YBN UNIVERSITY
Established by the Act of Government of Jharkhand Act 15, 2017
Gazette Notification No. 505, Dated 17th July 2017
As per Section 2(f) of UGC Act. 1956

YBN UNIVERSITY, RANCHI (JHARKHAND)

UNIVERSITY DEPARTMENT OF PHYSICS

SCHOOL OF SCIENCE

B.Sc.(Hons.) Programme in Physics
(Based on CBCS Pattern)

Detailed Guideline And Syllabus For Three years(36 Months) B.Sc.(Hons.)

Programme in Physics

Implemented From 2020 Onwards

APPROVED BY

THE BOARD OF STUDIES

UNIVERSITY DEPARTMENT OF PHYSICS
SCHOOL OF SCIENCE
YBN UNIVERSITY, RANCHI (JHARKHAND)

Our Vision:

Vision of the Physics department is to lay the foundational stone of excellence and spur development of the University as a premier Institution in the field of Physics, by igniting and nurturing enthusiasm, interests and passion, among the students through the advanced curricula.

Our Mission

1: To provide quality training to the students for Physics education and equip them with skills required for higher studies in International and National institutions of great repute.
2: To motivate young minds and unravel their talents both in the fields of Theoretical and Experimental Physics, through dedication to teaching, commitment to students and innovative teaching learning methods and assessment throughout the year.
3: To provide the students state of the art knowledge through upgraded and advanced curricula, hands on training in state of the art laboratories and in high end computation and simulation to make them competent from a global perspective.
4: To enable the students having a clear perspective of ongoing research activities in different fields of Physics .
5: To prepare the students ready for industry oriented jobs by having hands on training through "Summer Internship" program in different reputed Companies or Research Organizations.
6: To bridge the skill gaps and make students industry ready and relevant and dutiful towards society, by adding various value added courses like "Design Thinking", "Venture Ideation", "Human Values and Ethics"etc.
7: To add to the values of the University by introducing pioneering programs like M.Sc. (Tech) in Medical Physics and Instrumentation which is more job oriented program.
8: To evolve strategies in the Department for continuous Improvement in all aspects of academic and administrative issues.

Introduction to the Program:

The program is open to students with 10+2 passed in Science with Physics and Mathematics as compulsory papers. There is a variety of Core-courses that emphasize the fundamentals while keeping in mind the evolving nature of the subject. A strong laboratory component allows the students to explore a range of experiments from classic ones to those that are more recent and advanced. A platter of advanced discipline specific elective offer a glimpse into frontier areas of research and allow students to choose a field of specialization for higher study and socially as well as globally relevant foundation courses will help them to become more competent and confident in their professional career.

Program Educational Objective:

01: Graduates will have successful careers in academia while pursuing higher education.
02: Graduates may have successful careers in Government and Non-government sectors having developed an analytical mind with a keen sense of logic and rationality.
03: Graduates can investigate various problems and ways to solve which will be very beneficial to society.

Program Outcome:

01: Application of Core Theories of Physics: Apply the rigorous understanding of the core theories & principles of Physics, which includes Classical Physics, Quantum Physics, Statistical Physics, Electrodynamics, and Relativity while pursuing higher education or in necessary cases.
02: Demonstration of Experimental knowledge: Demonstrate a deeper understanding of the principles of Physics through experimentation and correct data interpretation.
03: Computer Simulation Knowledge: Visualize and verify the Theoretical predictions/propositions of Physics through Simulation via computer programming using different languages (Mathematica, Matlab, Python, C etc.).

04: Knowledge in Applied Physics Domain: Execute proficiently the understanding of Applied Physics domain in various real life problems, e.g., knowledge of Electronics and Instrumentation shall be helpful to design and develop several devices and sensors etc.
05: Problem Analysis through analytical approach :Analyze the applications of Mathematics to solve the problems in Physics & develop suitable mathematical method for new formulation of Physical theories.
06: Knowledge of Material Properties: Apply the knowledge about Material properties and Solid State Physics for developing different technologies to reshape the lifestyle of modern society.
07: Physics and Nature: Demonstrate a solid foundation about the fundamental interactions of nature (gravity, electromagnetic, weak, strong) and develop a solid foundation of atomic and nuclear structure, i.e., understand the fundamental theories to unravel nature at atomic and sub-atomic level as well as at large astrophysical length scale.
08: New Challenges: Take up new challenges to understand the reasoning of any physical phenomena through research and design solutions to meet the societal as well as scientific demands.
09: Ethical Practice and Dedication towards Scientific Community: Function effectively as an individual learner, and as an academician with commitment and dedication towards the global Scientific Community and most importantly without deviation from ethical principles.
10: Scientific Reporting: Demonstrate the ability to undertake a major, individual, physics-related project and reporting the results in a full scientific report and oral and poster presentation.
11: Effective Communication: Build up communication skills, both written and oral, to specialized and non-specialized audiences.

Programme Eligibility:
Qualified 10+2 level or equivalent examination with Physics as one of the subjects with 50% marks.

COURSE STRUCTURE (PHYSICS-HONOURS)

S.no.	Course	Credits
1.	**CORE COURSE** (14 Papers, C1 to C14)	14×4= 56
	Core Practical (14 Papers LAB I-XIV)	14×2= 28
2.	**ELECTIVE COURSE** (4 Papers)	
	Discipline Specific Elective (4 Papers, DSE 1 to DSE 4)	4×6= 24
3.	**GENERIC ELECTIVE**	
	Generic Elective (Theory) (4 Papers, GE 1 to GE 4)	6×4= 24
4.	**ABILITY ENHANCEMENT COURSES (AEC)**	
	Ability Enhancement Compulsory (2 Papers) Environmental Science English/MIL Communication	2×2= 4
	Ability Enhancement Elective (Skill based) (2 Papers)	2×2= 4
	TOTAL	**140**

PROPOSED SCHEME FOR CHOICE BASED CREDIT SYSTEM IN
B. Sc. Honours (PHYSICS)

SEM	CORE COURSE (14 Papers)	AEC Compulsory Course (AECC) (2 Papers)	AEC Elective Course (SEC) skill based (2 Papers)	Elective DSE (4 Papers)	Elective Generic (4 Papers)	Total Credits
I	Mathematical Physics-I (4-0-2 credits) Mechanics (4-0-2 credits)	*Eng./MIL Comm^{n}/* Env. Sc. (2 credits)			GE-1 (6 credits)	**20**
II	Thermal Physics (4-0-2 credits) Current electricity (4-0-2 credits)	*Env. Sc./* Eng./MIL Comm^{n} (2 credits)			GE-2 (6 credits)	**20**
III	Mathematical Physics-II (4-0-2 credits) Electrostatics and Magnetism (4-0-2 credits) Wave and Acoustics (4-0-2 credits)		SEC-1 (2 credits)		GE-3 (6 credits)	**26**
IV	Optics (4-0-2 credits) Quantum Mechanics (4-0-2 credits) Electromagnetic Theory (4-0-2 credits)		SEC-2 (2 credits)		GE-4 (6 credits)	**26**
V	Relativity, Atomic and Molecular (4-0-2 credits) Analog Electronics and Applications (4-0-2 credits)			DSE-1 (4-0-2 credits) DSE-2 (4-0-2 credits)		**24**
VI	Solid State Physics (4-0-2 credits) Statistical Mechanics (4-0-2 credits)			DSE-3 (4-0-2 credits) DSE-4 (4-0-2 credits)		**24**
Credits	**84**	**04**	**04**	**24**	**24**	**140**

YBN UNIVERSITY, RANCHI (JHARKHAND)

UNIVERSITY DEPARTMENT OF PHYSICS

School of Science

B.Sc. (H) Programme in Physics

(Based on CBCS Pattern)

SEM	COURSE OPTED	COURSE NAME	Distribution of Marks			
			END SEM	MID SEM	PRACTICAL	TOTAL
I	Ability Enhancement Compulsory Course-I	English Communications-I/ Environmental Science-I	50	20	30	100
	Core Course-I	Mathematical Physics-I	50	20	30	100
	Core Course-II	Mechanics	50	20	30	100
	Generic Elective-1	GE-1	50	20	30	100
II	Ability Enhancement Compulsory Course-II	English Communications-II/ Environmental Science-II	50	20	30	100
	Core Course-III	Thermal Physics	50	20	30	100
	Core Course-IV	Current Electricity	50	20	30	100
	Generic Elective-2	GE-2	50	20	30	100
III	Core Course-V	Mathematical Physics-II	50	20	30	100
	Core Course-VI	Electrostatics & Magnetism	50	20	30	100
	Core Course-VII	Wave & Acoustics	50	20	30	100
	Skill Enhancement Course-1	SEC-1	50	20	30	100
	Generic Elective-3	GE-3	50	20	30	100
IV	Core Course-VIII	Optics	50	20	30	100
	Core Course-IX	Quantum Mechanics	50	20	30	100
	Core Course-X	Electromagnetic Theory	50	20	30	100
	Skill Enhancement Course-2	SEC-2	50	20	30	100
	Generic Elective-4	GE-4	50	20	30	100
V	Core Course-XI	Relativity, Atomic and Molecular	50	20	30	100
	Core Course-XII	Analog Electronics & Application	50	20	30	100
	Discipline Specific Elective-1	DSE-1	50	20	30	100
	Discipline Specific Elective-2	DSE-2	50	20	30	100
VI	Core Course-XIII	Solid State Physics	50	20	30	100
	Core Course-XIV	Statistical Mechanics	50	20	30	100
	Discipline Specific Elective-3	DSE-3	50	20	30	100
	Discipline Specific Elective-4	DSE-4	50	20	30	100

