AP STATE COUNCIL OF HIGHER EDUCATION
B.Sc. PHYSICSSYLLABUS UNDER CBCS
w.e.f. 2023-24 (Revised in May 2023)

B.Sc. (HONOURS) PHYSICS Single Major

COURSE STRUCTURE UNDER CBCS

Year	Semester	Course	Title of the Course	Minor	Marks	No.ofHrs /Week	No.of Credits
I	I	1	Common paper for all Science Students		100	5	4
	I	2	Common paper for all Science Students		100	5	4
	II	3	Mechanics and Properties of Matter	Yes	100	3	4
			Mechanics and Properties of Matter Practical Course		50	2	
	II	4	Waves and Oscillations		100	3	4
			Waves and Oscillations Practical Course		50	2	
II	III	5	Optics	Yes	100	3	4
			Optics Practical Course		50	2	4
		6	Heat and Thermodynamics		100	3	4
			Heat and Thermodynamics Practical Course		50	2	
		7	Electronic Devices and Circuits		100	3	4
			Electronic Devices and Circuits Practical Course		50	2	
		8	Analog and Digital Electronics		100	3	4
			Analog and Digital Electronics Practical course		50	2	
	IV	9	Electricity and Magnetism	Yes	100	3	4
			Electricity and Magnetism Practical Course		50	2	
		10	Modern Physics	Yes	100	3	4
			Modern Physics Practical Course		50	2	
		11	Introduction to Nuclear and Particle Physics		100	3	4
			Introduction to Nuclear and Particle Physics Practical Course		50	2	

Year	Semester	Course	Title of the Course	Marks	No.ofHrs /Week	No.of Credits
III	V	12A	Optical Instruments and Optometry	100	3	4
			Optical Instruments and Optometry Practical Course	50	2	
		13A	Optical Imaging and Photography	100	3	4
			Optical Imaging and Photography Practical Course	50	2	
		12B	Low Temperature Physics & Refrigeration	100	3	4
			Low Temperature Physics & Refrigeration Practical Course	50	2	
		13B	Solar Energy and Applications	100	3	4
			Solar Energy and Applications Practical Course	50	2	
		12C	Applications of Electricity & Electronics	100	3	4
			Applications of Electricity & Electronics Practical Course	50	2	
		13C	Electronic Instrumentation	100	3	4
			Electronic Instrumentation Practical Course	50	2	
		Note-1: For Semester–V, Physics, any two of the above three pairs to be chosen as course, i.e. A,B Set or B,C Set or A,C Set. The pair shall not be broken (ABC allotment is random, not on any priority basis). **Note -2: For Minor any one of above three pairs to be chosen.**				
	VI	**Semester Internship/Apprenticeship/OJT with 12 credits**				

Committee Members

1. Dr.M.C.Rao, Prof. of Physics, Andhra Loyola College, Vijayawada-08, AP
2. Dr.Ch.Srinivasa Rao, Prof. of Physics, Andhra Loyola College, Vijayawada-08, AP
3. Dr.N.Krishna Mohan, Lecturer in Physics, V. S. R. Govt. Degree & P.G. College, Movva- 521135, AP
4. Smt. K.Seshulatha, Lecturer in Physics, Andhra Loyola College, Vijayawada-08, AP
5. Dr. H. Sudhakara Rao, Lecturer in Physics, Govt. Degree College for Men. Kadapa, AP

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B.Sc. (HONOURS) PHYSICS SINGLE MAJOR

MAJOR/MINOR

B.Sc. (HONOURS) PHYSICS SINGLE MAJOR

SYLLABUSUNDER CBCS

w.e.f. 2023-24 (Revised in May 2023)

SEMESTER-II

COURSE 3: MECHANICS AND PROPERTIES OF MATTER

Hours: 45 Credits: 3 3hrs/week

COURSE OBJECTIVE:

The course on Mechanics and Properties of Matter aims to provide students with a fundamental understanding of the behaviour of physical systems, both in terms of mechanical motion and in terms of the properties of matter

LEARNING OUTCOMES:

1. Students will be able to understand and apply the concepts of scalar and vector fields, calculate the gradient of a scalar field, determine the divergence and curl of a vector field.
2. Students will be able to apply the laws of motion, solve equations of motion for variable mass systems
3. Students will be able to define a rigid body and comprehend rotational kinematic relations, derive equations of motion for rotating bodies, analyze the precession of a top and gyroscope, understand the precession of the equinoxes
4. Students will be able to define central forces and provide examples, understand the characteristics and conservative nature of central forces, derive equations of motion under central forces.
5. Students will be able to differentiate between Galilean relativity and the concept of absolute frames, comprehend the postulates of the special theory of relativity, apply Lorentz transformations, understand and solve problems

UNIT-I VECTOR ANALYSIS 9hrs

Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

UNIT-II MECHANICS OF PARTICLES 9hrs

Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, Collisions in two and three dimensions, Concept of impact parameter, scattering cross-section, Rutherford scattering-derivation.

UNIT-III MECHANICS OF RIGID BODIES AND CONTINUOUS MEDIA 9hrs

Definition of rigid body, rotational kinematic relations, equation of motion for a rotating body, Precession of a top, Gyroscope, Precession of the equinoxes.Elastic constants of isotropic solids and their relations, Poisson's ratio and expression for Poisson's ratio.Classification of beams, types of bending, point load, distributed load.

UNIT-IV CENTRAL FORCES **9hrs**

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, conservative force as a negative gradient of potential energy, equations of motion under a . Derivation of Kepler's laws. Motion of satellites

UNIT-V SPECIAL THEORY OF RELATIVITY **9hrs**

Galilean relativity, Absolute frames. Michelson-Morley experiment, The negative result. Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation.

REFERENCE BOOKS:

1. BSc Physics -Telugu Akademy, Hyderabad
2. Mechanics - D.S. Mathur, Sulthan Chand & Co, New Delhi
3. Mechanics - J.C. Upadhyaya, Ramprasad & Co., Agra
4. Properties of Matter - D.S. Mathur, S.Chand & Co, New Delhi ,11th Edn., 2000
5. Physics Vol. I - Resnick-Halliday-Krane ,Wiley, 2001
6. Properties of Matter – Brijlal &Subrmanyam, S.Chand &Co. 1982
7. Dynamics of Particles and Rigid bodies– Anil Rao, Cambridge Univ Press, 2006
8. Mechanics-EM Purcell, Mc Graw Hill
9. University Physics-FW Sears, MW Zemansky & HD Young, Narosa Publications, Delhi
10. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
11. Mechanics, S.G.Venkatachalapathy, Margham Publication, 2003.

B.Sc. (HONOURS) PHYSICS SINGLE MAJOR

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SEMESTER-II

PRACTICAL COURSE 3: MECHANICS AND PROPERTIES OF MATTER

Hours: 30Credits: 1 2hrs/week

COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for measuring properties of matter and analyzing mechanical systems.

LEARNING OUTCOMES:

1. Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques to measure properties of matter and analyze mechanical systems.
2. Application of theory to practice: Students should be able to apply theoretical concepts learned in lectures to real-world situations, and understand the limitations of theoretical models.
3. Accurate recording and analysis of data: Students should be able to accurately record and analyze experimental data, including understanding the significance of error analysis and statistical methods.
4. Critical thinking and problem solving: Students should be able to identify sources of error, troubleshoot experimental problems, and develop critical thinking skills in experimental design and analysis.
5. Understanding of physical principles: Students should develop an understanding of the physical principles governing mechanical systems and the properties of matter, including elasticity, viscosity, and thermal expansion.

Minimum of 6 experiments to be done and recorded

1. Viscosity of liquid by the flow method (Poiseuille's method)
2. Young's modulus of the material of a bar (scale) by uniform bending
3. Young's modulus of the material a bar (scale) by non- uniform bending
4. Surface tension of a liquid by capillary rise method
5. Determination of radius of capillary tube by Hg thread method
6. Viscosity of liquid by Searle'sviscometer method
7. Bifilar suspension –moment of inertia of a regular rectangular body.
8. Determination of moment of inertia using Fly-wheel
9. Determination of the height of a building using a sextant.
10. Rigidity modulus of material of a wire-dynamic method (torsional pendulum)

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SEMESTER-II

COURSE 3: MECHANICS AND PROPERTIES OF MATTER

STUDENT ACTIVITIES

Unit I: Vector Analysis
Activity: Field Mapping

Students can choose a physical field (e.g., temperature, magnetic field) and create a field map by taking measurements at different points. They can then calculate the gradient of the field and analyse the variations. This activity helps them understand the concept of gradient in a scalar field.

Unit II: Mechanics of Particles
Activity: Collision Experiments

Students can set up simple collision experiments using marbles, carts, or other objects. They can measure the initial and final velocities, masses, and analyze the momentum conservation. By varying the conditions (e.g., masses, initial velocities), they can observe the effects on the collision outcomes.

Unit III: Mechanics of Rigid Bodies and Continuous Media
Activity: Balancing Act

Students can experiment with balancing various objects (e.g., rulers, books) on different points to understand the concept of center of mass and stability. They can analyse the equilibrium conditions and explore how the position of the center of mass affects the stability.

Unit IV: Central Forces
Activity: Pendulum Motion

Students can investigate the motion of a simple pendulum by varying its length and measuring the time period. They can analyze the relationship between the period and the length, and discuss the concept of centripetal force and its role in circular motion.

Unit V: Special Theory of Relativity
Activity: Time Measurement

Students can perform a time measurement experiment using simple devices like water clocks or sand timers. They can compare the measured time between two events at different relative speeds and discuss the concept of time dilation

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SEMESTER-II

COURSE 4: WAVES AND OSCILLATIONS

Hours: 45 Credits: 3 3hrs/week

COURSE OBJECTIVE:

This course provides students with a broad understanding of the physical principles of the oscillations, to help them develop critical thinking and quantitative reasoning skills, to empower them to think creatively and critically about scientific problems and experiments.

LEARNING OUTCOMES:

The student should be able

1. To describe the basic characteristics of waves such as frequency, wavelength, amplitude, period, and speed.
2. To utilize mathematical relationships related to wave characteristics.
3. To compare particle motion and wave motion in different types of waves.
4. To distinguish between Longitudinal and Transverse waves.
5. To get the knowledge about how to construct and analysis the square waves, saw tooth waves, etc. from Fourier analysis

UNIT-I Simple Harmonic oscillations **9hrs**

Simple harmonic oscillator and solution of the differential equation-Physical characteristics of SHM, torsion pendulum-measurements of rigidity modulus, compound pendulum- measurement of ‘g’, Principle of superposition, beats, combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies. Lissajous figures.

UNIT-II Damped and forced oscillations **9hrs**

Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, comparison with un-damped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance and velocity resonance.

UNIT-III Complex vibrations **9hr**

Fourier theorem and evaluation of the Fourier coefficients, analysis of periodic wave functions-square wave, triangular wave, saw tooth wave, simple problems on evolution of Fourier coefficients.

