narosa (2004).
17. Principles of Chemical Kinetics- 2rdEdition- James E. House.

18. Barrow, G.M. Physical Chemistry Tata McGraw- Hill (2007).
19. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.:New Delhi (2009).
20. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
21. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
22. Physical Chemistry by Thomas Engel**,** Philip Reid, Warren Hehre.

6. Ideal and real solutions [9L]

Introduction, chemical potential of liquids - ideal solutions, ideal dilute solutions -Raoult's and Henry's Law, liquid mixtures, phase diagram of binary systems : liquids - vapour pressure diagrams, temperature composition diagrams, liquid-liquid phase diagrams, solubility of partially miscible liquids-critical solution temperature, effect of impurity on partially miscible liquids, Problems. (***Ref. No:*** *1, Page Nos- 150-153, 155-157, 166 – 175,*

Ref. No: 2*, Page No. - 750-775, 696-705****Ref. No:4****, Page No. 261-292, 298- 302).*

Learning Outcomes

- Define various terms, laws, differentiate ideal and no-ideal solutions.
- Discuss / explain thermodynamic aspects of Ideal solutions-Gibbs free energy change,Volume change, Enthalpy change and entropy change of mixing of Ideal solution.
- Differentiate between ideal and non-ideal solutions and can apply Raoult's law.
- Interpretation of i) vapour pressure–composition diagram ii) temperature-compositiondiagram.
- Explain distillation of liquid solutions from temperature – composition diagram.
- Explain / discuss azeotropes, Lever rule, Henrys law and its application.
- Discuss / explain solubility of partially miscible liquids- systems with upper **c**ritical. Solution temperature, lower critical solution temperature and having both UCST and LCST.
- Explain / discuss concept of distribution of solute amongst pair of immiscible solvents.
- Derive distribution law and its thermodynamic proof.
- Apply solvent extraction to separate the components of from mixture interest.
- Solve problem by applying theory.

7. Conductometry [6 L]

Introduction, Electrolytic Conductance, Resistance, conductance, Ohm's law, cellconstant, specific and equivalent conductance, molar conductance, variation of equivalent and specific conductance with concentrations, Kohlrausch's law and its applications, conductivity cell, conductivity meter, Whetstone Bridge, determination of cell constant,

conductometric titrations (strong acid-strong base, strong acid-weak base, weak acid strong base) and Numericals. ***Ref-1:*** *398-402, 414-423, 433-434,* ***Ref-2:*** *519-527,* ***SupplementaryRef-3:*** *746-756,* ***Ref-4:*** *528-532.*

Learning Outcomes

- Explain / define different terms in conductometry such as electrolytic conductance, resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, Kohlrausch's law, etc.
- Discuss / explain Kohlrausch's law and its Applications, Conductivity Cell, Conductivity Meter, Whetstone Bridge.
- Explain / discuss conductometric titrations.
- Apply conductometric methods of analysis to real problem in analytical laboratory.
- Solve problems based on theory / equations.
- Correlate different terms with each other and derive equations for their correlations.

8. Colorimetry: [6 L]

Introduction, interaction of electromagnetic radiation with matter, essential terms: radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, Lambert-Beer's Law, molar absorptivity, deviations from Beer's Law, Colorimeter**:** *Principle, Construction and components, Working*. Applications–unknown conc. By calibration curve method, Determination of unknown concentration of Fe(III) by thiocynate method, Numericals. (***Ref- 2:*** *645-651, 658-661, 690,* ***Ref-3:*** *97, 100, 159-172,* ***Ref-4:*** *144-153, 157-160,* ***Ref-6-****Relevent pages).*

Learning Outcomes

- Explain / define different terms in Colorimetry such as radiant power, transmittance,absorbance, molar, Lamberts Law, Beer's Law, molar absorptivity
- Discuss / explain / derive Beer's law of absorptivity.
- Explain construction and working of colorimeter.
- Apply colorimetric methods of analysis to real problem in analytical laboratory.
- Solve problems based on theory / equations.
- Correlate different terms with each other and derive equations for their correlations.