CORE PAPERS

(Credit: 4-0-2 each)

C1. Mathematical Physics-I
C2. Mechanics
C3. Thermal Physics
C4. Current electricity
C5. Mathematical Physics II
C6. Electrostatics and Magnetism
C7. Wave and Acoustics
C8. Optics
C9. Quantum Mechanics
C10. Electromagnetic Theory
C11. Relativity, Atomic and Molecular Physics
C12. Analog Electronics and Applications
C13. Solid State Physics
C14. Statistical Mechanics

DISCIPLINE SPECIFIC ELECTIVE PAPERS

(Credit: 4-0-2 each)
Any four of the following subjects

DSE1. Mathematical Physics III
DSE2. Nuclear and Particle Physics
DSE3. Classical mechanics
DSE4. Digital electronics
DSE5. Experimental techniques
DSE6. Nano-science & technology
DSE7. Modern optics
DSE8. Dissertation

SKILL ENHANCEMENT COURSES

(Credit: 02 each) Any two of the following subjects

SEC1. Electrical Circuit Network Skills
SEC2. Basic Instrumentation Skills
SEC3. Renewable Energy And Energy Harvesting
SEC4. Applied Optics
SEC5. Computers and C Programming

COURSE STRUCTURE OF B.Sc PHYSICS HONS. FIRST SEMESTER													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional		L	T	P	Subjectwise Distribution
				Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks				
1Y3PHY101	Ability Enhancement Compulsory Course	English Communications-I/Environmental Science-I	100	50	17	20	07	30	10	2	-	-	2
1Y3PHY102	Core Course-I	Mathematical Physics-I	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY102P	Core Course-I Practical	Mathematical Physics-I Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY103	Core Course-II	Mechanics	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY103P	Core Course-II Practical	Mechanics Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY104	Generic Elective-I	Generic Elective-I	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY104P	Generic Elective-I Practical	Generic Elective-I Practical	30	30	10	-	-	-	-	-	-	2	2
	Grand Total		400										20

Minimum Passing Marks are equivalent to Grade D
Lectures T- Tutorials P- Practical, Major- Term End Theory Exam
Minor- Pre University Test
Sessional weightage – Attendance 50%, Three Class Tests/Assignments 50%
Syllabus of Generic Elective will be as per concerned Department Syllabus

Ability Enhancement Compulsory Course-I
AECC: English Communication-I

English Communication-I [Course Code: 1Y3PHY101] Credits: 2

Preamble:

The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. One of the critical links among human beings and an important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

The present course hopes to address some of these aspects through an interactive mode of teaching-learning process and by focusing on various dimensions of communication skills. Some of these are:

Language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, note-taking etc.

While, to an extent, the art of communication is natural to all living beings, in today's world of complexities, it has also acquired some elements of science. It is hoped that after studying this course, students will find a difference in their personal and professional interactions.

The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below. Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books.

1.**Introduction:**
Theory of Communication, Types and modes of Communication

2.**Language of Communication:**
Verbal and Non-verbal
(Spoken and Written)
Personal, Social and Business
Barriers and Strategies
Intra-personal, Inter-personal and Group communication

3.Speaking Skills:
Monologue
Dialogue

Recommended Readings:

1.Fluency in English - Part II, Oxford University Press, 2006.
2.Business English, Pearson, 2008.
3.Language, Literature and Creativity, Orient Blackswan, 2013.
4.Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjan Kaul, Dr Brati Biswas

Or, Ability Enhancement Compulsory Course-I (AECC-I – Environment Science-I)
[Course Code: 1Y3PHY101] Credits: 2

Unit 1 : Introduction to environmental studies (2 lectures)

•Multidisciplinary nature of environmental studies;

•Scope and importance; Concept of sustainability and sustainable development.

Unit 2 : Ecosystems (6 lectures)

• What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3 : Natural Resources : Renewable and Non---renewable Resources **(8 lectures)**

• Land resources and landuse change; Land degradation, soil erosion and desertification.

• Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

• Water : Use and over---exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter---state).

• Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4 : Biodiversity and Conservation (8 lectures)

•Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots

•India as a mega---biodiversity nation; Endangered and endemic species of India

•Threats to biodiversity : Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity : In---situ and Ex---situ conservation of biodiversity.

•Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Suggested Readings:

1.Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.

2.Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.

3.Gleeson, B. and Low, N. (eds.) 1999.Global Ethics and Environment, London, Routledge.

4.Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.

5.Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.

6.Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36---37.

7.McCully, P. 1996. Rivers no more: the environmental effects of dams(pp. 29---64). Zed Books.

8.McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

9.Odum, E.P., Odum, H.T. & Andrews, J. 1971.Fundamentals of Ecology. Philadelphia: Saunders.

10.Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.

11.Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
12.Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.Environment. 8th edition. John Wiley & Sons.
13.Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
14.Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
15.Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
16.Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
17.Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
18.Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
19.Wilson, E. O. 2006.The Creation: An appeal to save life on earth. New York: Norton.
20.World Commission on Environment and Development. 1987.Our Common Future. Oxford University Press.

CORE COURSE (HONOURS IN PHYSICS)

SEMESTER I

Course Code : 1Y3PHY102

PHYSICS-C I: MATHEMATICAL PHYSICS-I

(Credits: Theory-04) Theory: 60 Lectures

Mid Semester: 20 **End Semester: 50** **Full Marks: 70**

Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Calculus: First Order Differential Equations and Integrating Factor.

Second Order Differential equations: Homogeneous Equations with constant coefficients.. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral for typical source terms like polynomials, exponential, sine, cosine etc.

Calculus of multivariable functions: Partial derivatives, exact differentials. Integrating factor, with simple illustration.

Vector Calculus: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their geometrical interpretation. Scalar and Vector fields.

Vector Differentiation: Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

Vector Integration: Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications. Dirac Delta function and its properties:

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates. Expression for Gradient, Divergence, Curl and Laplacian in orthogonal curvilinear co- ordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Reference Books:

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
- An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
- Differential Equations, George F. Simmons, 2007, McGraw Hill.
- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book

PHYSICS LAB- LAB C I (2 Credits)
COURSE CODE :1Y3CHE102P FM: 30

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.

Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (*If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops*), Arrays (*1D & 2D*) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs:	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of $\boldsymbol{\pi}$
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving $\alpha = \tan\alpha$; $I = Io\,[(\sin\alpha)/\alpha]^2$ in optics
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation.	Evaluation of trigonometric functions e.g. *sinθ, cosθ, tanθ, etc.*

Also attempt some problems on differential equations like:

1. Solve the coupled first order differential equations

   $$\frac{dx}{dt} = y + x - \frac{x^3}{3}$$

   $$\frac{dy}{dt} = -x$$

   for four initial conditions x(0) = 0, y(0) = -1, -2, -3, -4. Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$.

2. The ordinary differential equation describing the motion of a pendulum is

   $\vartheta'' = -\sin(\vartheta)$

   The pendulum is released from rest at an angular displacement α i.e. $\vartheta(0) = \alpha$, $\vartheta'(0) = 0$. Use the RK4 method to solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot ϑ as a function of time in the range $0 \leq t \leq 8\pi$. Also, plot the analytic solution valid in the small ϑ ($sin\ \vartheta \approx \vartheta$).

3. Solve the differential equation:

   $$x^2 \frac{d^2y}{dx^2} - 4x(1+x)\frac{dy}{dx} + 2(1+x)y = x^3$$

   with the boundary conditions: at x = 1, $y = (1/2)e^2$, $dy/dx = -(3/2)e^2 - 0.5$, in the range $1 \leq x \leq 3$. Plot y and dy/dx against x in the given range. Both should appear on the same graph.

PHYSICS-C II: MECHANICS
Course Code: 1Y3PHY103
(Credits: Theory-04) Theory: 60 Lectures
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. Momentum of variable-mass system: motion of rocket.

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

Elasticity: Elastic constants and interrelation between them. Twisting torque on a Cylinder or Wire and twisting couple.

Flexure of beam: Bending of beam, Cantilever.