UNIT-IV Vibrating Strings and Bars **9hrs**

Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones and harmonics. Energy transport and transverse impedance.Longitudinal vibrations in bars-wave equation and its general solution. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. Tuning fork.

UNIT-V Ultrasonics: **9hrs**

Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magneto strictive methods, detection of ultrasonics, determination of wavelength of ultrasonic waves. Applications and uses of ultrasonic waves.

REFERENCE BOOKS:

1. BSc Physics Vol.1, Telugu Academy, Hyderabad.
2. Fundamentals of Physics. Halliday/Resnick/Walker ,Wiley India Edition 2007.
3. Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy,Orient Longman.
4. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
5. Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004
6. Introduction to Physics for Scientists and Engineers. F.J. Buche. McGraw Hill.

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SEMESTER-II

PRACTICAL COURSE 4: WAVES AND OSCILLATIONS

Hours: 30Credits: 1 2hrs/week

COURSE OBJECTIVE:

This course provides students with a broad understanding of the physical principles of the oscillations, to help them develop critical thinking and quantitative reasoning skills, to empower them to think creatively and critically about scientific problems and experiments.

LEARNING OUTCOMES:

1. Students are made to determine the unknown frequency of tuning fork by volume resonator experiment
2. Students are made to determine 'g' by compound/bar pendulum
3. Students are made to determine the force constant of a spring by static and dynamic method.
4. Students are made to determine the elastic constants of the material of a flat spiral spring.
5. Students are made to verify the laws of vibrations of stretched string –sonometer
6. Students are made to determine the frequency of a bar –Melde's experiment.
7. Students are made to study the damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.
8. Students are made to form Lissajous figures using CRO.

Minimum of 6 experiments to be done and recorded

Experiments

1. Volume resonator experiment
2. Determination of 'g' by compound/bar pendulum
3. Simple pendulum normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
4. Determination of the force constant of a spring by static and dynamic method.
5. Determination of the elastic constants of the material of a flat spiral spring.
6. Coupled oscillators
7. Verification of laws of vibrations of stretched string –sonometer
8. Determination of frequency of a bar –Melde's experiment.
9. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.
10. Formation of Lissajous figures using CRO.

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SEMESTER-II
COURSE 4: WAVES AND OSCILLATIONS

STUDENT ACTIVITIES

Unit-I Simple Harmonic oscillations:

Activity: Measuring the period of a simple pendulum and verifying the relationship between the period and the length of the pendulum. Students can use a stopwatch and a ruler to measure the time for a fixed number of oscillations and calculate the period.

Unit-II Damped and forced oscillations:

Activity: Measuring the damping coefficient of a mass-spring system and calculating the quality factor. Students can measure the amplitude of the system as it undergoes damped oscillations and use the logarithmic decrement formula to calculate the damping coefficient. They can then use the formula for the quality factor to evaluate the quality of the system.

Unit-III Complex vibrations:

Activity: Constructing a square wave using Fourier series and analyzing its Fourier coefficients. Students can use a software tool or a programming language to generate a square wave and then compute the Fourier coefficients. They can then plot the magnitude spectrum of the waveform and observe the harmonic components.

Unit-IV Vibrating Strings and Bars:

Activity: Measuring the speed of sound in a metal rod and comparing it with the theoretical value. Students can use a microphone and an oscilloscope to measure the time delay between two reflections of a sound pulse in the rod. They can then use the formula for the speed of sound in a solid to calculate the speed and compare it with the theoretical value.

Unit-V Ultrasonics:

Activity: Measuring the wavelength of ultrasonic waves using the diffraction of light. Students can use a laser and a diffraction grating to create a diffraction pattern of an ultrasonic wave. They can then measure the distance between the diffraction fringes and use the formula for the diffraction of light to calculate the wavelength of the ultrasonic wave.

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SEMESTER-III

COURSE 5: OPTICS

Hours: 45 Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The course on Optics aims to provide students with a fundamental understanding of the behaviour and properties of light and its interaction with matter.

LEARNING OUTCOMES:

Onsuccessfulcompletionof thiscourse,thestudentwillbeableto:

1. Explain about the different aberrations in lenses and discuss the methods of minimizing them
2. Understand the phenomenon of interference of light and its formation in (i) Lloyd's single mirror due to division of wave front and (ii) Thin films, Newton's rings and Michelson interferometer due to division of amplitude.
3. Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating and to describe the construction and working of zone plate and make the comparison of zone plate with convex lens
4. Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity.
5. Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields. To understand the basic principles of fibreoptic communication and explore the field of Holography and Nonlinear optics and their applications.

UNIT-I Aberrations **9Hrs**

Introduction – monochromatic aberrations, spherical aberration, methods of minimizing spherical aberration, coma, astigmatism and curvature of field, distortion. Chromatic aberration-the achromatic doublet. Achromatism for two lenses (i)in contact and (ii) separated by a distance.

UNIT-II Interference 9Hrs

Principle of superposition – coherence Conditions for interference of light. Fresnel's biprism determination of wavelength of light –change of phase on reflection.Oblique incidence of a plane wave on a thin film due to reflected light (cosine law) –colors of thin films- Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film). Determination of diameter of wire, Newton's

rings in reflected light.Determination of wavelength of monochromatic light using Newton's rings and Michelson Interferometer.

UNIT-III Diffraction **9Hrs**

Introduction,distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction – Diffraction due to single slit-Fraunhoffer, Fraunhofer diffraction pattern with N slits (diffraction grating).Resolving power of grating, Determination of wavelength of light in normal incidence using diffraction grating.Fresnel's half period zones-area of the half period zones-zone plate-comparison of zone plate with convex lens-difference between interference and diffraction.

UNIT-IV **Polarisation**
9Hrs

Polarized light: methods of polarization by reflection, refraction, double refraction, Brewster's law-Mauls law-Nicol prism polarizer and analyser, Quarter wave plate, Half wave plate-optical activity, determination of specific rotation by Laurent's half shade Polarimeter. Idea of elliptical and circular polarization

UNIT-V **Lasers and Holography**
9Hrs

Lasers: introduction, spontaneous emission, stimulated emission. Population Inversion, Laser principle-Einstein Coefficients-Types of lasers-He-Ne laser, Ruby laser- Applications of lasers. Holography: Basic principle of holography-Gabor hologram and its limitations, Applications of holography.

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REFERENCE BOOKS:

1. BSc Physics, Vol.2, Telugu Academy, Hyderabad
2. A Text Book of Optics-N Subramanyam, L Brijlal, S.Chand& Co.
3. Unified Physics Vol.II Optics & Thermodynamics – Jai Prakash Nath&Co.Ltd., Meerut
4. Optics,F.A. Jenkins and H.G. White, Mc Graw-Hill
5. Optics, AjayGhatak,Tata Mc Graw-Hill.
6. Introduction of Lasers – Avadhanulu, S.Chand& Co.
7. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

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SEMESTER-III

PRACTICAL COURSE 5: OPTICS

Hours: 30Credits: 1 2hrs/week

COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for studying light and its interactions with matter.

LEARNING OUTCOMES:

1. Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques for studying light and its interactions with matter.
2. Application of theory to practice: Students should be able to apply theoretical concepts learned in lectures to real-world situations, and understand the limitations of theoretical models.
3. Accurate recording and analysis of data: Students should be able to accurately record and analyze experimental data, including understanding the significance of error analysis and statistical methods.
4. Critical thinking and problem solving: Students should be able to identify sources of error, troubleshoot experimental problems, and develop critical thinking skills in experimental design and analysis.
5. Understanding of physical principles: Students should develop an understanding of the physical principles governing optics, including reflection, refraction, diffraction, interference, and polarization.

Minimum of 6 experiments to be done and recorded

1. Determination of radius of curvature of a given convex lens-Newton's rings.
2. Resolving power of grating.
3. Study of optical rotation –polarimeter.
4. Dispersive power of a prism.
5. Determination of wavelength of light using diffraction grating-minimum deviation method.
6. Determination of wavelength of light using diffraction grating-normal incidence method.
7. Determination of wavelength of laser light using diffraction grating.
8. Resolving power of a telescope.

9. Refractive index of a liquid-hallow prism
10. Determination of thickness of a thin wire by wedge method
11. Determination of refractive index of liquid-Boy's method.

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SEMESTER-II

COURSE 5: OPTICS

STUDENT ACTIVITIES

Suggested student activities

UNIT-I Aberrations:
Ask students to observe and sketch the different images produced by the lens at different distances. Build a simple optical system with two lenses in contact and ask students to calculate the focal length and magnification of the system. Then, introduce a thin glass plate between the lenses to simulate the effects of chromatic aberration and ask students to observe and discuss the changes in the image produced.
UNIT-II Interference:
Ask students to measure the diameter of the central bright spot and the diameter of the nth ring for different values of n, and then calculate the wavelength of light.

UNIT-III Diffraction:
Build a simple diffraction grating using a piece of cardboard and some sewing needles. Ask students to measure the distance between the needles, count the number of lines per unit length, and then calculate the grating spacing and the wavelength of light.

UNIT-IV Polarisation:
Ask students to measure the angle of rotation of the polarized light before and after passing through the sample, and then calculate the specific rotation of the sample.

UNIT-V Lasers and Holography:
Demonstrate the principle of holography using a laser beam, a beam splitter, and a photographic plate. Ask students to record a hologram of a simple object and then reconstruct the image using a laser beam.

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SEMESTER-III

COURSE 6: HEAT AND THERMODYNAMICS

Hours: 45 Credits: 3 3 hrs/week

COURSEOBJECTIVE:

The course on Heat and Thermodynamics aims to provide students with a fundamental understanding of the principles of heat and energy transfer and their applications in various fields

LEARNING OUTCOMES:

Onsuccessfulcompletionof thiscourse,thestudentwillbeableto:

1. Understandthebasicaspectsofkinetictheoryofgases,Maxwell-Boltzmann distribution law, equipartition of energies, mean free path of molecular collisions andthetransportphenomenon in ideal gases
2. Gain knowledge on the basic concepts of thermodynamics, the first and the second lawof thermodynamics, the basic principles of refrigeration, the concept of entropy, thethermodynamicpotentials and their physical interpretations. UnderstandtheworkingofCarnot'sidealheatengine,Carnot cycleanditsefficiency
3. Develop critical understanding of concept of Thermodynamic potentials,the formulation of Maxwell's equations and its applications.
4. Differentiatebetweenprinciplesandmethodstoproducelowtemperature, liquefy air,andunderstand thepracticalapplicationsofsubstances at lowtemperatures.
5. Examinethe natureof blackbodyradiationsand thebasictheories

UNIT-I:KINETICTHEORY OF GASES: 9hrs

Kinetic Theory of gases- Introduction, Maxwell's law of distribution of molecular velocities, Mean free path, Principle of equipartition of energy, Transport phenomenoninideal gases: viscosity and Thermal conductivity.

