VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Physics

V & VI Semester Syllabus

Bachelor of Science

With effect from 2023-24 and onwards

Third Year: 5th Semester										
Objective: Real time learning and ability to solve complex problems that are ill-structured										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exam (Hrs)
			IA	SEE	Total	L	T	P		
DSC5	21BSC5C5PHL	Classical Mechanics -I and Quantum Mechanics-I	40	60	100	4	-	-	4	2
	21BSC5C5PHP	Classical Mechanics -I and Quantum Mechanics-I Lab	25	25	50	-	-	4	2	3
DSC6	21BSC5C6PHL	Elements of Atomic, Molecular, and Laser Physics	40	60	100	4	-	-	4	2
	21BSC5C6PHP	Elements of Atomic, Molecular, and Laser Physics-Lab	25	25	50	-	-	4	2	3
Other dept. DSC course	21BSC5CXXXXX	Course title - Theory	40	60	100	4	-	-	4	2
	21BSC5CXXXXX	Course title - Lab	20	30	50	-	-	4	2	3
Other dept. DSC course	21BSC5CXXXXX	Course title - Theory	40	60	100	4	-	-	4	2
	21BSC5CXXXXX	Course title - Lab	20	30	50	-	-	4	2	3
SEC3	21BSC5S3PH1	Employability skills or Cyber Security	25	25	50	2		2	3	1
Total Credit									27	

Third Year: 6th Semester										
Objective: Real time learning and ability to solve complex problems that are ill-structured										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exam (Hrs)
			IA	SEE	Total	L	T	P		
DSC5	21BSC6C7PHL	Elements of Condensed Matter & Nuclear Physics	40	60	100	4	-	-	4	2
	21BSC6C7PHP	Elements of Condensed Matter & Nuclear Physics Lab	25	25	50	-	-	4	2	3
DSC6	21BSC6C8PHL	Electronic Instrumentation & Sensors	40	60	100	4	-	-	4	2
	21BSC6C8PHP	Electronic Instrumentation & Sensors Lab	25	25	50	-	-	4	2	3
Other dept. DSC course	21BSC5CXXXXX	Course title - Theory	40	60	100	4	-	-	4	2
	21BSC5CXXXXX	Course title - Lab	25	25	50	-	-	4	2	3
Other dept. DSC course	21BSC5CXXXXX	Course title - Theory	40	60	100	4	-	-	4	2
	21BSC5CXXXXX	Course title - Lab	25	25	50	-	-	4	2	3
IC1	21BSC6IC1PH1	Internship	25	25	50			4	2	2
								Total Credit	26	

Name of the Department: Physics

Semester-V

DSC 5: Classical Mechanics and Quantum Mechanics- I (Theory)

Course Title: Classical Mechanics and Quantum Mechanics- I (Theory)	**Course code: :** 21BSC5C5PHL
Total Contact Hours: 60 hours	**Course Credits: 4**
Internal Assessment Marks: 40 marks	**Duration of SEE: 02 hours**
Semester End Examination Marks: 60 marks	

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

- Identify the failure of classical physics at the microscopic level.
- Find the relationship between the normalization of a wave function and the ability to correctlycalculate expectation values or probability densities.
- Explain the concept of the Newtonian principle of relativity and differentiate between inertial andnon-inertial frames of reference.
- Apply the Lorentz transformations to transform velocities, frequencies, and wave numbers inspecial relativity.
- Calculate the relativistic Doppler effect.
- Explain the minimum uncertainty of measuring both observables on any quantum state.
- Describe the time-dependent and time-independent Schrödinger equation for simple potentialslike for instance one-dimensional potential well and Harmonic oscillator.
- Apply Hermitian operators, their eigenvalues and eigenvectors to find various commutation anduncertainty relations.

