KUVEMPU UNIVERSITY

BOARD OF STUDIES (BOS) IN PHYSICS
(UNDER GRADUATE PROGRAMME)

APPROVED SYLLABUS

(To be effective from the academic year 2023-24)

For

V AND VI SEMESTER PHYSICS PAPERS

of

B.SC./B.SC.(HONS.) DEGREE PROGRAMME

[Framed in according with the National Education policy (NEP-2020)

&basedon ***Model Physics Syllabus***prepared byphysics expert committee,

Karnataka State Higher Education Council, Bangalore]

Syllabus approved in the Board of Studies (BOS) meeting held on ***08-09-2023*** *at the*

Department **of Post-Graduate in Physics and Research,Jnana Sahyadri, Shankaraghatta**

Curriculum Structure-Physics
(Core and Electives)

Semesters- V and VI SEM

<table>
<tr><th>SEM</th><th>DSC</th><th>SEC</th><th>Core Papers</th><th>Teaching Hours (per Week)</th><th>Credits</th></tr>
<tr><td rowspan="4">Sem-5</td><td>A5 (Theory)</td><td>----</td><td rowspan="2">Classical Mechanics and Quantum Mechanics- I</td><td>4</td><td>4</td></tr>
<tr><td>A5 (Lab)</td><td>----</td><td>4</td><td>2</td></tr>
<tr><td>A6 (Theory)</td><td>----</td><td rowspan="2">Elements of Atomic, Molecular & Laser Physics</td><td>4</td><td>4</td></tr>
<tr><td>A6 (Lab)</td><td>----</td><td>4</td><td>2</td></tr>
<tr><td rowspan="4">Sem -6</td><td>A7 (Theory)</td><td>----</td><td rowspan="2">Elements of Condensed Matter & Nuclear Physics</td><td>4</td><td>4</td></tr>
<tr><td>A7 (Lab)</td><td>----</td><td>4</td><td>2</td></tr>
<tr><td>A8 (Theory)</td><td>----</td><td rowspan="2">Electronic Instrumentation & Sensors</td><td>4</td><td>4</td></tr>
<tr><td>A8 (Lab)</td><td>----</td><td>4</td><td>2</td></tr>
<tr><td>Sem-6</td><td>----</td><td>Internship/Project work/Dissertation</td><td>-----</td><td>4</td><td>2</td></tr>
</table>

Government of Karnataka
Model Curriculum

Syllabus for Semester-V

Program Name	BSc in Physics	Semester	V
Course Title	**Classical Mechanics and Quantum Mechanics- I (Theory)**		
Course Code:	PHY C9-T	No. of Credits	04
Contact hours	60 Hours	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Outcomes (COs): After the successful completion of the course, the student will be able to

- Understand the concepts of special theory and general theory of relativity.
- Get familiarized with Lagrangian formulation and apply it to few common problems.
- Explain variational principle and deduce Hamilton's equations from it.
- Define canonical transformations and Poisson Brackets, and explain their importance.
- Identify the failure of classical physics at the microscopic level.
- Concept of matter waves and its experimental verification.
- Find the relationship between the normalization of a wave function and the ability to correctly calculate expectation values or probability densities.
- Explain the minimum uncertainty of measuring both observables on any quantum state.
- Describe the time-dependent and time-independent Schrödinger equation for simple potentials like for instance one-dimensional potential well and Harmonic oscillator.
- Apply Hermitian operators, their eigenvalues and eigenvectors to find various commutation and uncertainty relations.

Content	60 Hrs.
Unit – 1: Special and General Theory of Relativity	
Special Theory of Relativity Constancy of speed of light. Postulates of Special Theory of Relativity. Lorentz – transformation equations (no derivation) Derivation of expressions for --Length contraction, Time dilation, and Relativistic addition of velocities. Relativity of simultaneity. Relativistic dynamics: Mass variation (no derivation), mass – energy relation (derivation), relativistic expression for kinetic energy, energy - momentum relation (Derivation). Classical and relativistic concepts of space and time, Minkowski's world, concept of four vectors, (xyz, ict), world line, space-time interval and its invariance.	10
General Theory of Relativity Inertial and gravitational mass, principle of equivalence, curved space time, Einstein theory of gravitation (brief).Experimental verification of general theory of relativity- brief explanation of effect of gravitational field: on a ray of light, on path of a planet about the sun.	5