UNIT-II:THERMODYNAMICS: 9 hrs

Introduction-
Reversibleandirreversibleprocesses,Carnot'sengineanditsefficiency,Carnot'stheorem,Thermodynamicscaleoftemperature, Second law of thermodynamics Entropy: Physical significance, Change in entropy inreversibleandirreversibleprocesses;Temperature-Entropy (T-S) diagram and its uses; change of entropy when ice changes intosteam.

UNIT-III:THERMODYNAMICPOTENTIALSANDMAXWELL'SEQUATIONS: 9 hrs

ThermodynamicPotentials-
InternalEnergy,Enthalpy,HelmholtzFreeEnergy,Gibb'sFreeEnergyandtheirsignificance,DerivationofMaxwell'sthermodynamicrelationsfromthermodynamicpotentials,Applicationsto(i)Clausius-Clayperon'sequation(ii)Joule-Kelvin coefficientforideal andVanderWaals'gases.

UNIT-IV:LOW TEMPERATUREPHYSICS: 9hrs

Methodsforproducingverylowtemperatures,JouleKelvineffect,porousplugexperiment,Jouleexpansion,DistinctionbetweenadiabaticandJouleThomsonexpansion,ExpressionforJouleThomsoncooling,Productionoflow temperaturesbyadiabaticdemagnetization(qualitative).

UNIT-V:QUANTUMTHEORY OF RADIATION: 9 hrs.

Spectral energy distribution of black body radiation, Wein'sdisplacementlaw andRayleigh-Jean'slaw(Noderivations),Planck's law of black body radiation-Derivation, Deduction of Wein's law and Rayleigh-Jean'slawfromPlanck'slaw,Solarconstantanditsdeterminationusing Angstrompyroheliometer,Estimation of surface temperature ofSun.

REFERENCE BOOKS

1. BScPhysics,Vol.2, TeluguAkademy,Hyderabad
2. Thermodynamics,R.C.Srivastava,S.K.Saha & Abhay K.Jain,Eastern EconomyEdition.
3. UnifiedPhysicsVol.2,Optics&Thermodynamics,JaiPrakash Nath & Co. Ltd.,Meerut
4. FundamentalsofPhysics.Halliday/Resnick/Walker. C. WileyIndiaEdition 2007
5. HeatandThermodynamics-N BrijLal,PSubrahmanyam, S.Chand&Co.,2012
6. HeatandThermodynamics-MSYadav,AnmolPublicationsPvt. Ltd,2000
7. UniversityPhysics,HDYoung,MWZemansky,FWSears,NarosaPublishers,NewDelhi

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SEMESTER-III

PRACTICAL COURSE 6: HEAT AND THERMODYNAMICS

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

The objectives for practicals in Heat and Thermodynamics can vary depending on the specific course or program, but here are some general objectives that may apply, to develop practical skills in the use of laboratory equipment and experimental techniques for studying heat and thermodynamics.

LEARNING OUTCOMRES:

1. Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques for studying heat and thermodynamics.
2. Application of theory to practice: Students should be able to apply theoretical concepts learned in lectures to real-world situations, and understand the limitations of theoretical models.
3. Accurate recording and analysis of data: Students should be able to accurately record and analyze experimental data, including understanding the significance of error analysis and statistical methods.
4. Critical thinking and problem solving: Students should be able to identify sources of error, troubleshoot experimental problems, and develop critical thinking skills in experimental design and analysis.
5. Understanding of physical principles: Students should develop an understanding of the physical principles governing heat and thermodynamics, including the laws of thermodynamics, heat transfer, and thermodynamic cycles.

Minimumof 6experimentstobedoneand recorded

1. Specificheat ofaliquid–Joule'scalorimeter–Barton'sradiation correction
2. Thermalconductivityofbadconductor-Lee'smethod
3. Thermalconductivityof rubber.
4. MeasurementofStefan'sconstant.

5. Specificheat ofaliquidbyapplyingNewton’slawofcoolingcorrection.
6. Heatingefficiencyofelectricalkettlewith varyingvoltages.
7. Thermo emf-thermocouple-Potentiometer
8. Thermalbehaviorofan electricbulb(filament/torchlightbulb)
9. MeasurementofStefan’sconstant-emissivemethod
10. Studyofvariation ofresistancewithtemperature-Thermistor.

B.Sc. (HONOURS) PHYSICS SINGLE MAJOR

SYLLABUS UNDER CBCS

w.e.f. 2023-24 (Revised in May 2023)

SEMESTER-III

COURSE 6: HEAT AND THERMODYNAMICS

STUDENT ACTIVITIES

Unit I: Kinetic Theory of Gases
Activity: Speed Distribution Analysis
Students can conduct a simple experiment using gas molecules (e.g., small balls) in a container. They can measure the speeds of the molecules using a motion sensor or stopwatch and analyze the distribution of molecular velocities. They can compare the observed distribution with the expected Maxwell's law of distribution.

Unit II: Thermodynamics
Activity: Heat Engine Efficiency Calculation
Students can work in groups to design a simple heat engine (e.g., using a syringe and a small turbine). They can measure the temperature changes and calculate the efficiency of their engine. They can compare their calculated efficiency with the theoretical Carnot efficiency to understand the limitations of real heat engines.

Unit III: Thermodynamic Potentials and Maxwell's Equations
Activity: Thermodynamic Relations Verification
Students can solve numerical problems involving different thermodynamic potentials (internal energy, enthalpy, Helmholtz free energy, and Gibbs free energy) and verify the Maxwell's thermodynamic relations. They can compare the calculated values using different relations to ensure consistency.

Unit IV: Low Temperature Physics
Activity: Adiabatic Demagnetization Experiment
They can discuss the distinction between adiabatic and Joule-Thomson expansions.

Unit V: Quantum Theory of Radiation
Activity: Black Body Radiation Spectrum Analysis
They can estimate the surface temperature of the Sun using the solar constant and Angstrom pyro heliometer data.

MAJOR

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SEMESTER-III

COURSE 7: ELECTRONIC DEVICES AND CIRCUITS

Hours: 45 Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The course on Electronic Devices and Circuits aims to provide students with a fundamental understanding of electronic devices and their applications in various circuits.

LEARNING OUTCOMES:

1. Understand the behavior of P-N junction diodes in forward and reverse bias conditions and analyze the impact of junction capacitance on diode characteristics.
2. Analyze and compare the characteristics and operation of different BJT configurations (CB, CE, and CC) and demonstrate proficiency in biasing techniques.
3. Comprehend the operation and characteristics of FETs, including JFETs and MOSFETs, and explain the working principles and characteristics of UJTs.
4. Describe the operation and applications of various photoelectric devices such as LEDs, photo diodes, phototransistors, and LDRs.
5. Understand the operation of rectifiers (half-wave, full-wave, and bridge), analyze the ripple factor and efficiency, and demonstrate knowledge of different filter types and three-terminal voltage regulators

UNIT I: PN JUNCTION DIODES 9 hrs

P-N junction Diode, Formation of depletion region, Forward and Reverse bias Ideal Diode, Diode equation– Reverse saturation current – Tunnel Diode- Construction, working, V-I characteristics and Applications, Zener diode – V I characteristics, Applications

UNIT –II:BIPOLAR JUNCTION TRANSISTOR AND ITS BIASING: (D.C) 9 hrs

Transistor construction, working of PNP and NPN Transistors, Active, Cutoff and Saturation conditions, Configurations of Transistor - CB, CE, and CC, Input and Output Characteristics of CB and CE configurations. Hybrid parameters of a Transistor and equivalent circuit,BJT Transistor Biasing – Need for stabilization, Thermal runaway, Stability factor, Biasing methods - Voltage-Divider Bias.

UNIT-III: FIELD EFFECT TRANSISTORS & POWER ELECTRONIC DEVICES – 9 hrs

Difference between JFET and BJT, Construction and working of JFET, Drain and Transfer Characteristics,MOSFET - Depletion-type, and Enhancement-Type MOSFETs. FET Biasing: Voltage Divider Biasing. UJT- Construction, working, V-I characteristics. SCR – Construction, Working and Characteristics

UNIT IV:PHOTO ELECTRIC DEVICES: 9 hrs

Light-Emitting Diodes (LEDs) - Construction, working, characteristics and Applications, IR Emitters, Photo diode - Construction, working characteristics and Applications, Phototransistors - Construction, working and characteristics,Applications, Structure and operation of LDR, Applications

UNIT-V: POWER SUPPLIES: 9 hrs

Rectifiers:Half wave, Full wave and bridge rectifiers-Efficiency (with derivations), ripple factor- Zener diode as Voltage Regulator, Filters- choke input (inductor), L-section, π-section filters. Three terminal fixed voltage IC-regulators(78XX and 79XX)

REFERENCE BOOKS:

1. Electronic Devices and Circuit Theory --- Robert L. Boylestad & Louis Nashelsky.
2. Electronic Devices and Circuits I – T.L.Floyd- PHI Fifth Edition
3. Integrated Electronics – Millmam & Halkias.
4. Electronic Devices & Circuits – Bogart.
5. Sedha R.S., A Text Book Of Applied Electronics, S.Chand & Company Ltd

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SEMESTER-III

PRACTICAL COURSE 7: ELECTRONIC DEVICES AND CIRCUITS

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

The course objectives for a practical course in Electronic Devices and Circuits might provide hands-on experience with the fundamental principles of electronic devices and circuits.

LEARNING OUTCOMES:

1. Understand the principles of electronic devices and circuits and their applications in real-world scenarios.
2. Analyze and design electronic circuits using diodes, transistors, and operational amplifiers.
3. Understand the importance of biasing and stability in electronic circuits and how to achieve them.
4. Develop the skills to design and analyze amplifier circuits and to understand the concept of feedback and its application in electronic circuits.
5. Analyze and design simple oscillators, power supplies, and filters.
6. Gain hands-on experience with electronic test equipment such as multimeters, oscilloscopes, and function generators.
7. Develop skills in circuit construction, measurement, and testing.
8. Learn how to troubleshoot and diagnose electronic circuit problems.
9. Understand the safety procedures for working with electronic circuits and equipment.

Minimum of 6 experiments to be done and recorded

1. V-I Characteristics of junction diode
2. V-I Characteristics of Zener diode
3. Transistor characteristics – CB configuration
4. Transistor characteristics – CE configuration
5. FET input and output characteristics
6. UJT characteristics
7. LDR characteristics
8. Full wave and Bridge rectifier with filters

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SEMESTER-III

COURSE 7: ELECTRONIC DEVICES AND CIRCUITS

STUDENT ACTIVITIES

Unit I: PN Junction Diodes
Activity: V-I Characteristic Analysis
Students can analyze the V-I characteristics of a PN junction diode by using a simple circuit setup. They can measure the voltage across the diode for different values of forward and reverse bias currents and plot the corresponding current-voltage graph. They can discuss the behavior of the diode in different bias conditions.