Surface Tension: Ripples and Gravity waves, Determination of Surface Tension by Jaeger's and Quinke's methods. Temperature dependance of Surface Tension.

Fluid Motion: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube and the corrections.

Central Force Motion: Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution.. Kepler's Laws.Weightlessness.

Reference Books:

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

PHYSICS LAB- LAB C II (2 Credits) **FM: 30**

Course Code : 1Y3PHY103P

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine **g** and velocity for a freely falling body using Digital Timing Technique
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Modulus of Rigidity of a bar by method of bending.
8. To determine the elastic Constants of a wire by Searle's method.
9. To determine the value of g using Bar Pendulum.
10. To determine the value of g using Kater's Pendulum.

Generic Elective -1

CHEMISTRY

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Course Code : 1Y3PHY104

(Credits: Theory - 04, Practical - 02)

Theory: 60 Lectures

There shall be FOUR questions from each section. Answer any FIVE questions selecting at least TWO questions from each section.

Section A: Inorganic Chemistry-1

(30 Periods)

I Atomic Structure: Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

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 hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d 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 1s and 2s 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).

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.

(15 Lectures)

II Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. 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 bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds. **MO Approach:** Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO. Comparison of VB and MO approaches.

(15 Lectures)

Section B: Organic Chemistry-1

(30 Periods)

I 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.

values. Aromaticity: Hückel's rule.

(5 Lectures)

II Stereochemistry

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

(10 Lectures)

III Aliphatic Hydrocarbons

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

Alkanes: Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: 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: Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$.

(15 Lectures)

Reference Books:

• J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.
• F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
• James E. Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
• T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
• Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
• R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.

Generic Elective -1 Lab

Course Code : 1Y3PHY104P

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

60 Lectures
Full Marks: 30
Time: $1\frac{1}{2}$ Hrs

One question is to be set.

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)

(a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography

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

Reference Books:

• Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
• Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
• Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
• Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960.

Practical-1: 20 Marks, Note Book: 05 Marks, Viva: 05 Marks.

OR,

MATHEMATICS

COURSE CODE : 1Y3PHY104

MATHEMATICS – I F.M: - 100

Instruction for Generic Elective: - 5x10

Nine Questions will be set. Candidates will be required to answer Five Questions.

Question no. 1 will be Compulsory consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 01 marks. Out of remaining 08 questions will be required to answer 04 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

DIFFERENTIAL CALCULUS I

Successive differentiation, nth order derivative of some standard functions. Leibnitz's theorem. nth derivative of rational functions. Taylor's and Maclaurin's series expansions of functions. Applications of Taylor's and Maclaurin's series. Tangent and Normal, their equations in the Cartesian form, parametric form, Tangents at the origin. Angle between two curves. Length of tangent, normal, sub tangent, subnormal in Cartesian forms.

INTEGRAL CALCULUS I

Integration of rational and irrational functions. Integration by partial fractions, Integration by transformations, Integration by substitution, Integration by parts.

GROUP - B

VECTORS I

Scalar and Vector point functions, vector function of a scalar variables, Continuity of a vector function. differentiation of a vector with respect to the scalar variable "t". Differentiation of a vector function. Derivatives of a sum of vectors, derivatives of a product of vectors (both scalar and vector products.)

COORDINATE GEOMETRY OF TWO DIMENSION I

Change of rectangular axes, Rotation and Shifting of origin. Transformation of the general equation of the second degree. Conditions for the general equation of second degree to represent a parabola, ellipse and hyperbola. Equations of the tangent and normal to a given curve using calculus.

REAL ANALYSIS I

Sequence: Definition, Bounds, Limit of a sequence, Monotonic Sequences and their Convergence, Algebraic operations and limits, Cauchy Sequence, General principle of convergence of a sequence.

BOOKS RECOMMENDED

1.Differential Calculus: A Das Gupta & S B Prasad
2. Integral Calculus : A Das Gupta
3.Vector Analysis : Lalji Prasad/ A Das Gupta & S B Prasad
4.Coordinate Geometry: A Das Gupta
5.Real Analysis : Lalji Prasad

COURSE STRUCTURE OF B.Sc PHYSICS HONS. SECOND SEMESTER													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional		L	T	P	Subjectwise Distribution
				Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks				
1Y3PHY201	Ability Enhancement Compulsory Course	English Communications-II/Environmental Science-II	100	50	17	20	07	30	-	2	-	-	2
1Y3PHY 202	Core Course-III	Thermal Physics	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY202P	Core Course-III Practical	Thermal Physics Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY203	Core Course-IV	Current Electricity	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY203P	Core Course-IV Practical	Current Electricity Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY204	Generic Elective-II	Generic Elective-II	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY204P	Generic Elective-II Practical	Generic Elective-II Practical	30	30	10	-	-	-	-	-	-	2	2
	Grand Total		400										20

Minimum Passing Marks are equivalent to Grade D
Lectures T- Tutorials P- Practical, Major- Term End Theory Exam
Minor- Pre University Test
Sessional weightage – Attendance 50%, Three Class Tests/Assignments 50%
Syllabus of Generic Elective will be as per concerned Department Syllabus

Ability Enhancement Compulsory Course-II
AECC-II: English Communication-II

English Communication-II [Course Code: 1Y3PHY201] Credits: 2

1.Speaking Skills:

Group Discussion

Effective Communication/ Mis- Communication

Interview

Public Speech

2.Reading and Understanding Close Reading Comprehension

Summary Paraphrasing Analysis and Interpretation

Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts

3.Writing Skills Documenting Report Writing Making notes Letter writing

Recommended Readings:

1. ***Fluency in English - Part II, Oxford University Press, 2006.***
2. ***Business English, Pearson, 2008.***
3. ***Language, Literature and Creativity, Orient Blackswan, 2013.***
4. ***Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas***

Or, Ability Enhancement Compulsory Course-II (AECC-II – Environment Science-II)
[Course Code: 1Y3PHY201] Credits: 2

Unit 1 : Environmental Pollution (8 lectures)

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

Unit 2 : Environmental Policies & Practices (7 lectures)

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 3 : Human Communities and the Environment (6 lectures)

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 4 : Field work (Equal to 5 lectures)

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site---Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems---pond, river, Delhi Ridge, etc.

Suggested Readings:

1.Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2.Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3.Gleeson, B. and Low, N. (eds.) 1999.Global Ethics and Environment, London, Routledge.
4.Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5.Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6.Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36---37.
7.McCully, P. 1996. Rivers no more: the environmental effects of dams(pp. 29---64). Zed Books.

8.McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9.Odum, E.P., Odum, H.T. & Andrews, J. 1971.Fundamentals of Ecology. Philadelphia: Saunders.
10.Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11.Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
12.Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.Environment. 8th edition. John Wiley & Sons.
13.Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
14.Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
15.Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
16.Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
17.Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
18.Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
19.Wilson, E. O. 2006.The Creation: An appeal to save life on earth. New York: Norton.
20.World Commission on Environment and Development. 1987.Our Common Future. Oxford University Press.

SEMESTER II
Core Course-III
[Course Code: 1Y3PHY202]
PHYSICS-C III: THERMAL PHYSICS
(Credits: Theory-04) Theory: 60 Lectures

Mid Semester: 20 **End Semester: 50** **Full Marks: 70**

Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Ideal gas: Review of the kinetic model of an ideal gas; interpretation of temperature. Equipartition of energy; Specific heats of gases

Real gas: Van der Waals model; equation of state, critical constants.

Transport Phenomena: Mean free path, transport of momentum (viscosity), of energy (thermal conduction) and matter (diffusion).

Joule-Thomson and adiabatic cooling: Joule -Thomson expansion; Joule expansion of an ideal gas; cooling in J-T expansion, adiabatic expansion of an ideal gas, principles of regenerative and cascade cooling, liquefaction of gases.

The laws of thermodynamics :, Carnot engine and its efficiency, Carnot's theorem, the second law of thermodynamics. Entropy as a thermodynamic variable; reversible and irreversible processes. Principle of increase of entropy. Thermodynamic scale of temperature; its identity with perfect gas scale, impossibility of attaining the absolute zero (third law).

Thermodynamic relationships: Maxwell's equations; application to Clausius-Clapeyron equation and Joule-Thomson effect. Thermodynamic potentials: Relation to thermodynamic variables;

Black body radiation: Stefan -Boltzmann law, Wien's displacement law. Rayleigh-Jeans law, Planck's hypothesis, mean energy of an oscillator and Planck's law

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.

PHYSICS LAB- LAB C III (2 Credits) **FM: 30**

[Course Code: 1Y3PHY202P]

1. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee's disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method and to determine Neutral Temperature.
6. Determination of Stefan's constant.
7. Verification of Planks radiation formulae.