Unit – 2: Lagrangian and Hamiltonian Mechanics	
Lagrangian Formulation Constraints, Holonomic constraints, non-holonomic constraints, Scleronomic and Rheonomic constraints-Brief explanation with examples. Generalized coordinates, degrees of freedom, Principle of virtual work, D'Alembert's principle, Lagrange equations (Derivation). Newton's equation of motion from Lagrange equations, Application of Lagrange equation to 1D simple pendulum, Atwood's machine and linear harmonic oscillator.	6
Variational principle&Hamiltonian Mechanics Hamilton's principle, Lagrange's equation of motion from Hamilton's principle. The Hamiltonian of a system, Hamilton's equations of motion, Hamilton's equations from variational principle, Integrals of Hamilton's equations, energy integrals, Canonical Transformations, Poison Brackets, fundamental properties and equations of motion in Poison Brackets.	9
Unit – 3: Introduction to Quantum Mechanics	
Brief discussion on failure of classical physics to explain black body radiation, Photoelectric effect, Compton effect, stability of atoms and spectra of atoms. Compton scattering: Expression for Compton shift (With derivation). **Matter waves:** de Broglie hypothesis of matter waves, Electron microscope (working principle, construction and applications), Wave description of particles by wave packets, Group and Phase velocities and relation between them(derivation), Experimental evidence for matter waves: Davisson- Germer experiment (with theory), G.P Thomson's experiment and its significance. **Heisenberg uncertainty principle:**Statement and explanation of Heisenberg's relation between momentum and position, energy and time, angular momentum and angular position, illustration of uncertainty principle by Gamma ray microscope thought experiment. Consequences of the uncertainty relations: Diffraction of electrons at a single slit, why electron cannot exist in nucleus? Two-slit experiment with photons and electrons. Linear superposition principle as a consequence.	15
Unit – 5: Foundation of Quantum Mechanics	
Probabilistic interpretation of the wave function - normalization and orthogonality of wave functions, Admissibility conditions on a wave function. **Schrödinger equation:** equation of motion of matter waves - Derivation of 1D time-dependent and time-independent wave equations Schrodinger wave equation for a free particle in one and threedimensions. Probability current density, equation of continuity and its physical significance, Postulates of Quantum mechanics: States as normalized wavefunctions. Dynamical variables as linear Hermitian operators (position, momentum, angular momentum, and energy as examples). Expectation values of operators and their time evolution. Ehrenfest theorem (no derivation), Commutator brackets- Simultaneous Eigen functions, Commutator bracket using position, momentum and angular momentum operators. Particle in a one-dimensional infinite potential well (derivation), degeneracy in three-dimensional case, Qualitative discussion of -- particle in a finite potential well, Transmission across a potential barrier, the tunnel effect, scanning tunnelling microscope (principle and applications), One-dimensional simple harmonic oscillator (qualitative) - concept of zero - point energy.	15

References	
1	Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2	Classical Mechanics, Takwale and Puranik-1989, Tata Mcgraw Hill, new Delhi
3	Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, 2009.
4	Quantum Physics, Berkeley Physics Course Vol. 4. E.H. Wichman, Tata McGraw-Hill Co., 2008.

5	Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, McGraw Hill, 2003.
6	P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill publication, ISBN: 9780070146174.
7	Ajoy Ghatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer Publication,ISBN 978-1-4020-2130-5.
8	Modern Physics; R.Murugeshan&K.Sivaprasath; S. Chand Publishing.
9	G Aruldhas, Quantum Mechanics, Phi Learning Private Ltd., ISBN: 97881203363.
10	Gupta, Kumar & Sharma, Quantum Mechanics, Jai Prakash Nath Publications.
11	Physics for Degree Students B.Sc., Third Year, C.L.Arora and P.S.Hemne, 1st edition, S.Chand& Company Pvt. Ltd., 2014.

Course Title	**Classical Mechanics and Quantum Mechanics- I Lab (Practical)**		**No. of Credits**	02
Course Code:	PHY C10-P	**Contact hours**	4 Hours per week	
Formative Assessment of Marks	25 Marks	**Summative Assessment Marks**	25	
Practical Content(NOTE: Do not repeat the experiment already performed in the previous semesters)				

Lab experiments (Students have to perform a minimumof EIGHT Experiments from the list below)

1. To determine 'g', the acceleration due to gravity, at a given place, from the L – T ^{2} graph, for a simple pendulum.
2. Studying the effect of mass of the bob on the time period of the simple pendulum.
   [**Hint:** With the same experimental set-up, take a few bobs of different materials (different masses) but of same size. Keep the length of the pendulum same for each case. Starting from a small angular displacement of about 10° find out, in each case, the time period of the pendulum, using bobs of different masses. Does the time period depend on the mass of the pendulum bob? If yes, then see the order in which the change occurs. If not, then do you see an additional reason to use the pendulum as a time measuring device.
3. Studying the effect of amplitude of oscillation on the time period of the simple pendulum.
   [**Hint:**With the same experimental set-up, keep the mass of the bob and length of the pendulum fixed. For measuring the angular amplitude, make a large protractor on the cardboard and have a scale marked on an arc from 0° to 90° in units of 5°. Fix it on the edge of a table by two drawing pins such that its 0°- line coincides with the suspension thread of the pendulum at rest. Start the pendulum oscillating with a very large angular amplitude (say 70°) and find the time period T of the pendulum. Change the amplitude of oscillation of the bob in small steps of 5° or 10° and determine the time period in each case till the amplitude becomes small (say 5°). Draw a graph between angular amplitude and T. How does the time period of the pendulum change with the amplitude of oscillation? How much does the value of T for A =10° differ from that for A= 50° from the graph you have drawn? Find at what amplitude of oscillation, the time period begins to vary? Determine the limit for the pendulum when it ceases to be a simple pendulum.]
4. Determine the acceleration of gravity is to use an Atwood's machine.
5. Study the conservation of energy and momentum using projectile motion.
6. Verification of the Principle of Conservation of Linear Momentum.
7. Determination of Planck constant and work function of the material of the cathode using Photoelectric cell.
8. To study the spectral characteristics of a photo-voltaic cell (Solar cell).