Unit II: Bipolar Junction Transistor and Its Biasing
Activity: Transistor Configuration Analysis
Students can analyze the characteristics of different transistor configurations (CB, CE, CC) using a transistor tester or a circuit setup. They can measure and compare the input/output characteristics, gain, and voltage levels for each configuration. They can discuss the advantages and disadvantages of each configuration.

Unit III: Field effect transistors &Power electronic devices
Activity: FET Transfer Characteristic Analysis
Students can analyze the transfer characteristics of a FET by measuring the drain current (ID) for different gate-source voltages (VGS). They can plot the transfer characteristic curve and observe the variations in ID with VGS. They can discuss the operation modes of FETs based on the transfer characteristics.

Unit IV: Photoelectric Devices
Activity: LED and Photodiode Circuit Demonstration
Students can set up simple LED and photodiode circuits to demonstrate their operation. They can observe the emission of light from an LED when a suitable voltage is applied and measure the current. They can also detect light using a photodiode and measure the output current for different light intensities.

Unit V: Power Supplies
Activity: Rectifier Efficiency Calculation
Students can analyze the efficiency of different rectifier circuits (half wave, full wave, and bridge rectifiers) by measuring the input and output power. They can calculate the rectifier efficiency and compare the results for different rectifier configurations. They can discuss the factors affecting efficiency and the importance of regulation

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SEMESTER-III

COURSE 8: ANALOG AND DIGITAL ELECTRONICS

Hours: 45 Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The course on Analog and Digital Electronics aims to provide students with a fundamental understanding of the principles of electronic circuits and their applications in both analog and digital systems.

LEARNING OUTCOMES:

Onsuccessfulcompletionof thiscourse,thestudentwillbeableto:

1. Understand Principles and Working of Operational Amplifier
2. Apply their knowledge on OP-Amp in different Applications
3. To understand the number systems, Binary codes and Complements.
4. To understand the Boolean algebra and simplification of Boolean expressions.
5. To analyze logic processes and implement logical operations using combinational logic circuits.
6. To understand the concepts of sequential circuits and to analyze sequential systems in terms of state machines

UNIT-I: OPERATIONAL AMPLIFIERS 9 hrs

a) Concept of feedback in CE amplifier, negative and positive feedback, advantages and disadvantages of negative feedback, Basic concepts of differential amplifier, Block diagram of op amp and its equivalent circuit, IC Diagram (IC 741), Ideal voltage transfer curve, Open loop Op-Amp configurations- differential, inverting and non-inverting Op-Amps.

b) Voltage Series Feedback Amplifier (Non-Inverting Op amp): Gain and Bandwidth derivations: Voltage Shunt Feedback Amplifier (Inverting Op amp): Gain and Bandwidth derivations

UNIT-II: PRACTICAL OPERATIONAL AMPLIFIER AND APPLICATIONS 9 hrs

a) Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Input offset voltage, Input bias current, Input offset current, total output offset voltage, CMRR, slew rate and concept of virtual ground.

b) Applications of Op-Amp: Linear Applications: Voltage Follower, Summing Amplifier, Subtracting Amplifier, Averaging Amplifier, Difference Amplifier, Integrator and Differentiator, Square Wave response of Integrator and Differentiator (Brief explanation only)

UNIT-III: NUMBER SYSTEMS, CODES AND LOGIC GATES 9 hrs

a) Number Systems and Codes: Decimal, Binary, Octal and Hexadecimal number systems, conversions, Binary addition, Binary subtraction using 1's and 2's complement methods, BCD code and Gray code – Conversions

b) Logic Gates: Construction and truth tables of OR, AND, NOT gates, Universal gates – Basic construction and truth tables of NOR & NAND, Realization of logic gates using NAND and NOR, XOR and XNOR Logic gates symbol and their truth tables. De Morgan's Laws, Boolean Laws, Simplification of Boolean Expressions using Boolean Laws

UNIT-IV: ARITHMETIC CIRCUITS & DATA PROCESSING CIRCUITS 9 hrs

a) Half Adder and Full Adder: Explanation of truth tables and Circuits. Half Subtractor and Full Subtractor: Explanation of truth tables and Circuits, 4 - bit binary Adder/Subtractor.

b) Multiplexers - 2 to 1 Multiplexer, 4 to 1 multiplexer, De-multiplexers: 1 to 2 Demultiplexer, 1 to 4 Demultiplexer, Applications of Multiplexers and Demultiplexers Decoders: 1 of 2 decoders, 2 of 4 decoders, Encoders: 4 to 2 Encoder, 8 to 3 Encoder, Applications of decoders and encoders

UNIT-V: SEQUENTIAL LOGIC CIRCUITS & CODE CONVERTERS 9 hrs

a) Combinational Logic vs Sequential Logic Circuits, Sequential Logic circuits: Flip-flops, Basic NAND, NOR Latches, Clocked SR Flip-flop, JK Flip-flop, D Flip-flop, Master-Slave Flip- flop, Conversion of Flip flops.

b) Code Converters: BCD to Decimal Converter, BCD to Gray Code Converter, BCD to 7 segment Decoders

Reference Books:

1. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
2. Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011,
3. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., TMH
4. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
5. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
6. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

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SEMESTER-III

PRACTICAL COURSE 8: ANALOG AND DIGITAL ELECTRONICS

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVES:

The course objectives for a practical course in Analog and Digital Electronics might provide students with hands-on experience in designing, constructing, and testing analog and digital electronic circuits.

LEARNING OUCOMES:

1. Understand the principles of analog and digital electronic circuits and their applications in real-world scenarios.
2. Analyze and design analog electronic circuits using diodes, transistors, and operational amplifiers.
3. Analyze and design digital electronic circuits using logic gates, flip-flops, and counters.
4. Understand the importance of biasing, feedback, and stability in electronic circuits and how to achieve them.
5. Develop the skills to design and analyze amplifier circuits and digital systems.

Minimum six experiments to be done and recorded.

1. To study the operational amplifier as inverting feedback amplifier with verifying gain
2. To study the operational amplifier as non-inverting feedback amplifier with verifying gain
3. To study operational amplifier as adder
4. To study operational amplifier as subtractor
5. To study operational amplifier as differentiator
6. To study operational amplifier as integrator
7. Logic Gates- OR, AND, NOT and NAND gates. Verification of Truth Tables.
8. Verification of De Morgan's Theorems.
9. Construction of Half adder and Full adders-Verification of truth tables
10. Flip flops
11. Multiplexer and De-multiplexer
12. Encoder and Decoder

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SEMESTER-III

COURSE 8: ANALOG AND DIGITAL ELECTRONICS

STUDENT ACTIBVITIES

UNIT-I: OPERATIONAL AMPLIFIERS

Circuit Analysis: Students can be asked to analyze different operational amplifier circuits such as inverting and non-inverting amplifiers, summing amplifiers, difference amplifiers, and integrators. They can be asked to calculate the gain, input and output impedance, and frequency response of the circuits.

Circuit Design: Students can be asked to design different operational amplifier circuits such as audio amplifiers, filters, and oscillators. They can be asked to select the appropriate op-amp and other components such as resistors, capacitors, and inductors to meet the desired specifications.

UNIT-II: PRACTICAL OPERATIONAL AMPLIFIER AND APPLICATIONS

Design an inverting amplifier circuit: Students can be asked to design and build an inverting amplifier circuit using an operational amplifier and a few passive components. They can then measure the gain and frequency response of the circuit using an oscilloscope and a function generator. They can also compare the measured values with the theoretical calculations and simulation results.

Build a summing amplifier circuit: Students can be asked to build a summing amplifier circuit using an operational amplifier and several input signals. They can then measure the output voltage of the circuit and compare it with the expected value. They can also investigate the effect of changing the input signal amplitudes and the resistor values on the circuit performance.

UNIT-III: NUMBER SYSTEMS, CODES AND LOGIC GATES

Convert numbers between different bases: Students can be asked to convert numbers between binary, decimal, and hexadecimal bases. They can practice converting both integer and fractional numbers, and verify their results using online conversion tools or calculators.

Design a binary adder circuit: Students can be asked to design and build a binary adder circuit using logic gates such as XOR, AND, and OR gates. They can then test the circuit by adding two binary numbers and comparing the result with the expected value.

UNIT-IV: ARITHMETIC CIRCUITS & DATA PROCESSING CIRCUITS

Design a data processing circuit: Students can be asked to design and build a data processing circuit that performs a specific function, such as filtering, modulation, or demodulation. They can use op-amps, filters, modulators, and demodulators to implement the circuit and test its performance using simulated or real-world signals.

Implement a digital signal processing algorithm: Students can be asked to implement a digital signal processing algorithm, such as a Fourier transform, a discrete cosine transform, or a digital filter. They can

use software tools such as MATLAB or Python to simulate the algorithm and test its performance using sample signals.

UNIT-V: SEQUENTIAL LOGIC CIRCUITS & CODE CONVERTERS

Design a flip-flop circuit: Students can be asked to design and build a flip-flop circuit using logic gates and test its operation by creating a sequence of logic signals. They can also compare the performance of different types of flip-flops, such as SR, D, JK, and T, and discuss their advantages and disadvantages in sequential circuits.

Implement a counter circuit: Students can be asked to design and build a counter circuit that counts up or down using flip-flops. They can use different types of counters, such as ripple, synchronous, or Johnson, and test their operation by connecting the output to LEDs or other indicators.

Design a code converter circuit: Students can be asked to design and build a code converter circuit that converts a binary code to another code, such as Gray code, BCD, or ASCII. They can use logic gates, multiplexers, and decoders to implement the circuit, and test its operation by inputting different codes

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SEMESTER-III

COURSE9: ELECTRICITY AND MAGNETISM

Hours: 45 Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The course on Electricity and Magnetism aims to provide students with a fundamental understanding of the principles of electricity, magnetism, and their interactions

LEARNING OUTCOMES:

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

1. Understand the Gauss law and its application to obtain electric field in different cases and formulate the relationship between electric displacement vector, electric polarization, Susceptibility, Permittivity and Dielectric constant.
2. To learn the methods used to solve problems using loop analysis, Nodal analysis, Thvenin's theorem, Norton's theorem, and the Superposition theorem
3. Distinguish between the magnetic effect of electric current and electromagnetic induction and apply the related laws in appropriate circumstances.
4. Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.
5. Develop an understanding on the unification of electric, and magnetic fields and Maxwell's equations governing electromagnetic waves.
6. Phenomenon of resonance in LCR AC-circuits, sharpness of resonance, Q- factor, Power factor and the comparative study of series and parallel resonant circuits

UNIT-I Electrostatics and Dielectrics 9hrs

Gauss's law-Statement and its proof, Electric field intensity due to (i) uniformly charged solid sphere, Electrical potential–Equipotential surfaces, Potential due to a uniformly charged sphere. Dielectrics-Polar and Non-polar dielectrics- Effect of electric field on dielectrics,Dielectric strength, Electric displacement D, electric polarization Relation between D, E and P, Dielectric constant and electric susceptibility.