DSC 5: Classical Mechanics and Quantum Mechanics- I (Theory)

Unit	Description	Hours
1	**Introduction to Newtonian Mechanics**: Frames of references, Newton's laws of motion, inertial and non-inertial frames. Mechanics of system of particles: Conservation of linear momentum, Angular momentum and torque, conservation of angular momentum, work done by a force, conservative force and conservative energy. **Lagrangian formulation**: Constraints, Holonomic constraints, non-holonomic constraints, Scleronomic and Rheonomic constraints. Generalized coordinates, degrees of freedom, Principle of virtual work, D'Alembert's principle, Lagrangian equations. Newton's equation of motion from Lagrange equations, simple pendulum, Atwood's machine and linear harmonic oscillator.	**15**
2	**Relativity:** Newtonian principle of relativity. Non-Inertial Systems: Non-inertial framesand fictitious forces. Uniformly rotating frame-Expression for Coriolis force. Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformation equations (Quantitative). Relativity of Simultaneity. Lorentz contraction. Time dilation.	**15**

	Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass energy Equivalence. Transformation of Energy and Momentum. Relativistic Doppler effect: Longitudinal Doppler Effect-Expression for apparent frequency. Relativistic Kinematics.	
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, Wave description of particles by wave packets, Group and Phase velocities and relation between them, Experimental evidence for matter waves: Davisson- Germer experiment, G.P Thomson's experiment and its significance. Heisenberg uncertainty principle: Elementary proof 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, Non existence of electron in the nucleus. Two-slit experiment with photons and electrons. Linear superposition principle as a consequence.	**15**
4	**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 - Schrodinger wave equation for a free particle in one and three- dimension, time-dependent and time-independent wave equations, 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, particle in a finite potential well (qualitative), Transmission across a potential barrier, the tunnel effect (qualitative), scanning tunnelling microscope, One-dimensional simple harmonic oscillator (qualitative) - concept of zero - point energy.	**15**

Reference Books:

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer
3. Classical Mechanics, G. Aruldhas, 2008, Prentice-Hall of India Private limited, New Delhi.
4. Classical Mechanics, Takwale and Puranik-1989, Tata Mcgraw Hill, new Delhi
5. Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, 2009.
6. Physics for Scientists & Engineers with Modern Physics, Serway & Jewett, 9th ed., Cengage Learning, 2014.
7. Quantum Physics, Berkeley Physics Course Vol. 4. E.H. Wichman, Tata McGraw-Hill Co., 2008.

8. Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, McGraw Hill, 2003.
9. P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hillpublication, ISBN: 9780070146174.
10. Ajoy Ghatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer Publication, ISBN 978-1-4020-2130-5.
11. Modern Physics; R.Murugeshan & K.Sivaprasath; S. Chand Publishing.
12. G Aruldhas, Quantum Mechanics, Phi Learning Private Ltd., ISBN: 97881203363.
13. Gupta, Kumar & Sharma, Quantum Mechanics, Jai Prakash Nath Publications.
14. Physics for Degree Students B.Sc., Third Year, C.L.Arora and P.S.Hemne, 1st edition, S.Chand & Company Pvt. Ltd., 2014.
15. Introduction to Special Theory of Relativity, Rober Resnick, John Wiley and Sons First Edition
16. Special Relativity, A P French, MIT, w.w. Nortan and Company First Ed (1968)

Name of the Department: Physics

Semester-V

DSC 5: Classical Mechanics and Quantum Mechanics- I (Lab)

Course Title: Classical Mechanics and Quantum Mechanics- I (Lab)	**Course code: :** 21BSC5C5PHP
Total Contact Hours: 56	**Course Credits: 02**
Internal Assessment Marks: 25 marks	**Duration of SEE: 03 hours**
Semester End Examination Marks: 25 marks	

Course Outcomes (CO's):
At the end of the course, students will be able to design, execute and analyse the experiments such as:

1. Acceleration due to gravity by various methods.
2. Basic experiments on Newtonian mechanics.
3. Basic experiments of modern physics.
4. Basic experiments of computational physics.

Lab experiments:

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.
3) Studying the effect of amplitude of oscillation on the time period of the 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 Photo-electric 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 study the characteristics of solar cell.
11) To find the value of e/m for an electron by Thomson's method using bar magnets.
12) To determine the value of e/m for an electron by magnetron method.
13) To study the tunnelling in Tunnel Diode using I-V characteristics.
14) Determination of quantum efficiency of Photodiode.
15) A code in C/C++/Scilab to find the first seven eigen states and eigen functions of Linear HarmonicOscillator by solving the Schrödinger equation.
16) A code in C/C++/Scilab to plot and analyse the wavefunctions for particle in an infinite potentialwell.
17) Measurement of wavelength of sodium D line/wavelength separation of sodium D doublet lines using Michelson Interferometer.