9. Determination of electron charge ‘e’ by Millikan’s Oil drop experiment.
10. To find the value of e/m for an electron by Thomson’s method using bar magnets.
11. To determine the value of e/m for an electron by magnetron method.
12. To study the tunnelling in Tunnel Diode using I-V characteristics.
13. Determination of quantum efficiency of Photodiode.
14. A code in C/C++/Scilab to find the first seven eigen states and eigen functions of Linear Harmonic Oscillator by solving the Schrödinger equation.
15. A code in C/C++/Scilab to plot and analyse the wavefunctions for particle in an infinite potential well.
16. Study of coupled oscillations.

NOTE:- Any relevant experiment of suitable standard may be performed as per availability of instruments.

References	
1	B.Sc Practical Physics by C.L Arora.
2	B.Sc Practical Physics by Harnam Singh and P.S Hemne
3	Practical Physics by G.S Squires.
4	Scilab Manual for CC-XI: Quantum Mechanics &Applications (32221501) by Dr Neetu Agrawal, Daulat Ram College, of Delhi.
5	Scilab Textbook Companion for Quantum Mechanics by M. C. Jain.
6	Scilab Textbook Companion for Quantum Mechanics by M. C. Jain.
7	Advanced Practical Physics for Students by Worsnop B L and Flint H T.

Program Name	BSc in Physics	**Semester**	V
Course Title	**Elements of Atomic, Molecular & Laser Physics (Theory)**		
Course Code:	PHY C11-T	**No. of Credits**	04
Contact hours	60 Hours	**Duration of SEA/Exam**	2 hours
Formative Assessment Marks	40	**Summative Assessment Marks**	60

Course Outcomes (COs): After the completion of the course, the student will be able to

- Describe atomic properties using basic atomic models.
- Interpret atomic spectra of elements using vector atom model.
- Interpret molecular spectra of compounds using basics of molecular physics.
- Explain laser systems and their applications in various fields.

Content	60 Hrs.
Unit – 1:Basic Atomic models	
Thomson's atomic model; Rutherford atomic model, Theory of alpha particle scattering - Rutherford scattering formula; Bohr atomic model – postulates, Derivation of expression for radius, total energy of electron; Origin of the spectral lines; Spectral series of hydrogen atom; Effect of nuclear motion on atomic spectra - derivation; Ritz combination principle; Correspondence principle; **Critical potentials** – critical potential, excitation potential and ionization potential; Atomic excitation and its types, Franck-Hertz experiment; Sommerfeld's atomic model, Derivation of condition for allowed elliptical orbits.	12
Activities: 1. Students to estimate radii of orbits and energies of electron in case of hydrogen atom in different orbits and plot the graph of radii / energy versus principal quantum number 'n'. Analyse the nature of the graph and draw the inferences. 2. Students to search critical, excitation and ionisation potentials of different elements and plot the graph of critical /excitation / ionisation potentials versus atomic number/mass number/neutron number of element. Analyse the nature of the graph and draw the inferences.	3
Unit – 2: Vector atomic model and optical spectra	
Vector atom model: model fundamentals, spatial quantization, spinning electron; Quantum numbers associated with vector atomic model; Coupling schemes – L-S and j-j schemes; Pauli's exclusion principle; Magnetic dipole moment due to orbital motion of electron – derivation; Magnetic dipole moment due to spin motion of electron; Lande g-factor and its calculation for different states; Stern-Gerlach experiment with theory;Spin-Orbit Interaction – qualitative. **Optical spectra** – spectral terms, spectral notations, selection rules, intensity rules; Fine structure of spectral lines with examples- Fine structure of sodium D-line. **Zeeman effect**: Types, example, Experimental study and classical theory of normal Zeeman effect - Zeeman shift expression, **Stark effect:** Experimental study, Types and examples.	12
Activities: 1. Students to couple a p-state and s-state electron via L-S and j-j coupling schemes for a system with two electrons and construct vector diagrams for each resultant. Analyse the coupling results and draw the inferences. 2. Students to estimate magnetic dipole moment due to orbital motion of electron for different	3