9. Column Chromatography [6 L]

Introduction, Principle of Column Chromatography, **Ion Exchange Chromatography:** Ion exchange resins, action of ion exchange resin (Ion exchange equilibria, Ion exchange capacity), Experimental technique, Application: i) Separation of

Metal ions / non-metal ions on Ion Exchange Chromatography (*Zn(II) and Mg(II)*, *Cl^- and Br^-),* ii) Purification of water, (***Ref-2:*** *186-192, 205-209*) **Adsorption Chromatography – Liquid solid chromatography**: Introduction, the technique of conventional chromatography, column packing materials, Selection of solvent for adsorption chromatography, Adsorption column preparation and loading, Application – Purification of anthracene (***Ref-5:*** *209-215, 221*), Size Exclusion Chromatography*(Supplementary -* ***Ref-4:*** *pages 111-153, 212-215,* ***Ref-6-****Relevent pages)*

Learning Outcomes

- Explain / define different terms in column chromatography such as stationary phase,mobile phase, elution, adsorption, ion exchange resin, adsorbate, etc.
- Explain properties of adsorbents, ion exchange resins, etc.
- Discuss / explain separation of ionic substances using resins.
- Discuss / explain separation of substances using silica gel / alumina.
- Apply column chromatographic process for real analysis in analytical laboratory.

References (Analytical Chemistry)

3. Principles of Physical Chemistry, S.H. Marron and C. F. Pruton4th ed., Oxford and IBH publishingcompany / CBS, new Delhi.

4. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham,

R. C. Denney, Longman Scientific and Technical, 1989.

7. Basic Concept of Analytical Chemistry- S. M. Khopkar

8. Vogel's Text Book of Practical Organic Chemistry, Furniss, Hannaford, Smith, Tatchel, 5th Ed.,Longman Scientific and Technical, 2004.

9. Analytical Chemistry, G.R. Chatwal, Sham Anand.

CH-402: Inorganic and Organic Chemistry [2 credit, 36L]

Chapter No.	Chapter	No of Lectures
1	Isomerism in coordination complexes	02
2	Valance Bond Theory of Coordination Compounds	04
3	Crystal field Theory	12
4	Aldehydes and ketones	05
5	Carboxylic acids and their derivatives	05
6	Amines and Diazonium Salts	04
7	Stereochemistry of Cyclohexane	04

3. Isomerism in coordination complexes [2 L]

Introduction, polymerization isomerism, ionization isomerism, hydrates isomerism, linkage isomerism, coordination isomerism, coordination position isomerism, geometric isomerism, optical isomerism.

***(Ref-1:** 232-236)*

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Isomerism in coordination complexes
2. Explain different types of isomerism in coordination complexes.

4. Valance Bond Theory of Coordination Compounds [4 L]

Aspects and assumptions of VBT, applications of VBT on the basis of hybridizationto explain the structure and bonding in $[Ag(NH_3)_2]^+$, $[Ni(Cl_4)]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Cr(H_2O_6)]^{3+}$,$[Fe(CN)_6]^{3-}$ (Inner orbital complex) and $[FeF_6]^{3-}$(outer orbital complex). Use of observedmagnetic moment in deciding the geometry in complexes with C.N.4, limitations of VBT. (**Ref-2:** 592-597, **Ref-3:**350-351).

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Apply principles of VBT to explain bonding in coordination compound of differentgeometries.
2. Correlate no of unpaired electrons and orbitals used for bonding.
4. Identify / explain / discuss inner and outer orbital complexes.

4. Explain / discuss limitation of VBT.

5. Crystal Field Theory [12 L]

Shapes of d-orbitals, Crystal field Theory (CFT): Assumptions, Application of CFT to

iii) Octahedral complexes (*splitting of 'd' orbitals in Oh ligand field, effect of weak and strong ligand fields, colour absorbed and spectrochemical series, crystal splitting energy, Crystal field stabilization energy and factors affecting it, tetragonal distortion in Cu(II) complexes*)

iv) Square planar complexes and iii) Tetrahedral complexes; spin only magnetic moment of Oh and Td complexes.