CORE COURSE-IV
PHYSICS-C IV: CURRNT ELECTRICITY
[Course Code: 1Y3PHY203]
(Credits: Theory-04) Theory: 60 Lectures
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) on point charge (2) on current carrying wire (3) between current elements.

DC circuits: growth and decay of current in CR and LR circuits, Growth and decay of currents in Series LCR circuit.

AC Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Logarithmic damping.
AC bridges; Anderson's, Owen's, Schering and Carey-Foster's bridges with their vector diagrams.

Network theorems: 2-port network and its T and π representations, T and π equivalence, h- parameters representations, Thevenin, Nortion, Superposition, Reciprocity and Maximum power transfer theorems, Miller theorem.

Reference Books:

- Electricity, Tayal D. C.
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Electricity and Magnetism, Chattopadhyaya and Rakshit
- Electricity and Magnetism, Mahajan and Rangwala
- Electricity and Magnetism, K. K. Tewary.

PHYSICS LAB- LAB C IV (2 Credits) **FM: 30**
[Course Code: 1Y3PHY203P]

1. To verify the Thevenin and Norton theorems.
2. To verify the Superposition and Maximum power transfer theorems.
3. To determine self inductance of a coil by Anderson's bridge.
4. To determine an unknown Low Resistance using Potentiometer.
5. To compare capacitances using De'Sauty's bridge.
6. Determination of constants of a ballistic galvanometer.
7. Determination of figure of merit of a moving coil galvanometer.

Generic Elective -2

CHEMISTRY

CHEMICAL ENERGETICS, EQUILIBRIA, QUANTUM CHEMISTRY & FUNCTIONAL ORGANIC CHEMISTRY-I

[Course Code: 1Y3PHY204]

(Credits: Theory - 04, Practical - 02) **[F.M.: 20+50+30]**

Theory: 60 Lectures

There shall be FOUR questions from each section. Answer any FIVE questions selecting at least TWO questions from each section.

Section A: Physical Chemistry-1

(30 Lectures)

I 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, 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.

(10 Lectures)

II Chemical Equilibrium:

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

(5 Lectures)

III 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.

(10 Lectures)

IV Quantum Chemistry

Born-Oppenheimer approximation: Separation of molecular energies into translational, rotational, vibrational and electronic components.

Postulates of quantum mechanics, quantum mechanical operators.

Free particle. quantization, normalization of wave functions, concept of zero-point energy.

(5 Lectures)

Section B: Organic Chemistry - 2

(30 Lectures)

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

I Aromatic hydrocarbons

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). Side chain oxidation of alkyl benzenes.

(8 Lectures)

II Alkyl and Aryl Halides

Alkyl Halides Types of Nucleophilic Substitution (S_N1, S_N2 and S_Ni) reactions.
Preparation: from alkenes and alcohols.
Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.
Aryl Halides Preparation: from phenol, Sandmeyer & 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.

(8 Lectures)

III Alcohols, Phenols and Ethers)

Alcohols: Preparation: Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.
Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: oxidation of diols. Pinacol-Pinacolone rearrangement.
Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts.
Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten– Baumann Reaction.
Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

(8 Lectures)

IV Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde)
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. Clemensen reduction and Wolff-Kishner reduction. Meerwein-Pondorff Verley reduction.

(6 Lectures)

Reference Books:

. G. M. Barrow: Physical Chemistry Tata McGraw---Hill (2007).
• G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).
• J. C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry Cengage Lening India Pvt. Ltd., New Delhi (2009).
• I.L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
• R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
• Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

Generic Elective -2 Lab
[Course Code: 1Y3PHY204P]
CHEMICAL ENERGETICS, EQUILIBRIA, QUANTUM CHEMISTRY & FUNCTIONAL ORGANIC CHEMISTRY-I

60 Lectures
Full Marks: 30
Time: $1^{1}/_{2}$ Hrs

One question is to be set.

Section A : Physical Chemistry

Thermochemistry

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.

Ionic equilibria

p^H measurements

a) Measurement of p^H of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using p^H-meter.

b) Preparation of buffer solutions:

(i) Sodium acetate-acetic acid

(ii) Ammonium chloride-ammonium hydroxide

Measurement of the p^H of buffer solutions and comparison of the values with theoretical values.

Section B : Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

(a) Bromination of Phenol/Aniline

(b) Benzoylation of amines/phenols

(c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

Reference Books :

• A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
• F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
• B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

Practical-1: 20 Marks, Note Book: 05 Marks, Viva: 05 Marks.

OR,

MATHEMATICS

COURSE CODE : 1Y3PHY204

MATHEMATICS – I F.M: - 100

Instruction for Generic Elective: - 5x10

Nine Questions will be set. Candidates will be required to answer Five Questions.

Question no. 1 will be Compulsory consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 01 marks. Out of remaining 08 questions will be required to answer 04 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Differential Calculus II

Partial Differentiation, Curvature, Asymptotes, Maxima and Minima of functions of two variables.

Integral Calculus II

Evaluation of definite integrals, reduction formulae, curve tracing, length and area,Surface area and volume of solids of revolution.

GROUP - B

Vector II

Gradient, Divergence and curl and second order vector differential operators in Cartesian coordinates systems.

Co- ordinate geometry of two dimensions II

Reduction of the general equation of second degree to the standard forms, Chord of Contact, Polar and pair of tangents in reference to general equation of conic, Polar equation.

Real Analysis II

Series: Definition, Convergent Series, Divergent Series, Pringsheim's theorem, Comparison tests, Cauchy's root test , D'Alembert's ratio test, Alternating series and Leibnitz test, Absolutely convergent series.

COURSE STRUCTURE OF B.Sc PHYSICS HONS. THIRD SEMESTER													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional		L	T	P	Subjectwise Distribution
				Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks				
1Y3PHY301	Core Course-V	Mathematical Physics-II	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY301P	Core Course-V Practical	Mathematical Physics-II Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY302	Core Course-VI	Electrostatics & Magnetism	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY302P	Core Course-VI Practical	Electrostatics & Magnetism Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY303	Core Course-VII	Wave & Acoustics	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY303P	Core Course-VII Practical	Wave & Acoustics Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY304	Skill Enhancement Course-1	Skill Enhancement Course-1	100	50	17	20	07	30	10	2	-	-	2
1Y3PHY305	Generic Elective-III	Generic Elective-III	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY305P	Generic Elective-III Practical	Generic Elective-IIIP	30	30	10	-	-	20	07	-	-	2	2
	Grand Total		500										26

Minimum Passing Marks are equivalent to Grade D
Lectures T- Tutorials P- Practical, Major- Term End Theory Exam
Minor- Pre University Test
Sessional weightage – Attendance 50%, Three Class Tests/Assignments 50%
Syllabus of Generic Elective will be as per concerned Department Syllabus

SEMESTER III
CORE COURSE
PHYSICS-C V: MATHEMATICAL PHYSICS-II
[Course Code: 1Y3PHY301]
(Credits: Theory-04) Theory: 60 Lectures
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Frobenius Method and Special Functions: Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Confluent Hypergeometric Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions and Orthogonality.

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string.

Reference Books:

- Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
- Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
- Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
- Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
- Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
- Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books

CORE COURSE PRACTICAL

PHYSICS-C V: MATHEMATICAL PHYSICS-II LAB

[Course Code: 1Y3PHY301P]

F.M.: 30

Topics	Description with Applications
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting, Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization. User defined functions, Introduction to Scilab functions, variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions,
	Numerical methods and developing the skills of writing a program.
Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke's law to calculate spring constant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)
Solution of ODE First order Differential equation Euler, modified Euler and Runge-Kutta second order methods Second order differential equation Fixed difference method	First order differential equation, Radioactive decay, Current in RC, LC circuits with DC source, Newton's law of cooling, Classical equations of motion, Second order Differential Equation, Harmonic oscillator (no friction), Damped Harmonic oscillator, Over damped, Critical damped, Oscillatory, Forced Harmonic oscillator, Transient and, Steady state solution Apply above to LCR circuits also.

PHYSICS-C VI: ELECROSTATICS AND MAGNETISM
[Course Code: 1Y3PHY302]
(Credits: Theory-04) Theory: 60 Lectures

Mid Semester: 20 **End Semester: 50** **Full Marks: 70**

Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Electric Field and Electric Potential

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson Equations and their solutions . The Uniqueness Theorem. Potential and Electric Field due to a dipole. Force and Torque on a dipole.

Electrostatic energy of system of charges. Conductors in an electrostatic Field. Surface charge and force on a conductor. Parallel-plate capacitor. Capacitance of an isolated spherical conductor.

Separation of variable: rectangular Cartesian coordinate, spherical coordinate

Method of images: point charge close to a grounded conducting plane, point charge near a grounded conducting sphere;

Multipole expansion ; Multipole expansion of the electrostatic potential, monopole, dipole, quadrupole approximations at large distances,

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics. Claussius-Mossotti equation, Langevin- Debye equation

Magnetic Properties of Matter: Magnetization vector (**M).** Magnetic Intensity (**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis. Boundary conditions at the interface of two media and application to a sphere of magnetic material placed in a uniform magnetic induction, Damagnetizing factor. Origin of magnetic moment. Langevin's theory of Diamagnetism and Paramagnetism.

Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

PHYSICS LAB- LAB C VI (2 Credits) FM: 30
[Course Code: 1Y3PHY302P]

1. Measurement of field strength B and its variation in a solenoid
2. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
3. To measure the Magnetic susceptibility of Solids.
4. Verification of Curie-Weiss Law for a ferroelectric material.
5. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.

CORE COURSE
PHYSICS-C VII: WAVE AND ACOUSTICS
[Course Code: 1Y3PHY303]
(Credits: Theory-04) Theory: 60 Lectures
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Even and odd functions and their Fourier expansions. Application. Analysis of saw-tooth and square wave.

Oscillations: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance;

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

Acoustics: The acoustics of halls, Reverberation period, Sabine's formula. Acoustic defects in a hall and their correction.

Reference Books

- Waves and Acoustics, P. K. Chakraborty and Satyabrata Chowdhury.
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.

PHYSICS LAB- LAB C VII (2 Credits) FM: 30
[Course Code: 1Y3PHY303P]

1. Verification of laws of transverse vibration in a string using sonometer.
2. Determination of speed of sound using Kundt's tube.
3. To determine the frequency of electrically maintained tuning fork by Melde's experiment.
4. To determine the Density of material of wire using sonometer.
5. To determine the Velocity of sound by resonance column.

SKILL ENHANCEMENT COURSES

SEC-1: ELECTRICAL CIRCUIT NETWORK SKILLS

(Credits: 2-0-0)

[Course Code: 1Y3PHY304]

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation.

Reference Books:

• A text book in Electrical Technology - B L Theraja - S Chand & Co.
• A text book of Electrical Technology - A K Theraja
• Performance and design of AC machines - M G Say ELBS Edn.

Generic Elective -3
CHEMISTRY
[Course Code: 1Y3PHY305]
SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II
(Credits: Theory - 04, Practicals - 02)
Theory: 60 Lectures

There shall be FOUR questions from each section. Answer any FIVE questions selecting at least TWO questions from each section.

Section A: Physical Chemistry - 2

(30 Lectures)

I Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law–non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Lever rule. Azeotropes.

Partial miscibility of liquids, Immiscibility of liquids, Nernst distribution law and its applications. **(6 Lectures)**

II Phase Equilibrium

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule. Phase diagrams of one-component systems (water and sulphur). **(8 Lectures)**

III Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water. **(8 Lectures)**

IV Electrochemistry

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. p^H determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only). **(8 Lectures)**

Section B: Organic Chemistry – 3 (30 Lectures)

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

I Carboxylic acids and their derivatives

Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell-Vohlard-Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic):

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acylderivatives. Reformatsky Reaction, Perkin condensation. **(6 Lectures)**

II Amines and Diazonium Salts

Amines (Aliphatic and Aromatic): Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten–Baumann Reaction. Electrophilic substitution(only aniline): nitration, bromination, sulphonation. **(6 Lectures)**

III Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. Reactions of Amino

acids: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test. Overview of structure of proteins.
Determination of Primary structure of Peptides by degradation: Edmann degradation (N-terminal). **(10 Lectures)**

IV Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. **(8 Lectures)**

Reference Books:

• G. M. Barrow: Physical Chemistry Tata McGraw Hill (2007).
• G. W. Castellan: Physical Chemistry 4th Ed. Narosa (2004).
• Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
• Finar, I. L. Organic Chemistry (Volume 1 & 2), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).

Generic Elective -3 Lab
[Course Code: 1Y3PHY305P]
SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II

60 Lectures
Full Marks: 30
Time: $1^1/_2$ Hrs

One question is to be set.

Section A : Physical Chemistry

Conductometry

I Determination of cell constant
II Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
III Perform the following conductometric titrations:
iv. Strong acid vs. strong base
v. Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:
I Strong acid vs. strong base
II Weak acid vs. strong base vii. Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

I Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.
II
1. Separation of amino acids by paper chromatography
2. Determination of the concentration of glycine solution by formylation method.
3. Determination of the saponification value of an oil/fat.
4. Determination of the iodine value of an oil/fat

Reference Books:

• A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
• F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman, 1960.
• B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.

Practical-1: 20 Marks, Note Book: 05 Marks, Viva: 05 Marks.

OR,

MATHEMATICS

COURSE CODE : 1Y3CHE305

MATHEMATICS – I F.M: - 100

Eleven Questions will be set. Candidates will be required to answer **Eight Questions.**

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 3 marks. Out of remaining 10 questions will be required to answer 7 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

REAL ANALYSIS III

Continuity & Derivability of function of one variable, relationship with continuity, Rolle's theorem, Lagrange's Mean Value theorem, Taylor's and Maclaurin's theorem with R_n.

2 Questions

SET THEORY I

Indexed family of sets, Generalised set of operations & Demorgan laws, Set mapping. Equivalence relation and related fundamental theorem of partition.

2 Questions

COMPLEX VARIABLE I

Real functions of two variables: Simultaneous and iterated limits: Continuity, partial derivatives, Differentiability and related necessary and sufficient conditions. **2 Questions**

GROUP - B

ABSTRACT ALGEBRA I

Binary operations, Notion of group, Abelian group and non-Abelian group with examples. Uniqueness of identity element and inverse elements in a group, different ways of defining a group, concept of Subgroup and cyclic group, Cosets, Lagrange's theorem. **2 Questions**

DIFFERENTIAL EQUATIONS

Differential equations of first order and higher degree, Clairaut's form, singular solution, orthogonal trajectories.

2 Questions

COURSE STRUCTURE OF B.Sc PHYSICS HONS.FOURTH SEMESTER													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional		L	T	P	Subjectwise Distribution
				Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks				
1Y3PHY401	Core Course-VIII	Optics	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY401P	Core Course-VIII Practical	Optics Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY402	Core Course-IX	Quantum Mechanics	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY402P	Core Course-IX Practical	Quantum Mechanics Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY403	Core Course-X	Electromagnetic Theory	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY403P	Core Course-X Practical	Electromagnetic Theory Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY404	Skill Enhancement Course-2	Skill Enhancement Course-2	100	50	17	20	07	30	-	2	-	-	2
1Y3PHY405	Generic Elective-IV	Generic Elective-IV	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY405P	Generic Elective-IV Practical	Generic Elective-IVP	30	30	10	-	-	20	07	-	-	2	2
	Grand Total		500										26

Minimum Passing Marks are equivalent to Grade D
Lectures T- Tutorials P- Practical, Major- Term End Theory Exam
Minor- Pre University Test
Sessional weightage – Attendance 50%, Three Class Tests/Assignments 50%
Syllabus of Generic Elective will be as per concerned Department Syllabus

SEMESTER IV
PHYSICS-C VIII: OPTICS
Course Code : 1Y3PHY401
(Credits: Theory-04) Theory: 60 Lectures
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle.

Interference: Division of amplitude and wavefront. Young's double slit experiment. Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination; Fringes of equal thickness. Newton's Rings: Measurement of wavelength and refractive index.

Interferometer: Michelson Interferometer, Idea of formation of fringes, Determination of Wavelength, Wavelength Difference. Fabry-Perot interferometer – theory and applications.

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope.N slits. Diffraction grating. Resolving power of grating.

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Polarization: Description of Linear, Circular and Elliptical Polarization. Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates.

Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization. Calculation of angle of rotation. Specific rotation. Laurent's half-shade polarimeter.

Reference Books

- Introduction to Geometrical and Physical Optics, B. K. Mathur.
- Geometrical and Physical Optics, P. K. Chakraborty.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill

PHYSICS LAB- LAB C VIII (2 Credits) FM: 30
[Course Code: 1Y3PHY401P]

1. Familiarization with: Schuster`s focusing; determination of angle of prism.
2. To determine refractive index of the Material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
4. To determine wavelength of sodium light using Fresnel Biprism.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
7. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
8. To determine dispersive power and resolving power of a plane diffraction grating.

PHYSICS-C IX: QUANTUM MECHANICS AND APPLICATIONS
(Credits: Theory-04) Theory: 60 Lectures
Course Code : 1Y3PHY402
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Schrodinger theory: Inadequcy of classical mechanics, Origin of old Quantum theory, Discretness of energy: Franck and Hertz experiment, Wave – particle duality of matter and radiation (Photoelectric effect, Compton effect, Davisson and Germer experiment), Wave function and its physical meaning, Wave packets, Schrodinger time – independent and time – dependent equations, Concept of stationary states, Probabilty density and probability current density.