states $2P_{1/2}$, $2P_{3/2}$, $2P_{5/2}$, $2P_{7/2}$, $2P_{9/2}$ and $2P_{11/2}$ and plot the graph of dipole moment versus total orbital angular momentum "J". Analyse the nature of the graph and draw the inferences.	
Unit – 3: Molecular Physics	
Types of molecules based on their moment of inertia; Types of molecular motions and energies; Born-Oppenheimer approximation; Origin of molecular spectra; Nature of molecular spectra; Theory of rigid rotator – energy levels and spectrum, Qualitative discussion on Non- rigid rotator and centrifugal distortion; Theory of vibrating molecule as a simple harmonic oscillator – energy levels and spectrum; Electronic spectra of molecules – fluorescence and phosphorescence **Raman effect** – Stoke's and anti-Stoke's lines, characteristics of Raman spectra, classical (Qualitative) and quantum theory, Experimental study of Raman effect; Applications of Raman effect.	12
Activities: 1. Students to estimate energy of rigid diatomic molecules CO, HCl and plot the graph of rotational energy versus rotational quantum number 'J'. Analyse the nature of the graph and draw the inferences. Also, students study the effect of isotopes on rotational energies. 2. Students to estimate energy of harmonic vibrating molecules CO, HCl and plot the graph of vibrational energy versus vibrational quantum number 'v'. Analyse the nature of the graph and draw the inferences.	3
Unit – 4: Laser Physics	
Characteristics of laser light; Interaction of radiation with matter - Induced absorption, spontaneous emission and stimulated emission with mention of rate equations; Einstein's A and B coefficients – Derivation of relation between Einstein's coefficients and radiation energy density; Possibility of amplification of light; Population inversion; Methods of pumping; Metastable states; Requisites of laser – energy source, active medium and laser cavity; Difference between Three level and four level lasers with examples; Types of lasers with examples; Construction and Working principle of Ruby Laser and He-Ne Laser; Application of lasers (qualitative) in science & research, isotope separation, communication, fusion, medicine, industry, war and space.	12
Activities: 1. Students to search different lasers used in medical field (ex: eye surgery, endoscopy, dentistry etc.), list their parameters and analyse the need of these parameters for specific application, and draw the inferences. Students also make the presentation of the study. 2. Students to search different lasers used in defense field (ex: range finding, laser weapon, etc.), list their parameters and analyse the need of these parameters for specific application, and draw the inferences. Students also make the presentation of the study.	3

References	
1	Modern Physics, R. Murugeshan, Kiruthiga Sivaprakash, Revised Edition, 2009, S. Chand & Company Ltd.
2	Atomic & Molecular spectra: Laser, Raj Kumar, Revised Edition, 2008, Kedar Nath Ram Nath Publishers, Meerut.
3	Atomic Physics, S.N. Ghoshal, Revised Edition, 2013, S. Chand & Company Ltd.
4	Concepts of Atomic Physics, S.P. Kuila, First Edition, 2018, New Central Book Agency (P) Ltd.
5	Concepts of Modern Physics, Arthur Beiser, Seventh Edition, 2015, Shobhit Mahajan, S. Rai Choudhury, 2002, McGraw-Hill.
6	Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M. McCash, Fourth Edition, 2008, Tata McGraw-Hill Publishers.
7	Elements of Spectroscopy – Atomic, Molecular and Laser Physics, Gupta, Kumar and Sharma, 2016, Pragati Publications

Course Title	**Elements of Atomic, Molecular & Laser Physics Lab (Practical)**	**No. of Credits**	02
Course Code:	PHY C12-P	**Contact hours**	4 Hours per week
Formative Assessment of Marks	25 Marks	Summative Assessment Marks	25
Practical Content(NOTE: Do not repeat the experiment already performed in the previous semesters)			

LIST OF EXPERIMENTS (Students have to perform a minimumof EIGHT Experiments from the list below)

1. To determine Planck's constant using LED.
2. To determine wavelength of spectral lines of mercury source using spectrometer.
3. To determine the value of Rydberg's constant using diffraction grating and hydrogen discharge tube.
4. To determine the wavelength of H_α emission line of Hydrogen atom.
5. To determine fine structure constant using fine structure separation of sodium D-lines using a plane diffraction grating.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the force constant and vibrational constant for the iodine molecule from its absorption spectrum.
9. To determine the wavelength of laser using diffraction by single slit/double slits.
10. To determine wavelength of He-Ne laser using plane diffraction grating.
11. To determine angular spread of He-Ne laser using plane diffraction grating.
12. Study of Raman scattering by CCl_4 using laser and spectrometer/CDS.

NOTE:- Any relevant experiment of suitable standard may be performed as per availability of instruments.

References	
1	Practical Physics, D.C. Tayal, First Millennium Edition, 2000, Himalaya Publishing House.
2	B.Sc. Practical Physics, C.L. Arora, Revised Edition, 2007, S. Chand &Comp.Ltd.
3	An Advanced Course in Practical Physics, D. Chattopadhyay, P.C. Rakshith, B. Saha, Revised Edition, 2002, New Central Book Agency Pvt. Ltd.
4	Physics through experiments, B. Saraf, 2013, Vikas Publications.