(Ref-1:*194-225).*

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Explain principle of CFT.
2. Apply crystal field theory to different type of complexes (Td, Oh, Sq. Pl complexes)
3. Explain: i) strong field and weak field ligand approach in Oh complexes ii) Magnetic properties of coordination compounds on the basis of weak and strong ligand field ligand concept. iii) Origin of colour of coordination complex.
4. Calculate field stabilization energy and magnetic moment for various complexes.
5. To identify Td and Sq. Pl complexes on the basis of magnetic properties / unpaired electrons.
6. Explain spectrochemical series, tetragonal distortion / Jahn-Teller effect in Cu(II) Oh complexes only.

Reference Books: (Inorganic Chemistry)

8. Concise inorganic chemistry, J. D. Lee, 5th Ed (1996), Blackwell Science
9. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
10. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.

11. Aldehydes and Ketones (aliphatic and aromatic) [5 L]

(Formaldehyde, acetaldehyde, acetone and benzaldehyde)

Introduction and IUPAC nomenclature, *Preparation:* from acid chlorides and from nitriles. *Reactions* – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test, Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemenson reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction. (***Ref-1:*** *657-700 and 797-816*)

Learning Outcome:

After studying the aldehydes and ketones student will able to-

1. Identify and draw the structures aldehydes and ketones from their names or fromstructure name can be assigned.
2. Explain / discuss synthesis of aldehydes and ketones.
3. Write / discuss the mechanism reactions aldehydes and ketones.
4. Explain /Discuss important reactions of aldehydes and ketones.
5. To correlate reagent and reactions of aldehydes and ketones
6. Give synthesis of expected aldehydes and ketones.
7. Perform inter conversion of functional groups.

12. **Carboxylic acids and their derivatives [5 L]**

Carboxylic acids (aliphatic and aromatic): Introduction and IUPAC nomenclature,

Preparation: Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell–Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (up to 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their inter conversion. Reaction: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. *(**Ref-1:** 713-745 and 753-785).*

Learning Outcome:

After studying the carboxylic acids and their derivatives student will able to-

1. Identify and draw the structures carboxylic acids and their derivatives from their names or from structure name can be assigned.
2. Explain / discuss synthesis of carboxylic acids and their derivatives.
3. Write / discuss the mechanism reactions carboxylic acids and their derivatives.
4. Explain /Discuss important reactions of carboxylic acids and their derivatives.
5. Correlate reagent and reactions of carboxylic acids and their derivatives
6. Give synthesis of expected carboxylic acids and their derivatives.
7. Perform inter conversion of functional groups.

13. Amines and Diazonium Salts: [4 L]

Amines (Aliphatic and Aromatic): Introduction and IUPAC nomenclature, *Preparation* from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Electrophilic substitution (Case Aniline): nitration, bromination, sulphonation.

Diazonium salts: Preparation from aromatic amines. (***Ref-1:** 821-877)*

Learning Outcome:

After studying the amines and diazonium Salts student will able to-

1. Identify and draw the structures amines from their names or from structure name can beassigned.
2. Explain / discuss synthesis of carboxylic amines.
3. Write / discuss the mechanism reactions carboxylic amines.
4. Explain /Discuss important reactions of carboxylic amines.
5. To correlate reagent and reactions of carboxylic amines.
6. Give synthesis diazonium salt from amines and reactions of diazonium salt.
7. Perform inter conversion of functional groups.

14. Stereochemistry of Cyclohexane: [4 L]

Bayer's strain theory, heat of combustion of cycloalkanes, structure of cyclohexane, axial and equatorial H atoms, conformations of cycloalkane, stability of conformations of cyclohexane, methyl and t-butyl monosubstituted cyclohexane, 1,1 and 1,2 dimethyl cyclohexane and their stability.

***(Ref-1:** 283-308*).

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Draw the structures of different conformations of cyclohexane.
2. Define terms such as axial hydrogen, equatorial hydrogen, confirmation, substitutedcyclohexane, etc.
3. Convert one conformation of cyclohexane to another conformation and should able toidentify governing structural changes.
4. Explain / discuss stability with respect to potential energy of different conformations ofcyclohexane.
5. Draw structures of different conformations of methyl / t-butyl monosubstitutedcyclohexane (axial, equatorial) and 1, 2 dimethyl cyclohexane.
6. Identify cis- and trans-isomers of 1, 2 dimethyl substituted cyclohexane and able tocompare their stability.