UNIT-II Current electricity 9hrs

Electrical conduction-drift velocity-current density, equation of continuity, ohms law and limitations, Kirchhoff's Law's, Wheatstone bridge-balancing condition - sensitivity.Branch current method, Nodal Analysis, star to delta & delta to star conversions. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer theorem.

UNIT-III Magneto statics 4hrs

Biot-Savart's law and its applications: (i) circular loop and (ii) solenoid, Ampere's Circuital Law and its application to Solenoid, Hall effect, determination of Hall coefficient and applications.

Electromagnetic Induction: 5 hrs

Faraday's laws of electromagnetic induction, Lenz's law, Self-induction and Mutual induction, Self-inductance of a long solenoid, Magnetic Energy density. Mutual inductance of a pair of coils. Coefficient of Coupling

UNIT-IV Electromagnetic waves-Maxwell's equations: 9hrs

Basic laws of electricity and magnetism- Maxwell's equations-integral and differential forms Derivation, concept of displacement current. Plane electromagnetic wave equation, Hertz experiment-Transverse nature of electromagnetic waves. Electromagnetic wave equation in conducting media. Pointing vector and propagation of electromagnetic waves

UNIT-V Varying and alternating currents: 9 hrs

Growth and decay of currents in LR, CR, LCR circuits-Critical damping. Alternating current - A.C. fundamentals, and A.C through pure R, L and C. Relation between current and voltage in LR and CR circuits, Phasor and Vector diagrams, LCR series and parallel resonant circuit, Q –factor, Power in ac circuits, Power factor.

REFERENCE BOOKS

1. BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
2. Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
3. Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand& Co.,
4."Electricity and Magnetism" by Brijlal and SubramanyamRatan Prakashan Mandir, 1966
5. "Electricity and Magnetism: Fundamentals, Theory, and Applications" by R. Murugeshan, Kiruthiga Sivaprasath, and M. Saravanapandian
6. "Electricity and Magnetism: Theory and Applications" by Ajoy Ghatak and S. Lokanathan
7. Electricity and Magnetism: Problems and Solutions" by Ashok Kumar and Rajesh Kumar
8. Electricity and Magnetism, R.Murugeshan, S. Chand & Co.

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SEMESTER-III

PRACTICAL COURSE 9: ELECTRICITY AND MAGNETISM

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

The course objective for a practical course in electricity and magnetism may include to develop practical skills in handling electrical and electronic components, such as resistors, capacitors, inductors, transformers, and oscillators.

LEARNING OUTCOMES:

Demonstrate a thorough understanding of the fundamental concepts and principles of electricity and magnetism.

Apply the laws and principles of electricity and magnetism to analyze and solve electrical and magnetic problems.

Design, construct, and test electrical circuits using various components and measuring instruments.

Measure and analyze electrical quantities such as voltage, current, resistance, capacitance, and inductance using appropriate instruments.

Apply the principles of electromagnetism to understand and analyze the behavior of magnetic fields and their interactions with electric currents

Minimum of 6 experiments to be done and recorded

1. Figure of merit of a moving coil galvanometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –Sonometer.
4. Verification of Kirchhoff's laws and Maximum Power Transfer theorem.
5. Verification of Thevenin's and Norton's theorem
6. Field along the axis of a circular coil carrying current-Stewart & Gee's apparatus.
7. Charging and discharging of CR circuit-Determination of time constant
8. A.C Impedance and Power factor
9. Determination of specific resistance of wire by using Carey Foster's bridge.

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SEMESTER-III

COURSE 9: ELECTRICITY AND MAGNETISM

STUDENT ACTIVITIES

UNIT-I Electrostatics and Dielectrics:

Conduct a simulation to visualize equipotential surfaces for a given charge distribution.

Conduct a group discussion on the significance of electric field lines and how they can be used to predict the motion of charged particles in electric fields.

UNIT-II Current electricity:

Conduct a Wheatstone bridge experiment in class and discuss the balancing condition and sensitivity.

Conduct a group activity where students are divided into groups and assigned a different circuit analysis method (nodal analysis, mesh analysis, superposition theorem, etc.) and asked to present their findings to the class.

UNIT-III Magneto statics and Electromagnetic Induction:

Conduct a demonstration to show the Hall effect and measure the Hall coefficient of a given material.

Conduct a group activity where students are divided into groups,and assigned a different application of Faraday's law (electromagnetic induction, transformers, etc.) and asked to present their findings to the class.

UNIT-IV Electromagnetic waves:

Conduct a group activity where students are asked to research the history of the development of Maxwell's equations and present their findings to the class.

Conduct a simulation to visualize the propagation of electromagnetic waves in different media (vacuum, air, water, etc.) and discuss the differences in the behaviour of waves in different media.

UNIT-V Varying and alternating currents:

Conduct a demonstration to show the resonance in an LCR circuit and measure the Q-factor.

Conduct a group activity where students are divided into groups and assigned a different power factor correction method (capacitor banks, synchronous condensers, etc.) and asked to present their findings to the class.

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SEMESTER-IV

COURSE 10: MODERN PHYSICS

Hours: 45 Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The course on Modern Physics aims to provide students with an understanding of the principles of modern physics and their applications in various fields.

LEARNING OUTCOMES:

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

1. Understand the principles of atomic structure and spectroscopy.
2. Understand the principles of molecular structure and spectroscopy
3. Develop critical understanding of concept of Matter waves and Uncertainty principle.
4. Get familiarized with the principles of quantum mechanics and the formulation of Schrodinger wave equation and its applications.
5. Increase the awareness and appreciation of superconductors and their practical applications

UNIT-I:Introduction to Atomic Structure and Spectroscopy: (9 hrs

Bohr's model of the hydrogen atom -Derivation for radius, energy and wave number - Hydrogen spectrum, Vectoratommodel – Stern and Gerlach experiment, Quantumnumbersassociatedwithit, Coupling schemes, Spectral terms and spectral notations,Selectionrules. Zeemaneffect,Experimental arrangementtostudyZeemaneffect.

UNIT-II: Molecular Structure and Spectroscopy (9 hrs

Molecular rotational and vibrational spectra, electronic energy levels and electronic transitions, Ramaneffect,Characteristicsof Raman effect, ExperimentalarrangementtostudyRamaneffect,QuantumtheoryofRaman effect,ApplicationsofRaman effect. Spectroscopic techniques: IR, UV-Visible, and Raman spectroscopy

UNIT-III:Matter waves & Uncertainty Principle: (9 hrs

Matter waves, de Broglie's hypothesis, Properties of matterwaves,DavissonandGermer'sexperiment,Heisenberg'suncertaintyprincipleforpositionandmomentum &energyandtime,Illustrationofuncertainty principle using diffraction of beam of electrons (Diffraction by a

single slit) andphotons (Gammaraymicroscope).

UNIT-IV: Quantum Mechanics: (9 hrs

Basic postulates of quantum mechanics, Schrodinger time independent and time dependentwave equations-Derivations, Physical interpretation of wave function, Eigen functions, Eigenvalues, Application of Schrodinger wave equation to (one-dimensional potential box ofinfiniteheight (Infinite PotentialWell)

UNIT-V: Superconductivity: (9 hrs

Introduction to Superconductivity, Experimental results-critical temperature, critical magnetic field, Meissner effect, London's Equation and Penetration Depth, Isotope effect, Type I and Type II superconductors, BCS theory, high Tc super conductors, Applications of superconductors

REFERENCE BOOKS

1. BScPhysics,Vol.4, TeluguAkademy,Hyderabad
2. AtomicPhysics byJ.B. Rajam; S.Chand&Co.,
3. ModernPhysics byR. MurugeshanandKiruthigaSivaPrasath. S. Chand& Co.
4. Concepts ofModernPhysics byArthurBeiser. TataMcGraw-HillEdition.
5. NuclearPhysics,D.C.Tayal,HimalayaPublishingHouse.
6. S.K.Kulkarni,Nanotechnology:Principles &Practices(CapitalPubl.Co.)
7. K.K.Chattopadhyay&A.N.Banerjee, Introd.to Nanoscience and Technology(PHILearningPriv.Limited).
8. Nanomaterials,AKBandopadhyay. NewAgeInternationalPvtLtd(2007)
9. Textbook of Nanoscience and Nanotechnology, BS Murthy, P Shankar, BaldevRaj,BBRath andJMurday-UniversitiesPress-IIM

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SEMESTER-IV

PRACTICAL COURSE 10: MODERN PHYSICS

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

The course objective for a practical course in Modern Physics may provide hands-on experience with experimental techniques and equipment used in modern physics experiments.

LEARNING OUTCOMES:

1. Apply experimental techniques and equipment to investigate and analyze phenomena related to modern physics, such as quantum mechanics, relativity, atomic physics, and nuclear physics.
2. Demonstrate a deep understanding of the principles and theories of modern physics through hands-on experimentation and data analysis.
3. Develop proficiency in using advanced laboratory instruments and techniques specific to modern physics experiments, such as spectroscopy, interferometry, particle detectors, and radiation measurement.
4. Analyze and interpret experimental data using statistical methods and error analysis, drawing meaningful conclusions and relating them to theoretical concepts.
5. Design and conduct independent experiments or investigations related to modern physics, demonstrating the ability to plan, execute, and analyze experimental procedures and results.

Minimumof 6experimentstobedoneand recorded

1. e/m of an electron byThomson method.
2. DeterminationofPlanck'sConstant(photocell).
3. Verification ofinversesquarelawoflight usingphotovoltaiccell.
4. DeterminationofthePlanck'sconstantusingLEDsofatleast4differentcolours.
5. Determinationofworkfunctionofmaterialoffilamentofdirectlyheatedvacuumdiode.
6. DeterminationofM &H.
7. Energygap ofasemiconductor usingjunction diode.
8. Energygap ofasemiconductorusingthermistor.

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SEMESTER-IV

COURSE 10: MODERN PHYSICS

STUDENT ACTIVITIES:

UNIT-I:Introduction to Atomic Structure and Spectroscopy

Spectroscopy Experiment:

Divide the students into small groups and provide each group with a spectrometer or spectroscope, a light source, and different samples or elements for analysis.

Instruct the students to carefully observe the spectra produced by the samples using the spectrometer. Encourage them to note the presence of specific spectral lines or patterns.

Data Collection:

Have the students record their observations in their lab notebooks or worksheets. They should note the wavelengths or colors of the observed spectral lines and any patterns they observe.

Analysis and Discussion:

Guide a class discussion on the observed spectra and their significance. Discuss how the observed spectral lines correspond to specific energy transitions in the atoms.

Ask students to compare the spectra of different samples or elements and identify any similarities or differences.

Discuss the concept of energy levels and how electrons transition between them, emitting or absorbing photons of specific wavelengths.

UNIT-II: Molecular Structure and Spectroscopy

Begin the activity with a brief introduction to molecular structure, discussing concepts such as chemical bonds, molecular geometry, and the importance of molecular structure in determining the properties and behavior of substances.