Government of Karnataka
Model Curriculum

Syllabus for Semester-VI

Program Name	BSc in Physics	Semester	VI
Course Title	**Elements of Condensed Matter & Nuclear Physics**		
Course Code:	**PHY C14 - T**	No. of Credits	04
Contact hours	60 Hours	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Outcomes (COs):

After the successful completion of the course, the student will be able to:

- Explain the basic properties of nucleus and get the idea of its inner information.
- Understand the concepts of binding energy and binding energy per nucleon v/s mass number graph.
- Describe the processes of alpha, beta and gamma decays based on well-established theories.
- Explain the basic aspects of interaction of gamma radiation with matter by photoelectric effect, Compton scattering and pair production.
- Explain the different nuclear radiation detectors such as ionization chamber, Geiger-Mueller counter etc.
- Explain the basic concept of scintillation detectors, photo-multiplier tube and semiconductor detector

Content	60 Hrs.
Unit – 1: Crystal systems&Free electron theory of metals	
Crystal systems Crystal structure: Space Lattice, Lattice translational vectors, Basis of crystal structure, Types of unit cells, primitive, non-primitive cells. Seven crystal systems, Coordination numbers, Miller Indices, Expression for inter planner spacing. **X Rays:** Production and properties of X rays, Coolidge tube, Continuous and characteristic X-ray spectra; Moseley's law. X-Ray diffraction, Scattering of X-rays, Bragg's law. Crystal diffraction: Bragg's X-ray spectrometer- powder diffraction method, Intensity vs 2θ plot (qualitative). **Free electron theory of metals:** Classical free electron model (Drude-Lorentz model), expression for electrical and thermal conductivity, Weidman-Franz law, Failure of classical free electron theory; Quantum free electron theory: Fermi-Dirac distribution function(expression for probability distribution F(E), statement only); Fermi Dirac distribution at T = 0 and T$\neq$ 0, F(E) vs E plots. Density of states for free electrons (statement only, no derivation), expressions for Fermi energy and average fermi energy at 0K. Qualitative discussion of lattice vibration and concept of Phonons.Specific heats of solids: Classical theory (qualitative)-limitations, Einstein's and Debye's theory of specific heats. Hall Effect in metals(qualitative).	15
Unit – 2: Magnetic Properties of Matter, Dielectrics and Superconductivity	
Magnetic Properties of Matter: Review of basic formulae: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, magnetization (M), Classification of Dia, Para, and ferro magnetic materials; Langevin Classical Theory of dia – and Paramagnetism. Curie's law, Ferromagnetism and Ferromagnetic Domains (qualitative). Discussion of B-H Curve. Hysteresis and Energy Loss, Hard and Soft	15

magnetic materials. **Dielectrics:** Static dielectric constant, polarizability (electronic, ionic and orientation), calculation of Lorentz field (derivation), Clausius-Mosotti equation (derivation), dielectric loss. Piezo electric effect, cause, examples and applications. **Superconductivity:** Definition, Experimental results – Zero resistivity and Critical temperature– The critical magnetic field – Meissner effect, Type I and type II superconductors.	
Unit – 3: General Properties of Nuclei& Radioactive decay	
General Properties of Nuclei: Constituents of nucleus and their intrinsic properties, quantitative facts about – mass, radii, charge density (matter density), binding energy (main features of binding energy versus mass number curve), angular momentum, parity, magnetic moment, electric quadrupole moments. **Radioactivity decay:** Radioactivity : definition of radioactivity, half-life, mean life, radioactivity equilibrium (a) Alpha decay: basics of α-decay processes, theory of α emission (brief), Gamow factor, Geiger-Nuttall law. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion (Definition)	15
Unit – 4: Interaction of Nuclear Radiation with matter and Nuclear radiation detectors	
Interaction of Nuclear Radiation with matter: Gamma ray interaction with matter, photoelectric effect, Compton scattering, pair production, Energy loss due to ionization (quantitative description of Bethe-Bloch formula), energy loss of electrons, introduction of Cerenkov radiation. **Detector for Nuclear Radiations:** Gas detectors: estimation of electric field, mobility of particle for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility)--qualitative only, Accelerators: Cyclotrons (with theory) and Synchrotrons (Qualitative).	15

References

Text Books

1. Solid State Physics-R. K. Puri and V.K. Babber., S.Chand publications,1st Edition(2004).
2. Fundamentals of Solid State Physics-B.S.Saxena,P.N. Saxena,Pragatiprakashan Meerut(2017).
3. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
4. Nuclear Physics, Irving Kaplan, Narosa Publishing House

Reference Books

1. Introduction to solid State Physics, Charles Kittel, VII edition, (1996)
2. Solid State Physics- A J Dekker, MacMillan India Ltd, (2000)
3. Essential of crystallography, M A Wahab, Narosa Publications (2009)
4. Solid State Physics-S O Pillai-New Age Int. Publishers (2001).
5. Concepts of nuclear physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
6. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
7. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
8. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (Institute of Physics (IOP) Publishing, 2004).
9. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
10. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).