Reference Books: (Organic Chemistry)

8. Morrison, R.T. and Boyd, R.N. *Organic Chemistry*, Prentice Hall of India, Sixth Edition,2002, 283-308.

Other Reference Books for all chapters:

9. Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers, ***Organic Chemistry***-Oxford University Press, USA, 2nd Ed.

10. Bahl, A. and Bahl, B.S. *Advanced Organic Chemistry,* S. Chand**,** 2010**.**

11. Graham Solomon, T. W., Fryhle, C. B. and Dnyder, S. A. ***Organic Chemistry****,* John Wileyand Sons (2014).

12. Mc Murry, J.E. ***Fundamentals of Organic Chemistry***, 7th Ed. Cengage Learning IndiaEdition, 2013.

13. Sykes, P. ***A Guidebook to Mechanism in Organic Chemistry****,* Orient Longman, NewDelhi (1988).

14. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.

CH-403: Practical Chemistry-IV [2 credit, 72* L]

* 72 L will be distributed as 58 L performing practical and 14 L for internal evaluation.

Instructions:

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. Use optimum concentrations and volumes
3. **Two burette method should be used for volumetric analysis (HomogeneousMixtures)**
4. Use of Microscale technique is recommended wherever possible.

H. Conductometry (Compulsory)

a) To determine the cell constant of the given cell using 0.01 M KCl solution and determine dissociation constant of a given monobasic weak acid.

b) To investigate the conductometric titration of any one of the following a) Strong acid against strong base b) Strong base against weak acid. (***standardization of base must be performed with KHP***)

I. Chromatography (compulsory)

1. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose (any one mixture) (Co + Al, Cu + Mg, Zn+Mg). Separation of cations must be confirmed by qualitative test

References:

i. Vogel's Textbook Quantitative Chemical Analysis, 3rd, 6th Ed.

ii) Experiments in chemistry, D. V. Jahagirdar, Himalaya publication.

J. Ideal and Real solutions (Any two)

4. To study the variation of mutual solubility temperature with % concentration for the phenol - water system
5. To study the effect of added electrolyte on the critical solution temperature of phenol- water system and to determine the concentration of the given solution of electrolyte.
6. To obtain the temperature-composition phase diagram for a two component liquid system with maximum (or minimum) boiling point and to determine the maximum (orminimum) boiling point and composition.

K. Adsorption (Compulsory)

1. To verify the Freundlich and Langmuir adsorption isotherm for adsorption of aceticacid on activated charcoal.

References:

iv)Systematic experimental physical chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjalipublication.

v) Practical Physical Chemistry, Vishwanathan and Raghwan , Viva book.

vi) Practical Chemistry, O. P. Pandey, D. N. Bajpai Dr. S. Giri, S Chand Publication

L. Synthesis of Coordination compounds (any two)

5. Synthesis of sodium cobaltinitrite (a laboratory chemical) from Co(II) salt and $NaNO_2$ salts. Comment on colour and magnetic properties of the complex. (Ref.-1, 2)
6. Synthesis of potassium Tris(oxalate)aluminium(III) using Al metal powder(Scrap aluminium). Comment on colour and magnetic properties of the complex. (Ref-2, 3, 4)
7. Synthesis of Tris(acetylacetone)iron(III) by green chemistry method by reaction between $Fe(OH)_3$ and acac. Comment on colour and magnetic properties of the complex. (Ref.- 5,6).
8. Synthesis of Tris(ethylenediamine)nickel(II) from Ni(II) salt, ethylediamine and sodium thiosulfate. Comment on colour and magnetic properties of the complex. (Ref.-7)

M. Inorganic colorimetric investigations (Any two)

4. Prepare standard solutions of $KMnO_4$ / $CuSO_4$, record their absorbance and Verify Beer's Law and determine unknown concentration. **(Compulsory)**