Explain the principles of spectroscopy, focusing on vibrational and rotational spectra and how they relate to molecular vibrations and rotations.

UNIT-III:Matter waves & Uncertainty Principle:

Begin the activity by introducing the concept of matter waves and the uncertainty principle. Discuss how the wave-particle duality of matter is a fundamental principle in quantum mechanics.

Provide a brief overview of the historical development of the uncertainty principle and its implications for our understanding of the behavior of particles on a microscopic scale.

UNIT-IV: Quantum Mechanics:

Begin the activity by providing an overview of quantum mechanics and its significance in understanding the behavior of particles on a microscopic scale.Discuss key concepts such as wave-particle duality, superposition, quantization, and the probabilistic nature of quantum systems

UNIT-V: Superconductivity:

Begin the activity by providing an overview of superconductivity, including its definition, properties, and significance in scientific and technological applications.

Discuss key concepts such as zero electrical resistance, Meissner effect, critical temperature, and type I and type II superconductors

MAJOR

B.Sc. (HONOURS) PHYSICS SINGLE MAJOR

SYLLABUS UNDER CBCS

w.e.f. 2023-24 (Revised in May 2023)

SEMESTER-IV

COURSE 11: INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

Hours: 45 Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The course aims to provide students with an understanding of the principles of Nuclear and Particle physics and their applications in various fields.

LEARNING OUTCOMES

By successful completion of the course, students will be able to

1. know about high energy particles and their applications which prepares them for further study and research in elcitrapphysics
2. Students can explain important concepts on nucleon-nucleon interaction, such as its short-range, spin dependence, isospin, and tensors.
3. Students can show the potential shapes from nucleon nucleon interactions.
4. Students can explain the single particle model, its strengths, and weaknesses
5. Students can explain magic numbers based on this model

UNIT-I: Introduction to Nuclear Physics 9hrs

Nuclear Structure: General Properties of Nuclei, Mass defect, Binding energy; Nuclear forces:Characteristicsof nuclear forces- Yukawa's mesontheory;NuclearModels-Liquiddropmodel-Semi empirical mass formula, nuclear shell model.

UNIT-II: Elementary Particles And Interactions 9hrs

Discovery and classification of elementary particles, properties of leptons, mesons and baryons; Types of interactions-strong, electromagnetic and weak interactions; Conservation laws – Isospin, parity, charge conjugation

UNIT-III: Nuclear Reactions and Nuclear Detectors 9hrs

Nuclear Reactions:Types of reactions, Conservation Laws in nuclear reactions, Reaction energetic, Threshold energy, nuclear cross-section;Nuclear detectors: Geiger- Muller counter, Scintillation counter, Cloudchamber

UNIT-IV: Nuclear Decays and Nuclear Accelerators 9hrs

Nuclear Decays: Gamow's theory of alpha decay, Fermi's theory of Beta- decay, Energy release in Beta-decay, selection rules.Nuclear Accelerators:Types-Electrostatic and electrodynamics accelerators; Cyclotron-construction, working and applications; Synchrocyclotron-construction, working and applications.

UNIT-V:Applications of Nuclear and Particle Physics 9hrs

Medical Applications: Radiation therapy and imaging techniques, nuclear energy: nuclear reactors and power generation, Particle physics in high-energy Astro Physics

Reference Books:

1. Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).
2. Nuclear Physics, Theory and experiment – P.R. Roy and B.P. Nigam, New Age Int.1997.
3. Atomic and Nuclear Physics (Vol.2), S.N. Ghoshal, S. Chand & Co. (1994).
4. Nuclear Physics, D.C. Tayal, Himalaya Pub. (1997).
5. Atomic and Nuclear Physics, R.C. Sharma, K. Nath& Co., Meerut.
6. Nuclei and Particles, E. Segre.
7. Introduction to Nuclear Physics, H.A. Enge, Addison Wesley (1975).

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SEMESTER-IV

PRACTICAL COURSE 11: INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

To familiarize students with experimental techniques and methodologies used in nuclear and particle physics.

To provide hands-on experience in conducting experiments related to nuclear and particle physics.

LEARNING OUTCOMES:

1. Gain a solid understanding of fundamental concepts in nuclear and particle physics.
2. Acquire knowledge of experimental techniques and methodologies used in the field.
3. Understand the principles and operation of laboratory equipment and instruments specific to nuclear and particle physics experiments.
4. Develop proficiency in conducting experiments related to nuclear and particle physics.
5. Acquire skills in data acquisition, analysis, and interpretation using appropriate software and techniques.
6. Learn to design and perform experiments, including calibration, measurement, and control of variables.

TSIL STNEMIREPXE

1. GM counter – Determination of dead time
2. egatlov gnitarepo sti fo noitamitse dna retnuoc MG fo evruc citsiretcarahc fo ydutS
3. retnuoc MG eht fo ecruos ammag a rof ycneiciffe fo noitamitsE
4. retnuoc MG gnisu wal erauqs esrevni yfirev oT
5. fo noitaunetta dna noitcudorPbremsstrahlung
6. retnuoc MG eht fo ecruos ateb a rof ycneiciffe fo noitamitsE
7. selcitrap ateb fo gnirettacs kcab fo ydutS

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SEMESTER-IV

COURSE 11: INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

STUDENT ACTIVITIES

UNIT-I: INTRODUCTION TO NUCLEAR PHYSICS

Provide students with a computer simulation or interactive app that allows them to explore radioactive decay processes.
Ask students to observe and analyze the decay patterns of different isotopes, including the concept of half-life.
Guide students to make connections between the simulation results and the fundamental principles of nuclear physics

UNIT-II: ELEMENTARY PARTICLES AND INTERACTIONS

Divide students into small groups and assign each group a specific elementary particle (e.g., proton, electron, neutrino, quark).
Instruct students to create a poster showcasing their assigned particle, including its properties, classification, and interactions.
Encourage creativity in the presentation of information, such as diagrams, illustrations, and concise explanations.
Have each group present their posters to the class, promoting discussion and comparisons between different particles.

UNIT-III: NUCLEAR REACTIONS AND NUCLEAR DETECTORS

Divide students into small groups and assign each group a specific scenario that requires radiation shielding, such as a nuclear power plant, a medical facility, or a space mission.
Instruct students to research and design an effective radiation shielding system for their assigned scenario, considering factors such as the type of radiation, the intensity of radiation, and the materials available for shielding.
Encourage students to calculate and compare the attenuation properties of different materials and discuss the trade-offs between effectiveness, cost, and practicality in their designs.
Have each group present their shielding design to the class, explaining their rationale and addressing potential challenges or limitations

UNIT-IV: NUCLEAR DECAYS AND NUCLEAR ACCELERATORS

Provide students with a radioactive decay chain involving multiple decays, such as alpha decay, beta decay, and gamma decay.
Instruct students to analyze the decay chain and determine the sequence of decays, including the types of particles emitted and the resulting daughter nuclei.
Ask students to calculate the half-lives of the parent and daughter nuclei based on the decay data and explore the concept of radioactive equilibrium.
Encourage students to discuss the practical applications and significance of decay chains in fields such as radiometric dating or medical imaging

UNIT-V: APPLICATIONS OF NUCLEAR AND PARTICLE PHYSICS

Assign students specific medical imaging techniques based on nuclear and particle physics, such as positron emission tomography (PET), single-photon emission computed tomography (SPECT), or computed tomography (CT).
Instruct students to research and present on the principles behind their assigned imaging technique, including the interaction of particles or radiation with matter, detector technology, and image reconstruction methods.
Ask students to discuss the advantages, limitations, and specific medical applications of their assigned imaging technique.
Encourage students to critically analyze the role of nuclear and particle physics in advancing medical diagnostics and treatment planning

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SEMESTER-V

COURSE 12A: OPTICAL INSTRUMENTS AND OPTOMETRY

Hours: 45 Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The objective of the course on Optical Instruments and Optometry is to provide students with a comprehensive understanding of the principles, design, and application of optical instruments used in various fields, with a specific focus on optometry

LEARNINGOUTCOMES:

Studentsatthesuccessfulcompletionofthecoursewill beableto:

1. Understandtheconstructionandworkingprinciplesof variousopticalinstrumentsusedindailylife.
2. Acquireacriticalknowledgeonthe various defectsofeyeandtheircorrecting methodswithsuitable lenses.
3. Demonstrateskillsofusingbiological microscopethroughhandsonexperience.
4. Understandthevarioustechniquesusedinoptometryandcomputerbasedeyetesting.
5. Comprehendthevarious applications ofmicroscopesandtelescopes.

UNIT-IOpticalMicroscopes 9 hrs

SimpleMicroscope-Construction,Magnifyingpower,normaladjustment;CompoundMicroscope-Construction,Magnifyingpower,normaladjustment,Phasecontrastmicroscope-Operatingprinciple,travellingmicroscope-Construction,workinganduses

UNIT-IITelescopes 9 hrs

RefractingTelescopes and Reflecting telescopes, Construction, working and magnifying power ofAstronomical Telescope and Terrestrial Telescopes, Binoculars – working principle andapplications.

UNIT-IIIApplicationsOfOpticalInstruments 9 hrs

Introductory ideas and applications of various microscopes *viz*., (i) Optical microscopes(Compoundmicroscope,Stereomicroscope,Confocalmicroscope)(ii)Electronmicroscopes(TEM,SEM),(iii)ScanningProbemicroscope(iv)ScanningAcousticmicroscopeand(v)X-raymicroscope. Introductory ideas and applications of various telescopes *viz*., (i) Optical telescopes (ii)Radio telescopes (iii) Solar telescopes (iv) Infrared telescope (v) Ultraviolet telescope

UNIT-IVOpticalVision 9 hrs

Introduction to optical Vision, Eye as an optical instrument, Formation of image in the eyeand thecamera,Ophthalmic lenses,Myopia and Hypermetropia defects, Removal of defects in vision using ophthalmic lenses,Contactlenses-Workingprinciple,DifferenttypesofContact lenses.

UNIT-VOphthalmicTechniquesandOptometry 9 hrs

Ophthalmoscopeandkeratometerandtheirworkingprinciples,Evaluationofeyedisorders, Guidelines for standardized eye chart preparation, Simple phoropter and itsworking principle and its uses, Principles of Computerbasedeyetesting

Reference Books

1. OpticsandOpticalInstruments: AnIntroductionbyB.K.Johnson,DoverPublications.
2. Modern Optical Instruments and their construction by or ford Henry-Publisher: BiblioLife,LLC.
3. ATextBook ofOpticsbyBrjLal andN.Subramanyam,S.Chand&Co.
4. PracticalOpticsbyMennNaftly,ElsevierSciencePublishing.
5. Applications ofOpticsindailylife|CK-12Foundation.https://flexbooks.ck12.org›
6. Websourcessuggestedbytheteacherconcernedandthecollegelibrarianincluding Readingmaterial.