Operators: Eigenvalues and eigenfunction; linear operators, product of two operators, commuting and noncommuting operators, simulataneous eigenfunctions, orthogonal functions. Hermitian operators, their eigenvalues, Hermitian adjoint operators, expectation values of an operator.

One-dimensional problems: Rectangular potential barrier, Square well potential of finite and infinite depth, Particle in a rectangular box.

Heisenberg's uncertainity principle: Derivation of uncertainity relation using Schawrtz inequality and simple applications of uncertainity principle, expectation value of Time derivative of operators, Ehrenfest theorem.

Application to 1-D Problem : Simple harmonic oscillator, eigenfunctions and eigenvalues of the ground state and excited states; zero-point energy. Orthogonality *of* wave functions. Rigid rotator.

Reference Books:

Introduction to Quantum mechanics, Nikhil Ranjan Roy, 2016, Vikash Publishing House Pvt. Ltd.
A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer

PHYSICS LAB- LAB C IX (2 Credits) **FM: 30**

COURSE CODE : 1Y3PHY402P

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$d^2y/dr^2 = A(r)u(r)$, $A(r) = 2m/h^2 \times [V(r) - E]$ where $V(r) = -e^2/r$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take $e = 3.795\ (eVÅ)^{1/2}$, $ħc = 1973$ (eVÅ) and $m = 0.511 \times 10^6\ eV/c^2$.

2. Solve the s-wave radial Schrodinger equation for an atom:

$d^2y/dr^2 = A(r)u(r)$, $A(r) = 2m/h^2 * [V(r) - E]$

where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential $V(r) = -e^2/r \times (e^{-r/a})$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take $e = 3.795\ (eVÅ)^{1/2}$, $m = 0.511 \times 10^6\ eV/c^2$, and a = 3 Å, 5 Å, 7 Å. In these units $ħc = 1973$ (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$d^2y/dr^2 = A(r)u(r)$, $A(r) = 2m/h^2 \times [V(r) - E]$

For the anharmonic oscillator potential $V(r) = ½\ kr^2 + 1/3br^3$ for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose $m = 940\ MeV/c^2$, $k = 100\ MeV\ fm^{-2}$, b = 0, 10, 30 $MeV\ fm^{-3}$. In these units, ćħ = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

$d^2y/dr^2 = A(r)u(r)$, $A(r) = 2μ/h^2 \times [V(r) - E]$

Where μ is the reduced mass of the two-atom system for the Morse potential

$(r) = D\ (e^{-2αr'} - e^{-αr'})$, $r' = (r-r_0)/r$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.

Take: $m = 940 \times 106 eV/C^2$, $D = 0.755501$ eV, $α = 1.44$, $r_o = 0.131349$ Å.

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. To show the tunneling effect in tunnel diode using I-V characteristics.
8. Quantum efficiency of CCDs
9. Verification of plcank's uncertainly principle
10. Determination of wavelength of an electron in ground state of hydrogen and establish de-Broglie relation.

PHYSICS-C X: ELECTROMAGNETIC THEORY
(Credits: Theory-04) Theory: 60 Lectures
Course Code : 1Y3PHY403
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Maxwell Equations: Review of Maxwell's equations. Displacement Current. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting vector and Poynting Theorem. Electromagnetic (EM) Energy Density.

EM Wave Propagation in dielectric Media: Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves.

EM Wave in conducting Media: Propagation through conducting media, relaxation time, skin depth. reflection at and transmission through a conducting surface Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth.Electromagnetic theory of dispersion.
Electromagnetic potentials: Magnetic vector potential **A** and scalar potential φ. Lorentz gauge, Coulomb's gauge. Maxwell's equation in terms of potentials. Gauge invariance.

Radiation From Accelerated Charge : Retarded Potential, Lenard-Wiechart Potential, Electric-Dipole Radiation, Magnetic- Dipole Radiation, Radiation from an accelerated charged particle along and perpendicular to the direction of Motion.
Reference Books:

1. Electromagnetic Theory, Chopra and Agarwal.
2. Electromagnetics, B. B. Laud.
3. Electromagnetic Theory,, Satya Prakash
4. Electromagnetic Theory, Gupta and Kumar
5. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
6. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning

PHYSICS LAB- LAB C X (2 Credits) FM: 30
Course Code : 1Y3PHY403P

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
5. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
6. To determine the Boltzmann constant using V-I characteristics of PN junction diode.

SEC-2: BASIC INSTRUMENTATION SKILLS

Course Code : 1Y3PHY404

(Credits: 1-0-1) F.M. 100[50+20+30]

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. **Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. **(4 Lectures)**

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. **AC millivoltmeter:** Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter**,** specifications and their significance. **(4 Lectures)**

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working. **(10 Lectures)**

Signal Generators and Analysis Instruments: Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis. **(4 Lectures)**

Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter. **(4 Lectures)**

Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution. **(4 Lectures)**

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.

3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
6. Measurement of rise, fall and delay times using a CRO.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

Reference Books:

• A text book in Electrical Technology - B L Theraja - S Chand and Co.
• Performance and design of AC machines - M G Say ELBS Edn.
• Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
• Logic circuit design, Shimon P. Vingron, 2012, Springer.
• Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
• Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
• Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
• Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Generic Elective - 4
Course Code : 1Y3PHY405

Mid Semester: 20 **End Semester: 50** **Full Marks: 70**

CHEMISTRY OF S-, P- AND D-BLOCK ELEMENTS, STATES OF MATTER & CHEMICAL KINETICS

(Credits: Theory - 04, Practical - 02)

Theory: 60 Lectures

There shall be FOUR questions from each section. Answer any FIVE questions selecting at least TWO questions from each section.

Section A: Inorganic Chemistry-1

(30 Lectures)

I General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Hydrometallurgy, Methods of purification of metals (Al, Pb, Fe, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.

(5 Lectures)

II s- and p-Block Elements

Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity, Allotropy in C and S.

Oxidation states, inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

(5 Lectures)

III Compounds of s- and p-Block Elements

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane).

Structure, bonding and their important properties of the following compounds and their applications: NH_3, N_2H_4, PCl_3, PCl_5 and $SOCl_2$.

(10 Lectures)

IV Transition Elements (3d series)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction.

(10 Lectures)

Section B: Physical Chemistry - 3

(30 Lectures)

I Kinetic Theory of Gases

(A) Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2.

(6 Lectures)

(B) Most probable, average and root mean square velocities (no derivation). Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

(6 Lectures)

II Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

(6 Lectures)

III Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography-Law of constancy of interfacial angles, Law of rational indices. Miller indices. Bragg's law. Structures of NaCl, KCl and CsCl.

(6 Lectures)

IV Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero and first order reactions. Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

(6 Lectures)

Reference Books:

• J. D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
• F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
• G. M. Barrow: Physical Chemistry Tata McGraw Hill (2007).
• G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).

Generic Elective – 4 Lab
Course Code : 1Y3PHY405P
CHEMISTRY OF S-, P- AND D-BLOCK ELEMENTS, STATES OF MATTER & CHEMICAL KINETICS

60 Lectures

Full Marks: 30
Time: $1^{1}/_{2}$ Hrs

One question is to be set.

Section A: Inorganic Chemistry

Semi-micro qualitative analysis using H_2S of mixtures- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH^{4+}, Pb^{2+}, Ag^{+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^{+}

Anions : CO_3^{2-}, S^{2-}, SO_2^{-}, $S_2O_3^{2-}$, CH_3COO^{-}, Cl^{-}, Br^{-}, I^{-}, NO_3^{-},SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^{-} (Spot tests should be carried out wherever feasible)

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).

a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

3. Initial rate method: Iodide-persulphate reaction

4. Integrated rate method:

a. Acid hydrolysis of methyl acetate with hydrochloric acid.

b. Saponification of ethyl acetate.
c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Reference Books:
• A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
• A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.

Practical-1: 20 Marks, Note Book: 05 Marks, Viva: 05 Marks.

OR,

Generic Elective - 4

Course Code : 1Y3PHY405

Instruction for Generic Elective: -

Eleven Questions will be set. Candidates will be required to answer **Seven Questions.**

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 3 marks. Out of remaining 9 questions will be required to answer 7. Each question will be of 10 marks.

Divisibility and primes, H.C.F., Euclid's Algorithm, unique factorization, perfect numbers. Residue class, complete and reduced residue system, congruences and their properties, Fermat's theorem, Wilson's theorem.

Arithmetical functions, Euler's and Mobius function, Mobius inversion formula.

The Diophantine equations: $ax + by = c$, $x^2 + y^2 = z^2$.
Algebraic Congruence, solution by inspection, Solution of $ax \equiv b \pmod{c}$, system of linear congruences, Chinese remainder theorem.
Farey sequence, continued fractions, Pell's equation.