Course Title	Elements of Condensed Matter & Nuclear Physics Lab (Practical)		No. of Credits	02
Course Code:	PHY C15-P	Contact hours	4 Hours per week	
Formative Assessment of Marks	25 Marks	Summative Assessment Marks	25	

Practical Content(NOTE: Do not repeat the experiment already performed in the previous semesters)

Students have to perform a minimumof EIGHT Experiments from the list below

CONDENSED MATTER PHYSICS:

1. Hall Effect in semiconductor: determination of mobility, hall coefficient.
2. Energy gap of semiconductor (diode/transistor) by reverse saturation method
3. Thermistor energy gap
4. Fermi Energy of Copper
5. Analysis of X-ray diffraction spectra and calculation of lattice parameter.
6. Specific Heat of Solid by Electrical Method
7. Determination of Dielectric Constant of polar liquid.
8. Determination of dipole moment of organic liquid
9. B-H Curve Using CRO.
10. Spectral Response of Photo Diode and its I-V Characteristics.
11. Determination of particle size from XRD pattern using Debye-Scherrer formula.
12. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method).
13. Measurement of susceptibility of paramagnetic solid (Gouy's Method)

NUCLEAR PHYSICS

1. Study the characteristics of Geiger-Mùller Tube. Determine the threshold voltage, plateau region and operating voltage.
2. Study the absorption of beta particles in aluminium foils using GM counter. Determine mass attenuation coefficient of Aluminium foils.
3. Study the absorption of beta particles in thin copper foils using G M counter and determine mass attenuation coefficient.
4. Study the attenuation of gamma rays in lead foils using Cs-137 source and G M counter. Calculate mass attenuation coefficient of Lead for Gamma.
5. Determine the end point energy of Tl-204 source by studying the absorption of beta particles in aluminium foils.
6. Study the attenuation of absorption of gamma rays in polymeric materials using Cs-137 source and G M counter

NOTE:- Any relevant experiment of suitable standard may be performed as per availability of instruments.

References	
1	IGNOU : Practical Physics Manual
2	Saraf: Experiment in Physics, Vikas Publications
3	S.P. Singh: Advanced Practical Physics
4	Melissons: Experiments in Modern Physics
5	Misra and Misra, Physics Lab. Manual, South Asian publishers, (2000)
6	Gupta and Kumar, Practical physics, Pragati prakashan, (1976)

Program Name	BSc in Physics	Semester	VI
Course Title	Electronic Instrumentation & Sensors (Theory)		
Course Code:	PHY C16 - T	No. of Credits	04
Contact hours	60 Hours	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Outcomes (COs):

After the successful completion of the course, the student will be able to:

- Identify different types of tests and measuring instruments used in practice and understand their basic working principles.
- Get hands on training in wiring a circuit, soldering, making a measurement using an electronic circuit used in instrumentation.
- Have an understanding of the basic electronic components viz., resistors, capacitors, inductors, discrete and integrated circuits, colour codes, values and pin diagram, their practical use.
- Understanding of the measurement of voltage, current, resistance value, identification of the terminals of a transistor and ICs.
- Identify and understand the different types of transducers and sensors used in robust and hand-held instruments.
- Understand and give a mathematical treatment of the working of rectifiers, filter, data converters and different types of transducers.
- Connect the concepts learnt in the course to their practical use in daily life.
- Develop basic hands-on skills in the usage of oscilloscopes, multimeters, rectifiers, amplifiers, oscillators and high voltage probes, generators and digital meters.
- Servicing of simple faults of domestic appliances: Iron box, immersion heater, fan, hot plate, battery charger, emergency lamp and the like.

Content	60 Hrs.
Unit – 1: Power supply and Measuring instruments	
Power supply AC power and its characteristics, Single phase and three phase, Need for DC power supply and its characteristics, line voltage and frequency, Rectifier bridge, Filters: Capacitor and inductor filers, L-section and π-section filters, ripple factor, electronic voltage regulators, stabilization factor, voltage regulation using ICs.	6
Basic electrical measuring instruments Cathode ray oscilloscope- Block diagram, basic principle, electron beam, CRT features, signal display. Basic elements of digital storage oscilloscopes. Basic DC voltmeter for measuring potential difference, Extending Voltmeter range, AC voltmeter using rectifiers Basic DC ammeter, requirement of a shunt, Extending of ammeter ranges. **Topics for self-study:** *Average value and RMS value of current, Ripple factor, Average AC input power and DC output power, efficiency of a DC power supply. Multirange voltmeter and ammeter.*	6
Activities: 1. Design and wire your own DC regulated power supply. Power output: 5 V, 10 V, ± 5 V. Components required: A step down transformer, semiconductor diodes (BY126/127), Inductor, Capacitor, Zener diode or 3-pin voltage regulator or IC. Measure the ripple factor and efficiency at each stage. Tabulate the result. 2. Extend the range of measurement of voltage of a voltmeter (analog or digital) using external component and circuitry. Design your own circuit and report.	3