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SEMESTER-V

PRACTICAL COURSE 12A: OPTICAL INSTRUMENTS AND OPTOMETRY

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

The objective of the practical course on Optical Instruments and Optometry is to provide students with hands-on experience and practical skills in the operation, calibration, and application of optical instruments used in optometry

Learning Outcomes:

On successful completion of this practical course, student shall beable to:

1. Listout,identifyandhandlevariousequipment likebinoculars,telescopesandmicroscopes.
2. Learntheprocedures ofoperationofvariousopticalinstruments.
3. Demonstrate skills on testing the power of lenses, improving the resolution oftelescopesand microscopes.
4. Acquire skills in observing and measuring the power, focal length and differentrefractiveerrors ofeye.
5. Performsometechniquesrelatedtotestingthebloodandotherbiologicalsamples.
6. UnderstandthetechniqueofoperationofComputereyetestingandevaluation.
7.

Practical(Laboratory) Syllabus:

1. Evaluationofmagnifyingpowerofsimplemicroscope.
2. Measurement of reflection and transmission coefficient of certain materials using amicroscope.
3. Resolvingpoweroftelescope
4. Determinationofradiiofdifferent capillarytubesusingtravellingmicroscope.
5. Refractive index of a liquid (water) using (i) concave mirror and (ii) convex lens and aplanemirror.
6. Removalofrefractiveerrorsofeyeusingcombinationoflenses.
7. Determination ofpowerofaconvexlensbyfindingitsfocal length.

LabReferences:

1. A Practical Guide to Experimental Geometrical Optics byYuriy A. Garbovskiy-CambridgeUniv. Press
2. https://physics.columbia.edu/sites/default/files/content/Lab%20Resources/1292%20Lab%20Manual.pdf
3. https://www.lnmiit.ac.in/Department/Physics/uploaded_files/lab-manual.pdf

4. BasicOpticsExperiments-http://www.phys.unm.edu›OpticsLab›Basics

5. A Practical Guide to Experimental Geometrical Optics by Yuriy A. Garbovskiy,AnatoliyV. Glushchenko, Cambridge Univ. Press

6. Web sources suggested by the teacher concerned.http://www.phy.olemiss.edu/~thomas/weblab/Optics_lab_Items/Telescope_Microscope

_PROCED_Spring_2018.pdf

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SEMESTER-V

COURSE 12A: OPTICAL INSTRUMENTS AND OPTOMETRY

STUDENT ACTIVITIES

Co-CurricularActivities

(a) Mandatory: (*Training of students by teacher in field related skills: (lab:10 + field:05*)

1. **For Teacher**: Training of students by the teacher (if necessary, by a local expert) inlaboratory/field for a total of notless than 15 hours on the field techniques/skills onthefamiliarizationofvariousopticalinstrumentsavailableinthelaboratory;construction of different types of telescopes and their comparison in construction,operationandtheir utilityandlimitations; the detailsof constructionof eyeandvarious defects in the eye sight, emerging techniques in the design of eye lensesincluding contact lenses and making the student to understand on the testing of abiological sampleusingaclinical microscope

For Student: Students shall (individually) visit and observe the functioning of opticalinstruments at any one of the following places /centres like (a) pathological laboratory**or**(b)alocalophthalmologist**or**(c)alocaloptician tounderstandthevarioustypesof eye lenses **or** (d) a local computer based eye testing centre**or** (e) an optician, whofixes contact lenses **or** (f) a local cinema theatre **or** (g) a planetarium.Student shallwritetheobservationsandsubmitahand-writtenFieldwork/Projectworknotexceeding10 pages in thegiven formatto the teacher.

2. MaxmarksforFieldwork/Project work:05.
3. SuggestedFormatforFieldwork/Projectwork:*Titlepage,studentdetails, indexpage,details of placevisited,observations, findings andacknowledgements*.
4. Unittests(IE).

(b) <u>SuggestedCo-CurricularActivities</u>

1. Trainingofstudentsbyrelatedindustrialexperts.
2. Assignments(includingtechnicalassignmentslikeidentifyingtoolsinthelensgrinding, frame fitting, lens cleaning culture and other operational techniques withsafetyand security,IPR)
3. Seminars,Groupdiscussions,Quiz,Debatesetc.(onrelatedtopics).
4. Preparationofvideosontoolsandtechniquesinopticalinstrumentsandopticallenses,cont act lenses.
5. Makingamodelmicroscopeandmeasuringitsmagnification.
6. Makingasimpleastronomical telescopeusingtwoconvexlenses.
7. Checkingthepowerofyourspectaclesorlensesathome.
8. Studentsshalltakeupmakingtheirown(i)Telescopeand(ii)Binocularswiththeaccessories availableat home.

https://paksc.org/pk/science-experiments/physics-experiments/how-to-make-astronomical-telescope

https://kids.nationalgeographic.com/nature/article/make-a-telescope

https://learning-center.homesciencetools.com/article/how-to-make-a-telescope-optical-science-project/

http://scipop.iucaa.in/Amateurs/telemaking.html

9. Collectionof material/figures/photosrelatedtovarioustypes of lensesandtheirpower.
10. Visittoanyeyeresearchlaboratories, ifavailable
11. Invitedlecturesandpresentations onrelatedtopicsbyfield/industrialexperts

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SEMESTER-V

COURSE 13A: OPTICAL IMAGING AND PHOTOGRAPHY

Hours: 45 Credits: 3 3 hrs/week

COURSE OBJECTIVE:

The objective of the course on Optical Imaging and Photography is to provide students with a comprehensive understanding of the principles, techniques, and applications of optical imaging and photography. The course aims to develop students' theoretical knowledge and practical skills in capturing, processing, and interpreting images using optical devices and imaging technologies.

LEARNING OUTCOMES:

Students aftersuccessfulcompletionofthecoursewillbeableto:

1. Identifythedifferenttypesofcamerasandcameralensesaccordingtodifferentpurposes.
2. Identifyandunderstandthe focallength ofthedifferenttypesoflenses
3. Acquire a critical knowledge on natural and artificial sources of light and theirapplication in photography.
4. Demonstrateskills ofcamerausageespeciallyDigital Cameras. To understandthevariousImagedevelopmentandeditingtechniques.
5. Comprehendtheconceptofdifferenttypes ofcommonshootingtechniques.

Unit-I:Introduction to Photography: 9 hrs

Working principle of a camera, Image formation in simple cameraand human eye, Types of cameras Pin-hole camera , Single Lens Reflex (SLR) camera, TwinLens Reflex (TLR) camera , Digital Single-lens reflex camera (DSLR), Digital camera, Droneflyingcameras,Careandmaintenanceof camera.

Unit-II:DigitalPhotography: 9 hrs

Different types of Digital cameras and their parts, Working of DSLR camera, Types of lenses-Normal, Wide angle, telephoto, Zoom lenses, Digital Image formation, Digital camera imagesensors, Size of the image, Depth of focus, Depth of field, Exposure time, Aperture, Shutterspeed,ISO,filters,knowledgeonpixels andtheiruses,resolution.

Unit-III:PhotographicLightSources: 9 hrs

Need for the light in photography, Light sources- Natural light, Sun light, Moon light,Ambientlight, Artificial light sources-Flood light, Spot light, Halogen light, Halogen flash light, Digitallights,Exposure, Studiophotography

Unit-IV:PhotographicShootingTechniques: 9 hrs

Significance and role of Camera lens in photo shooting, Arrangement of lenses in a Camera-Positioning, Techniques involved in the use of DSLR cameras, Usage of Filters, Techniquesof Photomicrography, High speed Photography with motor driven camera, Basic ideas onUnderwater Photography, Medical Photography, Astronomical Photography.

Unit-V:Photo Manipulation: 9 hrs

Developing and printing the photographs, equipment and materials used in developing andprinting, image mixing and printing, Image editing through image editingsoftware's likeAdobe Photoshop – Adjustment of Brightness, Contrast, Tonal and Colour Values, Methods of storing and processing, Image transportationthroughPendrive, CD, HDD and CLOUD[Internet]

IIIReferenceBooks:

1. Objectandimage; Anintroductionto photographybyGeorgeMCraven,PHI
2. AnIntroductiontoDigitalPhotoImagingAgfa,1994
3. AdvancePhotographybyM.Langford.
4. DigitalPhotography-Ahandson IntroductionbyPhillipKrejcarek,DelmerPublishers
5. Multimedia–AnIntroductionbyJohnVillamil,PHI
6. https://www.adobe.com/in/creativecloud/photography/discover/dslr-camera.html
7. Websourcessuggestedbytheteacherconcernedandthecollegelibrarianincludingreadingmaterial.

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SEMESTER-V

PRACTICAL COURSE 13A: OPTICAL IMAGING AND PHOTOGRAPHY

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

The objective of the practical course on Optical Imaging and Photography is to provide students with hands-on experience and practical skills in capturing, processing, and interpreting optical images using various imaging techniques and equipment. The course aims to develop students' proficiency in operating optical imaging devices, utilizing image processing software, and analyzing images for different applications.

LEARNING OUTCOMES:

On successful completion of this practical course, student shall beable to:

1. Listout,identifyandunderstand variousimageformation techniquesincludingEye.
2. LearntheproceduresofusingAnalogandDigitalcameras.
3. DemonstratethefocusingtechniquesofAnalogandDigitalcameras.
4. Acquireskillsin theeditinganddevelopmentofphotos andvideos.
5. Performsomeexperimentalskillsrelatedtoimages,videosusingtheequipment availableinthelab orin a local studio.

Practical(Laboratory)Syllabus:

6. Construction ofasimplepinholeCameraand studyit'sworking.
7. Captureanimageusinga DigitalCameraandapplyeditingtechniques.
8. Understanding various image formats and convert one image format intoother(For ex:JPEGto BMP)
9. Convertavideostream intoimagestreambyusingasuitableeditingsoftware.
10. Evaluatethe numberofpixelsand sizeof digitalImage.
11. Comparison ofthequalityofa8-bit,16-bitand 32bitimages.
12. Performthereductionandenlargement ofagivenDigitalImage.
13. Change the appearance of an image by applying the filters (For ex: from the IR image ofthegivendigitalImagebysuitableIR filter)

V. LabReferences:

1. DSLRPhotographyforBeginnersbyBrianBlack
2. TheArtofPhotographybyBruceBarnbaum
3. PhotoshopforPhotographersbyJohnSlavio
4. https://www.youtube.com/channel/UCwWyFRy2l6aUFMsRemP51Sw. YouTuberesource.
5. https://www.udemy.com/course/complete-photography-course/
6. Websourcessuggestedbytheteacher concerned.

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SEMESTER-V
COURSE 13A: OPTICAL IMAGING AND PHOTOGRAPHY
STUDENT ACTIVITIES

Co-CurricularActivities

(a) Mandatory:(*Trainingofstudentsbyteacherinfieldrelatedskills:(lab:10+field:05*):

1. **ForTeacher**:Trainingofstudentsbytheteacher(ifnecessary,byalocalexpert)inlaboratory/field for not less than 15 hours on the field techniques/skills of Image formationbyusinglensesandmirrors.Alsotomakestudentstounderstandtheconstruction,operationand thePhysicsprinciplesinvolvedin anormalCameraandDigitalCamera.