5. Prepare solution of Fe(III) and SCN^- of in different molar proportion, record their absorbance and calculate equilibrium constant of $[Fe(SCN)]^{2+}$ complex (Ref.-9,10)
6. Prepare solution of Fe(III)/Cu(II) and salicylic acid in different molar proportion and determine metal ligand ratio in Fe(III) or Cu(II)–Salicylic acid complex. (Ref.-11, 12, 13)

References

14. Handbook of Preparative Inorganic Chemistry, Volume 2, Second Edition, Edited By Georg BraueR, Academic Press, New York, London, 1965. (Page-1541)
15. Practical Chemistry, Panday, Bjpai, Giri, S.Chand and Co.
16. McNeese, T.J.; Wierda, D.A. Synthesis of Potassium Tris(oxalato)aluminate(III) Trihydrate.

Journal of Chemical Education,1983, 60(11), 1001.

17. Inorganic Syntheses Vol -1 by H S Booth. First Ed, 1939. (page-36).
18. Novel Synthesis of Tris(acetylacetonato)-iron(III), ***Journal of Chem. Soc. Dalton Trans.***

1983

19. Metal Acetylacetonate Synthesis Experiments: Which Is Greener?, ***Journal of ChemicalEducation,*** 2011, 88, 947–953, dx.doi.org/10.1021/ed100174f

20. Experimental Inorganic/Physical Chemistry: An Investigative, Integrated Approach to Practical Project Work, Mounir A. Malati, Woodhead Publishing Limited, 1999.
21. Vogel's Textbook Quantitative Chemical Analysis, 6th Ed.
22. Colorimetric Determination of the Iron(III)-Thiocyanate Reaction Equilibrium Constant with Calibration and Equilibrium Solutions Prepared in a Cuvette by Sequential Additions of One Reagent to the Other, ***Journal of Chemical Education***, Vol.88 No.3 March 2011.
23. Experiments in chemistry, D. V. Jahagirdar, Himalaya publication.
24. A spectrophotometric study of complex formation between Fe(III) and salicylic acid, Kinya Ogawa, Nobuko Tobe, Bulletin of chemical society of Japan, 39, 227-232, 1966.
25. Salicylate determination by complexation with Fe(III) and optical absorbance spectroscopy
26. Determination of Equilibrium Constants of Metal Complexes from Spectrophotometric Measurements: An Undergraduate Laboratory Experiment, ***Journal of Chemical Education***, Vol.76, No. 9, September 1999.

N. Organic Estimations (any two)

4. **Determination of molecular weight:** Determination of molecular weight of organicacid by titration against standardized NaOH - a) monobasic acid or b) dibasic acid
5. **Estimation of amides:** Determine the amount of acetamide in given solution byvolumetric method. (Standardization of acid must be performed)
6. **Estimation of Ethyl benzoate:** To determine the amount of ethyl benzoate in givensolution volumetrically. (Standardization of acid must be performed).

References:

iii) Vogel's textbook of practical organic chemistry
iv) Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal

Examination Pattern: At the time of examination student has to perform one experiment either from inorganic sections or organic section. 50% students must be assigned inorganic chemistry and 50% organic chemistry experiment. In case of organic qualitative analysis, after separation of binary mixture any one compound has to be analysed. Distribution of or 35 marks: 30 marks for experimental performance and 5 mark for oral.

Section - C: Industrial Visit

Visit any Chemical / Pharmaceutical / Polymer / Research Institutes / Sugar Factories / wastewater treatment plant, etc. and submit report.

Learning Outcomes

9. Verify theoretical principles experimentally

10. Interpret the experimental data on the basis of theoretical principles.

11. Correlate the theory to the experiments. Understand / verify theoretical principles byexperiment or explain practical output with the help of theory.

12. Understand systematic methods of identification of substance by chemical methods.

13. Write balanced equation for all the chemical reactions performed in the laboratory.

Sr.NO	Name Of the Course	Course Code	Units	Issue

14. Perform organic and inorganic synthesis and able to follow the progress of the chemicalreaction.

15. Set up the apparatus properly for the designed experiments.

16. Perform the quantitative chemical analysis of substances and able to explain principlesbehind it.