NOTE: Students have to perform at-least EIGHT Experiments from the above list

Reference Books:

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. Computational Quantum Mechanics using Scilab, BIT Mesra.
7. Advanced Practical Physics for Students by Worsnop B L and Flint H T.

Name of the Department: Physics

Semester-V

DSC 6: Elements of Atomic, Molecular & Laser Physics (Theory)

Course Title: Elements of Atomic, Molecular & Laser Physics (Theory)	**Course code:** 21BSC5C6PHL
Total Contact Hours: 60	**Course Credits: 04**
Internal Assessment Marks: 40 marks	**Duration of SEE: 02 hours**
Semester End Examination Marks: 60 marks	

Course Outcomes (CO's): 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.

DSC 6: Elements of Atomic, Molecular & Laser Physics (Theory)

Unit	Description	Hours
1	**Basic Atomic models** Thomson's atomic model; Rutherford atomic model – 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 ionisation potential; Atomic excitation and its types, Franck-Hertz experiment; Sommerfeld's atomic model – model, Derivation of condition for allowed elliptical orbits.	**15**
2	**Vector atomic model and optical spectra** Vector atom model – model fundamentals, spatial quantisation, 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 – Experimental arrangement and Principle; Fine structure of spectral lines with examples; Spin-orbit coupling/Spin-Orbit Interaction – qualitative; Optical spectra – spectral terms, spectral notations, selection rules, intensity rules; Fine structure of the sodium D-line; Zeeman effect: Types, Experimental study and classical theory of normal Zeeman effect, Zeeman shift expression (no derivation), examples; Stark effect: Experimental study, Types and examples.	**15**

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 molecularspectra; 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 and quantum approaches, Experimental study of Raman effect; Applications of Raman effect.	
4	**Laser Physics** Ordinary light versus laser light; 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 NDYAG Laser and CO2 Laser; Application of lasers (qualitative) in science & research, isotope separation, communication, fusion, medicine, industry, war and space.	**15**

Reference Books:
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.

Name of the Department: Physics

Semester-V

DSC 6: Elements of Atomic, Molecular & Laser Physics (Lab)

Course Title: Elements of Atomic, Molecular & Laser Physics (Lab)	**Course code: :** 21BSC5C6PHP
Total Contact Hours: 56	**Course Credits: 02**
Internal Assessment Marks:25 marks	**Duration of SEE: 03 hours**
Semester End Examination Marks: 25 marks	

Course Outcomes (CO's): At the end of the course:

- Students would be able to understand Basic experiments of modern physics such as: Determination of Plank's constants, Determination of ionization potential, Rydberg's constant of H-spectrum, Single and double slit diffraction, Photo electric effect and determination of charge of the electron and e/m of the electron.
- Students would able to understand the applications of LASER and measurement of various physical quantities using LASER source.

LIST OF EXPERIMENTS

1. To determine wavelength of spectral lines of mercury source using spectrometer.
2. To determine dispersive power of a plane diffraction grating.
3. To determine the value of Rydberg's constant using diffraction grating & hydrogen discharge tube.
4. To determine the wavelength of H-alpha 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 absorptionspectrum.
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. Refractive index of liquid using Laser Source.
13. Study of Raman scattering by CCl_4 using laser and spectrometer/CDS.
14. Charge of an electron by dispersion measurement.
15. Spectral response of LDR.

NOTE: Students have to perform at-least EIGHT Experiments from the above list.

Reference Books:

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. Chatopadhyaya, P.C. Rakshith, B. Saha, Revised Edition,2002, New Central Book Agency Pvt. Ltd.
4. Physics through experiments, B. Saraf, 2013, Vikas Publications.