Books Recommended:

- *Number Theory – G H Hardy & E M Wright.*
- *Number Theory – S G telang.*
- *Number Theory – Harikisan*
- *Number Theory – S. B. Malik*

COURSE STRUCTURE OF B.Sc PHYSICS HONS.FIFTH SEMESTER													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional		L	T	P	Subject wise Distribution
				Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks				
1Y3PHY501	Core Course-XI	Relativity, Atomic & Molecular Physics	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY501P	Core Course-XI Practical	Relativity, Atomic & Molecular Physics Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY502	Core Course-XII	Analog, Electronics & Application	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY502P	Core Course-XII Practical	Analog, Electronics & Application Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY503	Discipline Specific Elective-1	DSE-I	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY503P	Discipline Specific Elective-1 Practical	DSE-I Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY504	Discipline Specific Elective-2	DSE-II	70	50	17	-	-	20	-	4	-	-	4
1Y3PHY504P	Discipline Specific Elective-2 Practical	DSE-II Practical	30	30	10	-	-	-	-	-	-	2	2
	Grand Total		400										24

Minimum Passing Marks are equivalent to Grade D
Lectures T- Tutorials P- Practical, Major- Term End Theory Exam
Minor- Pre University Test
Sessional weightage – Attendance 50%, Three Class Tests/Assignments 50%

SEMESTER V

PHYSICS-C XI: RELATIVITY, ATOMIC AND MOLECULAR PHYSICS

Course Code : 1Y3PHY501

(Credits: Theory-04) Theory: 60 Lectures

Mid Semester: 20 End Semester: 50 Full Marks: 70

Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

The Lorentz transformations: Galilean transformations, Michelson-Morley experiment. Einstein's basic postulates and derivation of Lorentz transformations; length contraction, simultaneity, synchronization and time dilation, Einstein's velocity addition rule, Doppler effect in light, aberration of light.

Relativistic dynamics*:* Variation of mass with velocity, mass-energy equivalence, relativistic formulae for momentum and energy.

The structure of space-time*:* Four-vectors; invariance of an interval, time-like, space-like and light-like intervals, Minkowski world.

Relativistic electrodynamics: Electric field of a point charge in uniform motion; transverse components, magnetism as a relativistic phenomenon. Invariance of Maxwell's equations.

Atomic Physics: Bohr's theory of Hydrogen atom. Bohr- Somerfield theory, statement of selection rule for atomic transition and their applications to Na atom. vector atom model, L-S and j-j couplings. Normal and anomalous Zeeman effect using vector model of atom.

Molecular Physics: Rotational Spectra, molecules as rigid and non rigid rotator, Vibrational spectra, diatomic molecule as a harmonic and anharmonic oscillator, molecules as a vibrating rotator.

PHYSICS LAB- LAB C XI (2 Credits) FM: 30

Course Code : 1Y3PHY501P

1. Measurement of Planck’s constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the first excitation energy of Argon.
5. To determine the Planck’s constant using LEDs of at least 4 different colours.
6. To show the tunneling effect in tunnel diode using I-V characteristics.
7. To determine the wavelength of laser source using diffraction of single slit.
8. To determine the wavelength of laser source using diffraction of double slits.
9. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

PHYSICS-C XII:ANALOG ELECTRONICS AND APPLICATION
(Credits: Theory-04) Theory: 60 Lectures
Course Code : 1Y3PHY502
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)
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Semiconductor Physics : Semiconductor, Conduction in semiconductors, Energy bands and conduction, conductivity, mobility and resistivity, Doping, Diffusion, p-n junction, biasing, depletion layer capacitance, Diode equation, Zener diode.

Diode and wave shaping circuits: Diode as a circuit element, Diode parameters, Temperature effects, Diode model, Diode as a switch, Diode switching parameters, effects, Diode model, Diode rectifier circuits (half and full wave), Ripple factor, Smoothing RC filters, Limitation of diode as a rectifier, Clipping and clamping circuits. Zener diode, characteristics and Zener diode regulated power supply.

BJT-based circuits: Bipolar junction transistor structure, modes of operation, dc characteristics and dc parameters, Load line and Q-point, stabilization, Small-signal equivalent models (low and high frequencies).

FET-based circuits: Junction field -effect transistor structure, modes of operation, dc characteristics and dc parameters, Load line and Q-point, Biasing circuits (voltage divider and self-bias) and Q-point stabilisation, Small-signal equivalent models (low and high frequencies).

Ampilifiers: Features of amplifier configurations, Analysis and design of RC coupled voltage amplifier using BJT (CE mode) and JFET (Cs mode), Frequency response, Concept of Bode plots, Classes of amplifiers, Push-pull class A and class B-amplifier.

Feedback AND OSCILLATION: Feedback concept and feedback equation, Positive and negative feedback, Characteristics of negative feedback, Criteria of oscillations, RC phase shift oscillator, RF oscillators (Hartley and Colpitt), Astable multivibrator using BJT.

PHYSICS LAB- LAB C XII (2 Credits) FM: 30
Course Code : 1Y3PHY502P

1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
6. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
7. To design a phase shift oscillator of given specifications using BJT.
8. To design inverting amplifier using Op-amp (741,351) and study its frequency response
9. To design non-inverting amplifier using Op-amp 741 & study its frequency response
10. To investigate the use of an op-amp as an Integrator and Differentiator.

DISCIPLINE SPECIFIC ELECTIVE

PHYSICS-DSE I: MATHEMATICAL PHYSICS-III
Course Code : 1Y3PHY503
(Credits: Theory-04) Theory: 60 Lectures
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles, order of singularity, Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.

Integrals Transforms:
Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.).
Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Convolution Theorem. Inverse LT. Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

Reference Books:

- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
- Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
- First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett.
- Mathematical Physics, B. D. Gupta.
- Mathematical Physics, B. S. Rajput.
- Mathematical Physics, H. K. Dass.
- Mathematical methods in Physics, E. Butkov.
- Mathematical methods in Physics, Potter and Goldberg.

PHYSICS-DSE I PRACTICAL
Course Code : 1Y3PHY503P
F.M. : 30

Scilab based simulations experiments based on Mathematical Physics problems like

1. Solve differential equations:

$\frac{dy}{dx} = e^{-x}$ *with* $y = 0$ *for* $x = 0$

$\frac{dy}{dx} + e^{-x} y = x^2$

$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = -y$

$\frac{d^2y}{dt^2} + e^{-t}\frac{dy}{dt} = -y$

2. Dirac Delta Function:

Evaluate $\frac{1}{\sqrt{2\pi\sigma^2}} \int e^{\frac{-(x-2)^2}{2\sigma^2}} (x+3)dx,$ for $\boldsymbol{\sigma}$ = 1, 0.1, 0.01 and show it tends to 5.

3.Fourier Series:

Program to sum $\sum_{n=1}^{\infty} (0.2)^n$

Evaluate the Fourier coefficients of a given periodic function (square wave).

4. Frobenius method and Special functions:

$\int_{-1}^{+1} P_n(\mu) P_m(\mu) d\mu = \delta_{n,m}$

Plot $P_n(x)$, $j_v(x)$

Show recursion relation.

5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).

6. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.

PHYSICS-DSE II: NUCLEAR AND PARTICLE PHYSICS

(Credits: Theory-04) Theory: 60 Lectures

Course Code : 1Y3PHY504

Mid Semester: 20 End Semester: 50 Full Marks: 70

Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

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Structure on nucleus; discovery of the nucleus, composition. Basic properties; charge, mass, size, spin, magnetic moment, electric quadrupole moment, binding energy, binding energy per necleon and its observed variation with mass number of the nucleus, semi empirical mass formulae, explanation of the binding energy curve. Liquid drop model of the nucleus.

Nuclear forces: two-nucleon system, deuteron problem, binding energy, nuclear potential well, pp and pn scattering experiments, meson theory of nuclear forces, e.g. Bartlett, Heisenberg, Majorana forces and potentials, mirror nuclei, nuclear energy levels, nuclear gamma rays.

Radioactivity: decay constant, half-life, mean life; Geiger-Nuttal law, Successive disintegration, secular and transient equilibrium, neutrino and antineutrino. basics of α-decay processes, theory of α-emission, Gamow factor

Detectors for charged particles; Ion chamber, Geiger-Muller counter, resolving time, Scintillation counter.

Accelerators: Need for accelerators; cyclotron, synchrocyclotron, variable energy cyclotron, phase stability.

Nuclear reactions; Rutherford's experiments of nuclear transmutation, conservation theorems, Q-value, threshold energy, cross-section of nuclear reactions. Concept of compound and direct Reaction, resonance reaction,

Artificial radioactivity: Nuclear fission, Neutron reactions, Fermi and transuranic elements, chain reaction, criticality, moderators.

Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Concept of quark model.