3. Measure the characteristics of the signal waveform using a CRO and function generator. Tabulate the frequency and time period. Learn the function of Trigger input in an CRO. 4. Learn to use a Storage Oscilloscope for measuring the characteristics of a repetitive input signal. Convince yourself how signal averaging using Storage CRO improves S/N ratio.	
Unit – 2: Wave form generators and Filters	
Basic principle of standard AF signal generator:Fixed frequency and variable frequency, AF sine and square wave generator, basic Wein-bridge network and oscillator configuration, Triangular and saw tooth wave generators, circuitry and waveforms.	6
Passive and active filters. Fundamental theorem of filters, Proof of the theorem by considering a symmetrical T-network. Types of filters, Circuitry and Cut-off frequency and frequency response of Passive (RC) and Active (op-amp based) filters: Low pass, high pass and band pass.	6
Activities: 1. Measure the amplitude and frequency of the different waveforms and tabulate the results. Required instruments: A 10 MHz oscilloscope, Function generators (sine wave and square wave). 2. Explore where signal filtering network is used in real life. Visit a nearby telephone exchange and discuss with the Engineers and technicians. Prepare a report. 3. Explore op-amp which works from a single supply biasing voltage (+15V). Construct an inverting/non-inverting amplifier powered by a single supply voltage instead of dual or bipolar supply voltage. 4. Op-amp is a linear (analog) IC. Can it be used to function as logic gates? Explore, construct and implement AND, OR NAND and NOR gate functions using op-amps. 5. Verify the truth table. Hint: LM3900 op-amp may be used. The status of the output may be checked by LED.	3
Unit – 3:Data Conversion and display	
Digital to Analog (D/A) and Analog to Digital (A/D) converters – A/D converter with preamplification and filtering. D/A converter - Variable resistor network, Ladder type (R-2R) D/A converter, Op-amp based D/A converter. (4 hours)	4
Digital display systems and Indicators- Classification of displays, Light Emitting Diodes (LED) and Liquid Crystal Display (LCD) – Structure and working.	4
Data Transmission systems – Advantages and disadvantages of digital transmission over analog transmission, Pulse amplitude modulation (PAM), Pulse time modulation (PTM) and Pulse widthmodulation (PWM)- General principles. Principle of Phase Sensitive Detection (PSD).	4
Topic for self-study:*Lock-in amplifier and its application, phase locked loop.* **Activities:** 1. Explore where modulation and demodulation technique is employed in real life. Visit a Radio broadcasting station. (Aakashavani or Private). Prepare a report on different AM and FM stations. 2. Explore and find out the difference between a standard op-amp and an instrumentation op-amp. Compare the two and prepare a report.	3
Unit – 4:Transducers and sensors	
Definition and types of transducers. Basic characteristics of an electrical transducer, factors governing the selection of a transducer, Resistive transducer-potentiometer, Strain gauge and types (general description), Resistance thermometer-platinum resistance thermometer. Thermistor. Inductive Transducer-general principles, Linear Variable Differential Transducer (LDVT)- principle and construction, Capacitive Transducer, Piezo-electric transducer, Photoelectric transducer, Photovoltaic cell, photo diode and phototransistor – principle and working.	12

Activities:	3
1. Construct your own thermocouple for the measurement of temperature with copper and constantan wires. Use the thermocouple and a Digital multimeter (DMM). Record the emf (voltage induced) by maintaining one of the junctions at a constant temperature (say at 0o C, melting ice) and another junction at variable temperature bath. Tabulate the voltages induced and temperatures read out using standard chart (Chart can be downloaded from the internet). **2.** Observe a solar water heater. Some solar water heaters are fitted with an anode rod (alloy of aluminium). Study why it is required. Describe the principle behind solar water heater.	