Name of the Department: Physics

Semester-VI

DSC 7: Elements of Condensed Matter & Nuclear Physics (Theory)

Course Title: Elements of Condensed Matter & Nuclear Physics (Theory)	**Course code: :** 21BSC6C7PHL
Total Contact Hours: 60 hours	**Course Credits: 4**
Internal Assessment Marks: 40 marks	**Duration of SEE: 02 hours**
Semester End Examination Marks: 60 marks	

Course Outcomes (CO's): 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 detectors.

DSC 6: Elements of Atomic, Molecular & Laser Physics (Theory)

Unit	Description	Hours
1	**Crystal systems and X-rays:** Crystal structure**:** Space Lattice, Lattice translational vectors, Basis of crystal structure, Types of unit cells, primitive, non-primitive cells.. Seven crystal system, 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 level and Fermi energy, Fermi-Dirac distribution function (expression for probability distribution F(E), statement only); Fermi Dirac distribution at T=0 and $E<E_f$, at $T\neq 0$ and $E>E_f$, F(E) vs E plot at T = 0 and $T\neq 0$. Density of states for free electrons (statement only, no derivation). Qualitative discussion of lattice vibration and concept of Phonons.; Specific heats of solids: Classical theory, Einstein's and Debye's theory ofspecific heats. Hall Effect in metals.	**15**
2	**Magnetic Properties of Matter, Dielectrics and Superconductivity Magnetic Properties of Matter** Review of basic formulae: Magnetic intensity, magnetic induction, permeability,	**15**

	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, Hardand Soft 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.	
3	**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 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**
4	**Interaction of Nuclear Radiation with matter**: Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, Energy loss due to ionization (quantitative description of Bethe Block 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 and Synchrotrons.	**15**

Reference 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,Pragati prakashan Meerut(2017).
3. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
4. Nuclear Physics, Irving Kaplan, Narosa Publishing House
5. Introduction to solid State Physics, ***Charles Kittel***, VII edition, (**1996**)
6. Solid State Physics- **A J Dekker**, MacMillan India Ltd, (**2000**)
7. Essential of crystallography**, M A Wahab**, Narosa Publications (**2009)**
8. Solid State Physics-**S O Pillai**-New Age Int. Publishers (**2001**).
9. Concepts of nuclear physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
10. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
11. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
12. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (Institute of Physics (IOP)Publishing, 2004).
13. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
14. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).

Name of the Department: Physics

Semester-VI

DSC 7: Elements of Condensed Matter & Nuclear Physics (Lab)

Course Title: Elements of Condensed Matter & Nuclear Physics (Lab)	**Course code: :** 21BSC6C7PHP
Total Contact Hours: 56	**Course Credits: 02**
Internal Assessment Marks: 25 marks	**Duration of SEE: 03 hours**
Semester End Examination Marks: 25 marks	

Course Outcomes (CO's):
At the end of the course students would able to:

- Design and execute the experiments on condensed matter.
- Understand the determination of various values of nuclear radiation using nuclear detector.

LIST OF PRACTICALS: CONDENSED MATTER PHYSICS and NUCLEAR 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. Plank's constant by LED.
7. Specific Heat of Solid by Electrical Method
8. Determination of Dielectric Constant of polar liquid.
9. Determination of dipole moment of organic liquid
10. B-H Curve Using CRO.
11. Spectral Response of Photo Diode and its I-V Characteristics.
12. Determination of particle size from XRD pattern using Debye-Scherrer formula.
13. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method).
14. Measurement of susceptibility of paramagnetic solid (Gouy's Method)
15. Study the characteristics of Geiger-Mùller Tube. Determine the threshold voltage, plateau regionand operating voltage.
16. Study the absorption of beta particles in aluminium foils using GM counter. Determine mass attenuation coefficient of Aluminium foils.
17. Verification of Inverse Square law of radiation.
18. Study the absorption of beta particles in thin copper foils using G M counter and determine massattenuation coefficient.
19. 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.
20. Determine the end point energy of Tl-204 source by studying the absorption of beta particles in aluminum foils.
21. Study the attenuation of absorption of gamma rays in polymeric materials using Cs-137 source andG M counter.