Reference Books:

• Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
• Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
• Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
• Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
• Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
• Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
• Basic ideas and concepts in Nuclear Physics - An Introductory Approach by

PHYSICS LAB- LAB DSE II (2 Credits) **FM: 30**

Course Code : 1Y3PHY504P

1. Demonstration of presence of Static Electricity
2. Demonstration of phenomenon of Corona Discharge
3. To determine the plateau and optimal operating voltage of a Geiger-Müller
4. To determining the resolving (dead) time τ of a Geiger – Muller counter
5. DETERMINING THE EFFICIENCY OF A GEIGER-MULLER COUNTER
6. DETERMINING THE HALF LIFE OF A RADIO ISOTOPE USING GEIGER – MULLER COUNTER
7. Experiment with Alpha Scintillation Counter

COURSE STRUCTURE OF B.Sc PHYSICS HONS. SIXTH SEMESTER													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional		L	T	P	Subjectwise Distribution
				Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks				
1Y3PHY601	Core Course-XIII	Solid State Physics	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY601P	Core Course-XIII Practical	Solid State Physics Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY602	Core Course-XIV	Statistical Mechanics	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY602P	Core Course-XIV Practical	Statistical Mechanics Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY603	Discipline Specific Elective-3	DSE-III	70	50	17	-	-	20	07	4	-	-	4
1Y3PHY603P	Discipline Specific Elective-3 Practical	DSE-III Practical	30	30	10	-	-	-	-	-	-	2	2
1Y3PHY604	Discipline Specific Elective-4	DSE-IV	70	50	17	-	-	20	-	4	-	-	4
1Y3PHY604P	Discipline Specific Elective-4 Practical	DSE-IV Practical	30	30	10	-	-	-	-	-	-	2	2
	Grand Total		400										24

Minimum Passing Marks are equivalent to Grade D
Lectures T- Tutorials P- Practical, Major- Term End Theory Exam
Minor- Pre University Test
Sessional weightage – Attendance 50%, Three Class Tests/Assignments 50%

SEMESTER VI

PHYSICS-C XIII: SOLID STATE PHYSICS

(Credits: Theory-04) Theory: 60 Lectures

Course Code : 1Y3PHY601

Mid Semester: 20 End Semester: 50 Full Marks: 70

Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Crystal geometry: Crystal lattice; crystal planes and Miller indices, unit cells. Typical crystal structures;. Symmetry elements; rotation, inversion and reflection, point groups and crystal classes.

Crystallography: Diffraction of X-rays by a crystal lattice. Laue's formulation of X-ray diffraction; reciprocal lattice, Bragg's equation, Laue spots.

Types of binding in solids (Qualitative idea only): Covalent binding and its origin, Ionic binding, energy of binding, transition between covalent and ionic binding, metallic binding, Van der Waals binding, hydrogen bond.

Lattice Vibrations: Dynamics of a chain of atoms, chain of two types of atoms, optical and acoustic modes, interaction of light with ionic crystals, Einstein's and Debye's theories of specific heats of solids.

Conduction in metals: Drude's theory, Electrical conductivity, Hall effect and magnetoresistance, thermal conductivity of metals, thermal properties of free-electron gas, Sommerfeld's theory of conduction in metals.

Elementary band theory: Periodic potential and Bloach theorem, Kroning- Penny model, band gap, Effective mass, Band structure of metals, insulators and semiconductors. Conductivity of Semiconductor, mobility.

Superconductivity: Occurrence, Critical temperature and critical magnetic field, Meissner effect, Superconductivity- Type I, Type II.

Reference Books:

Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India

PHYSICS LAB- LAB C XIII (2 Credits) FM: 30

Course Code : 1Y3PHY601P

1. To determine the Hall coefficient of a semiconductor sample.
2. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150^0C) and to determine its band gap.
3. To measure the Dielectric Constant of a dielectric Materials with frequency
4. To determine the refractive index of a dielectric layer using SPR
5. To determine the value of e/m by using a Bar magnet.

PHYSICS-C XIV: STATISTICAL MECHANICS

(Credits: Theory-04) Theory: 60 Lectures

Course Code : 1Y3PHY602

Mid Semester: 20 End Semester: 50 Full Marks: 70

Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Classical Statistics: Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy

Classical Theory of Radiation: Properties of Thermal Radiation. Blackbody Radiation. Kirchhoff's law. Stefan-Boltzmann law:Wien's Displacement law. Wien's Distribution Law. Rayleigh-Jean's Law.

Bose-Einstein Statistics: B-E distribution law, Thermodynamic functions of a Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He .

Fermi-Dirac Statistics: Fermi-Dirac Distribution Law, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals,

Reference Books:

• Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
• Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
• Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
• Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
• Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
• An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Pres

PHYSICS LAB- LAB C XIV (2 Credits) FM: 30

Course Code : 1Y3PHY602P

Use C/C++/Scilab for solving the problems based on Statistical Mechanics like

1. Plot Planck's law for Black Body radiation and compare it with Wein's Law and Raleigh-Jeans Law at high temperature (room temperature) and low temperature.
2. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases
3. Plot Maxwell-Boltzmann distribution function versus temperature.
4. Plot Fermi-Dirac distribution function versus temperature.
5. Plot Bose-Einstein distribution function versus temperature.

PHYSICS-DSE III: CLASSICAL MECHANICS

(Credits: Theory-04) Theory: 60 Lectures

Course Code : 1Y3PHY603

Mid Semester: 20 End Semester: 50 Full Marks: 70

Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Lagrangian : Generalised coordinates and velocities, Constraints, principle of virtual work Calculus of variation, Lagrange's equation, Applications to simple systems such as coupled oscillators. Cyclic coordinates, symmetries and conservation laws. Advantages of Lagrangian:electromechanical Analogies.

Hamiltonian: Canonical momenta & Hamiltonian. Hamilton's equations of motion. Principle of least action. Applications: Hamiltonian for a harmonic oscillator, compound pendulum. Canonical transformation, Poisson Brackets, Hamilton-Jacobi theory, solution of harmonic oscillator using Hamilton-Jacobi theory.

Motion under central force: two body problem, reduction to the equivalent one body problem, Differential equation for the orbit, Condition for stable circular orbit , keplar's law, center of mass and lab frame of reference, Rutherford scattering.

Rigid body dynamics: moment of inertia and product of inertia, rotating top, precession and nutation, Euler angles

Rotating frame of reference: rotating frame of reference, centrifugal force, corlisis force and its effects.

Reference Books:

1. Intoduction to Classical mechanics, Nikhil Ranjan Roy, 2016, Vikash Pub House Pvt. Ltd.
2. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002,Pearson Education.
3. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
4. The Classical Theory of Fields, L.D Landau, E.M Lifshitz, 4th Edn., 2003, Elsevier.
5. Introduction to Electrodynamics, D.J. Griffiths, 2012, Pearson Education.
6. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.

PHYSICS LAB- LAB DSE III (2 Credits) FM: 30

Course Code : 1Y3PHY603P

1. To determine the acceleration due to gravity by object drop method
2. To determine the acceleration due to gravity by Simple Pendulum
3. To determine the acceleration due to gravity with the help of Compound Pendulum
4. To determine the radius of gyration and moment of inertia of a Compound Pendulum about its centre of gravity
5. Determination of the moment of inertia of given body using inertia table.
6. Determination of the moment of inertia of given body using inertia table using lamp and scale arrangement.
7. Prove the perpendicular axis theorem of moment of inertia using inertia table
8. Study two normal modes of Coupled Oscillator and record the oscillations to determine the time period for both the modes.
9. Record the oscillations for Resonance Mode. To determine the Coupled Time Period and Beat Time Period of the oscillation also compare the experimental values of time period with calculated values?
10. To determine the Spring Constant with the help of Coupled Oscillator

PHYSICS-DSE IV: DIGITAL SYSTEMS AND APPLICATIONS
(Credits: Theory-04) Theory: 60 Lectures
Course Code : 1Y3PHY604
Mid Semester: 20 End Semester: 50 Full Marks: 70
Short Answer Type: 2.5 Marks (4 out of 5) & Long Answer Type: 10 Marks (4 out of 6)

Digital Circuits: Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates. NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.
Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.
Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.
Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders, 4-bit binary Adder.
Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.
Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator.
Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).
Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

Reference Books:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning
5. Logic circuit design, Shimon P. Vingron, 2012, Springer.
6. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
7. Digital Electronics, Floyd.
8. Digital Computer Electronics, Malvino

PHYSICS LAB- LAB DSE IV (2 Credits) FM: 30
Course Code : 1Y3PHY604P

1. To design a switch (NOT gate) using a transistor.
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. To design a combinational logic system for a specified Truth Table.
4. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
5. To minimize a given logic circuit.
6. Half Adder, Full Adder and 4-bit binary Adder.
7. Half Adder and Full Adder Truth table verification using I.C.
8. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
9. To design an astable multivibrator of given specifications using 555 Timer.
10. To design a monostable multivibrator of given specifications using 555 Timer.