References

1. Physics for Degree students (Third Year) – C.L. Arora and P.S. Hemne, S, Chand and Co. Pvt. Ltd. 2014 (For Unit-1, Power supplies)
2. Electronic Instrumentation, 3rd Edition, H.S. Kalsi, McGraw Hill Education India Pvt. Ltd. 2011 (For rest of the syllabus)
3. Instrumentation – Devices and Systems (2nd Edition)– C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill Education Pvt. Ltd. (Especially for circuitry and analysis of signal generators and filters)

Course Title	Electronic Instrumentation & Sensors Lab (Practical)		No. of Credits	02
Course Code:	PHY C17-P	Contact hours	4 Hours per week	
Formative Assessment of Marks	25 Marks	Summative Assessment Marks	25	

Practical Content(NOTE: Do not repeat the experiment already performed in the previous semesters)

List of experiments:(Students have to perform a minimumof EIGHT Experiments from the list below)

1. Construct a DC power supply using a bridge rectifier and a capacitor filter. Use a Zener diode or a 3- pin voltage regulator and study the load and line regulation characteristics. Measure ripple factor with and without filter and compare with theoretical values.
2. Calibration of a low range voltmeter using a potentiometer.
3. Calibration of an ammeter using a potentiometer.
4. Design and construct a Wien bridge oscillator (sine wave oscillator) using µA 741 op-amp. Choose the values of R and C for a sine wave frequency of 1 KHz. Vary the value of R and C to change the oscillation frequency.
5. Design and construct a square wave generator using µA 741 op-amp. Determine its frequency and compare with the theoretical value. Also measure the slew rate of the op-amp. If the 741 is replace by LM318, study how does the waveform compare with the previous one.
6. Study the frequency response of a first order op-amp low pass filter.
7. Study the characteristics of pn-junction of a solar cell and determine its efficiency.
8. Study the illumination intensity of a solar cell using a standard photo detector (e.g., lux meter).
9. Study the characteristics of a LED (variation of intensity of emitted light).
10. Study the characteristics of a thermistor (temperature coefficient of resistance)
11. Study the characteristics of a photo-diode.
12. Determine the coupling coefficient of a piezo-electric crystal.
13. Study the amplitude modulation using a transistor.
14. Performance analysis of A/D and D/A converter using resistor ladder network and op-amp.

NOTE:- Any relevant experiment of suitable standard may be performed as per availability of instruments.

References

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. B.Sc. Practical Physics, C.L. Arora (Revised Edition), S. Chand and Co. Ltd. 2007
3. Practical Physics, D.C. Tayal, First Millennium Edition, Himalaya Publishing House, 2000

KUVEMPU UNIVERSITY
NEP-2020

Pattern of continuous Evaluation and Semester End Examination

Assessment should be a combination of continuous formative evaluation and an end-point summative evaluation as per the Guidelines provided by Karnataka state Higher education Council.

Total marks for each course shall be based on continuous assessments and semester-end examinations as per the uniform pattern of 40: 60 for IA and Semester End theory examinations respectively and 50: 50 for IA and Semester End practical examinations respectively, in all the Universities, their Affiliated and Autonomous Colleges.

Total Marks for each course = 100

Continuous assessment (C1) = 20 marks
Continuous assessment (C2) = 20 marks
Semester End Examination (C3) = 60 marks

i. Formative evaluation process (Internal Assessment).

a. The first component (C1) of assessment is for 20 marks. This shall be based on tests, assignments, seminars, case studies, fieldwork, project work etc. This assessment and score process should be completed after completing 50% of the syllabus of the course/s and within 45 working days of the semester program.

b. The second component (C2) of assessment is for 20 marks. This shall be based on the test, assignment, seminar, case study, fieldwork, internship / industrial practicum/project work etc. This assessment and score process should be based on the completion of the remaining 50 per cent of the syllabus of the courses of the semester.

Activities	C1	C2	Total Marks
Session Test	10 marks	10 marks	20 marks
Seminars/Presentations/Activity	10 marks	-	10 marks
Case study/Assignment/Fieldwork/Project work etc.		10 marks	10 marks
	20 marks	20 marks	40 Marks

ii. Summative evaluation process (Semester End theory Examination).

During the 17th – 19th week of the semester, a semester-end examination shall be conducted by the University for each course. This forms the third and final component of assessment (C3) and the maximum marks for the final component will be 60 marks.

iii. Practical Examination: For the practical course of full credits, marks shall be for **50 marks** awarded as follows

Internal Assessment for 25 Marks: 15 Marks for maintaining Practical record and 10 marks for practical test. Test shall be conducted after the completion of Practical Classes.

End Semester Practical Examination: End Semester Practical examination shall be conducted for **25 marks.**

QUESTION PAPER PATTERN FOR DEGREE COURSES
(DSC, OE and Languages)

First Semester ………. Degree Examination, April/May 2022

(CBCS NEP Scheme)

Paper: DSC- …………………….

Time: 02 Hours **Max. Marks: 60**

I. Select the most appropriate answer from the options provided: 10 x 1= 10

1)……………………………….

a) b) c) d)

2)……………………………….

a) b) c) d)

.
.
.

10)…………………………….

a) b) c) d)

II. Answer/Write short notes on any **FIVE** of the following: 05 x 03 = 15

1)
2)
3)
4)
5)
6)
7)
8)

III. Answer any **THREE** questions from the following: 03 x 05 = 15

1)
2)
3)
4)
5)

IV. Answer the following* 02 x 10 = 20

1) --

OR

----

2) --

OR

----

*May have sub questions if required