NOTE: Students have to perform at-least EIGHT Experiments from the above list

Reference Books:
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)

Name of the Department: Physics

Semester-VI

DSC 8: Electronic Instrumentation & Sensors (Theory)

Course Title: Electronic Instrumentation & Sensors (Theory)	**Course code: :** 21BSC6C8PHL
Total Contact Hours: 60	**Course Credits: 04**
Internal Assessment Marks: 40 marks	**Duration of SEE: 02 hours**
Semester End Examination Marks: 60 marks	

Course Outcomes (CO's): 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 theirbasic working principles.
- Get hands on training in wiring a circuit, soldering, making a measurement using an electronic circuitused 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 theterminals of a transistor and ICs.
- Identify and understand the different types of transducers and sensors used in robust and hand-heldinstruments.
- Understand and give a mathematical treatment of the working of rectifiers, filter, data convertersand 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, batterycharger, emergency lamp and the like.

DSC 7: Electronic Instrumentation & Sensors (Theory)

Unit	Description	Hours
1	**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 (construction and working), Filters: Capacitor and inductor filers, L-section and π-section filters, ripple factor, electronic voltage regulators, stabilization factor, voltage regulation using monolithic ICs (78XX, 79XX). **Basic electrical measuring instruments** Cathode ray oscilloscope- Block diagram, basic principle, electron beam, CRT features, signal display. Basic elements of digital storage oscilloscopes.	**15**

	Basic DC voltmeter for measuring potential difference, Extending Voltmeter range, AC voltmeterusing rectifiers Basic DC ammeter, requirement of a shunt, Extending of ammeter ranges.	
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. 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	**15**
3	**Data Conversion and display** Digital to Analog (D/A) and Analog to Digital (A/D) converters – A/D converter with pre- amplification and filtering. D/A converter - Variable resistor network, Ladder type (R-2R) D/A converter, Op-amp based D/A converter. Digital display systems and Indicators- Classification of displays, Light Emitting Diodes (LED) and Liquid Crystal Display (LCD) – Structure and working. Data Transmission systems – Advantages and disadvantages of digital transmission over analog transmission, Pulse amplitude modulation (PAM), Pulse time modulation (PTM) and Pulse width modulation (PWM)- General principles. Principle of Phase Sensitive Detection (PSD).	
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.	**15**

Reference Books:

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 restof the syllabus)
3. Instrumentation – Devices and Systems (2nd Edition)– C.S. Rangan, G.R. Sarma, V.S.V. Mani, TataMcGraw Hill Education Pvt. Ltd. (Especially for circuitry and analysis of signal generators and filters)

Name of the Department: Physics

Semester-VI

DSC 8: Electronic Instrumentation & Sensors (Lab)

Course Title: Electronic Instrumentation & Sensors (Lab)	**Course code: :** 21BSC6C8PHP
Total Contact Hours: 56	**Course Credits: 02**
Internal Assessment Marks: 25 marks	**Duration of SEE: 03 hours**
Semester End Examination Marks 25 marks	

Course Outcomes (CO's):

At the end of the course:

- The students would gain the knowledge of Basic Electronics circuits.
- They would know about common solid-state devices: Semiconductor diodes and transistors. The topics also include the Rectifiers, Filters and their applications.
- They would know about the applications of Op-Amp.
- They would know about the applications of Transducers.

LIST OF EXPERIMENTS

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. Construction of simple multimeter.
3. Calibration of a low range voltmeter using a potentiometer
4. Calibration of an ammeter using a potentiometer
5. Design and construct a Wien bridge oscillator (sine wave oscillator) using μA 741 op-amp. Choose thevalues of R and C for a sine wave frequency of 1 KHz. Vary the value of R and C to change the oscillation frequency.
6. 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.
7. Study the frequency response of a first order op-amp low pass filter
8. Study the frequency response of a second order op-amp low pass filter.
9. Study the illumination intensity of a solar cell using a standard photo detector (e.g., lux meter).
10. Study the characteristics of a LED (variation of intensity of emitted light).
11. Study the characteristics of a thermistor (temperature coefficient of resistance).
12. Study the characteristics of a photo-diode.
13. Low-pass and High-pass RC filters, Determination of cutoff frequency.
14. Determine the coupling coefficient of a piezo-electric crystal.

NOTE: Students have to perform at-least EIGHT Experiments from the above list

Reference Books:
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.