   2.For Student: Students shall (individually) visit a local Photo studio or any such facilityinauniversity/researchorganization/privateandobserve(i)theoperationofdifferentdigital cameras, compact and SLR and in taking photographs using different types of lensesbyvaryingaperture,shutter speedfor stillcamera,videocamera,CCTVandspycamera**or** (ii) The use of natural light, tungsten light, fluorescent light, electronic flash reflectors,exposure meters, studioflashandits accessories**or** (iii)the usage of variouslightingtechniques for different lenses and will do practice on special areas of photography inoutdoor and indoor conditions **or** (iv) the different processes viz., Audio video recording,mixing, editing, dubbing of sound, using different types of microphones **or** (v) the handlingofthedigitalvideocameras,DVD,HDD,accessoriesandexposuretotakedifferentcommonshots,dimensionofimagesandmovementsasperrequirement**or**(v)thecomputer system by digital editing software,printing the photographstakenby digitalcameras and the image transportation to the storage media, sending photographs through E-mail and Scanning the photographs, capture frames and analysis of images and record theirobservations and submit a hand-written Fieldwork/Project work not exceeding 10 pages inthegivenformat to theteacher.

   3. MaxmarksforFieldwork/Project work:05.
   4. SuggestedFormatforFieldwork/Projectwork:*Titlepage,studentdetails,indexpage,details of placevisited,observations,findingsandacknowledgements*.
   5. Tests(IE).

(b) SuggestedCo-CurricularActivities:

1. Trainingofstudents bya related skilled person from aPhotostudio.
2. Assignments (including technical assignments like identifying the tools &techniquesinvolved in photography and handling, operational techniques of different Cameraswithsafetyand security)
3. Seminars,Groupdiscussions,Quiz,Debatesetc.(onrelatedtopics).
4. PreparationofvideosontoolsandtechniquesrelatedtoImageformationandPhotographicTechniques.
5. Practice taking outdoor photographs with a digital camera in (i) Black & White and (ii)Colourin the followingconditions**:**
   Landscapes – Street / Building – Sculpture – Insect / Animal movement– Industrialplant (outside view) – Children, birds (close up / long shot / model photography)- slowandfast movingobjects-Night photographyetc.
6. Shootingofdifferentareasandtopicssuchassports,wildlife,modeling,drama,documentary, serial, story board making, news, interview, seminar/ workshop, industrial,livebroadcasting, musical event, advertisement, etc.
7. Collection of material/figures/

8. photos related to various components of a Camera, writingandorganizingthem in asystematic wayin afile.
9. Visits to any local Photo Studio or any Lab in universities, research organizations,privatefirms, etc.
10. Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrial experts.

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SEMESTER-V

COURSE 12B: LOW TEMPERATURE PHYSICS & REFRIGERATION

Hours: 45 Credits: 33 hrs/week

COURSE OBJECTIVE:

The objective of the course on Low Temperature Physics & Refrigeration is to provide students with a comprehensive understanding of the fundamental principles, concepts, and applications of low-temperature physics and refrigeration systems. The course aims to develop students' theoretical knowledge and practical skills in working with low temperatures, understanding cryogenic phenomena, and operating refrigeration systems.

LEARNING OUTCOMES:

Students aftersuccessfulcompletionofthecoursewillbeableto

1. IdentifyvariousmethodsandtechniquesusedtoproducelowtemperaturesintheLaboratory.
2. Acquireacritical knowledgeonrefrigeration and airconditioning.
3. DemonstrateskillsofRefrigeratorsthroughhandsonexperienceandlearnsaboutrefrigeration componentsand theiraccessories.
4. Understandthe classification,propertiesofrefrigerants andtheireffects onenvironment.
5. ComprehendtheapplicationsofLowTemperaturePhysics andrefrigeration.

UNIT-IProductionOfLowTemperature 9hrs

Productionoflowtemperatures-Introduction,Freezingmixtures,Joule-Thomsoneffect,Regenerativecooling,Differentmethodsofliquefactionofgases,liquefactionofair,Production ofliquidhydrogenandnitrogen,Adiabaticdemagnetization,Propertiesofmaterialsat low temperatures

UNIT-IIMeasurementofLowTemperature9hrs

Gas thermometer and its correction and calibration, Secondary thermometers, resistancethermometers,thermocouples,Vapourpressurethermometers,Magneticthermometers,Advantagesand drawbacks of each typeof thermometer.

UNIT-IIIPrinciplesofRefrigeration9hrs

Introduction to Refrigeration- Natural and artificial refrigeration , Stages of refrigeration,Types of refrigeration - Vapor compression and vapor absorption refrigeration systems,Refrigerationcycleandexplanationwithablockdiagram,Introductoryideasonair-conditioning.

Refrigerants-Introduction,Idealrefrigerant,Propertiesofrefrigerant,Classificationofrefrigerants, commonlyused refrigerants,Eco-friendlyrefrigerants

UNIT-IVComponents ofRefrigerator 9hrs

Refrigerator and its working, Block diagram, Coefficient of Performance (COP), Tons ofrefrigeration (TR) and Energy Efficiency Ratio (EER), Refrigerator components: Types ofcompressors,evaporators,
condensers,andtheirfunctionalaspects,defrostinginarefrigerator,Refrigerant leakage and detection

UNIT-VApplications ofLowTemperature &Refrigeration 9hrs

Applications of Low temperatures: Preservation of biological material, Food freezing, liquidnitrogen and liquid hydrogen in medical field, Superconducting magnets in MRI-Tissueablation(cryosurgery)-Cryogenicrocket propulsion system.
Applications ofrefrigeration: Domestic refrigerators, Water coolers, Cold storages,Iceplants, Food preservation methods, Chemical and Process industries, Cold treatment ofmetals,Construction field, Desalinationofwater,Datacenters.

References

1. HeatandThermodynamicsbyBrijLal &N.Subramanyam,S.ChandPublishers.
2. ThermalPhysics bySCGarg,RMBansal&CKGhosh,McGrawHillEducation,India
3. HeatandThermodynamicsbyMMZemansky,McGrawHillEducation(India).
4. Low-TemperaturePhysics byChristianE.&SiegfriedH.,Springer.
5. ThermalEngineeringbyS.Singh,S.Pati,Ch:18Introduction toRefrigeration.
6. ThePhysicsHyperTextBook.Refrigerators.https://physics.info/refrigerators/
7. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P)limited,New Delhi
8. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar,Dhanpatraiand sons, Delhi
9. https://trc.nist.gov/cryogenics/Papers/Review/2017-Low_Temperature_Applications_and_Challenges.pdf
10. https://nptel.ac.in/content/storage2/courses/112105129/pdf/RAC%20Lecture%203.pdf
11. OtherWebsources suggestedbytheteacherconcernedandthe readingmaterial.https://nptel.ac.in

B.Sc. (HONOURS) PHYSICS SINGLE MAJOR

SYLLABUS UNDER CBCS
w.e.f. 2023-24 (Revised in May 2023)
SEMESTER-V

PRACTICAL COURSE 12B: LOW TEMPERATURE PHYSICS & REFRIGERATION

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

The objective of the practical course on Low Temperature Physics & Refrigeration is to provide students with hands-on experience and practical skills in working with low temperatures, operating refrigeration systems, and conducting experiments in the field of low temperature physics. The course aims to develop students' proficiency in handling cryogenic equipment, performing temperature measurements, and conducting experiments at low temperatures.

LEARNING OUTCOMES:

Oncompletion ofpracticalcourse,studentshallbeableto

1. Listout,identifyandhandleequipmentusedinrefrigerationandlowtemperature lab.
2. Learntheprocedures ofpreparationofFreezingMixtures.
3. DemonstrateskillsondevelopingvariousFreezingmixturesandmaterialsandtheirapplications in agriculture, medicine and dayto daylife.
4. Acquireskillsinobservingandmeasuringvariousmethodologiesofverylowtemperatures
5. PerformsometechniquesrelatedtoRefrigerationandFreezingindailylife.

Practical(Laboratory)Syllabus:*(30hrs.Maxmarks:50*))

RecordthePrinciplesandapplicationsofRefrigeratorsandFreezers.

1. Measure the temperatures below Melting point of Ice using a thermometer available intheLab.
2. Make a freezing mixture by adding different salts viz., Sodium chloride, PotassiumHydrate(KOH),Calciumchloridetoiceindifferentproportionsandobservethetemperaturechanges.
3. Studytheoperationofarefrigerator andunderstandtheworkingofdifferentparts.
4. Study the properties of refrigerants like chlorofluorocarbons-hydrochlorofluoro-carbonsandrecord thelowest temperatures obtained.
5. Consider a simple faulty refrigerator and try to troubleshoot the simple problems byunderstandingits working.

6. UnderstandthepracticalproblemoffillingtheFreonGasintotheRefrigerator.
7. Get the Liquid Nitrogen or Liquid Helium from nearby Veterinary Hospital and measuretheirtemperaturesusingchromel-alumelthermocoupleormercurythermometerandobserve their physical properties like colour, smell etc and precautions to be taken fortheirsafehandling.
8. Preparation offreezedryingfoodwith Dryiceandliquidnitrogen
9. Preparationoffreezedryingfood withliquidnitrogen

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SYLLABUS UNDER CBCS

w.e.f. 2023-24 (Revised in May 2023)

SEMESTER-V

PRACTICAL COURSE 12B: LOW TEMPERATURE PHYSICS & REFRIGERATION

STUDENT ACTIVITIES

Co-CurricularActivities:

(a) Mandatory:(*Trainingofstudents byteacherinfieldrelatedskills:(lab:10+field:05*)

1. **ForTeacher**: Training of students by the teacher in the in the laboratory/field for atotal of not less than 15 hours on the techniques/skills of Low Temperature Production,methods used and applications of Low temperatures and refrigeration in day to day lifeandotherapplications inmedicine and industry.
2. **For Student**: Student shall (individually) visit (i) a small ice plant or a cold storageplant(ii)AirConditioner(AC)repairshopor(iii)Refrigeratorrepairshoptounderstandthec onstruction,workingprincipleandthetroubleshootingofthesedevices after interacting with the technicians. **Or** Student shall observe the variousthermodynamic processes taking place while working with the refrigerator and observetheleakdetectioninrefrigerationsystembydifferentmethods,airremovalandcharging of a refrigeration unit and testing of a refrigeration system to find out theRefrigerating capacity/Ton of refrigeration (TR) and the Power input. **Or** Student shallidentify the refrigerantcylinder by color coding and standing pressure. **Or**Studentshall visit the freezer aisle of a supermarket and observes the bags of different frozenfruits. Student shall write the observations and submit a hand-written Fieldwork/Projectworknot exceeding10 pagesinthegiven formatto the teacher.

3. MaxmarksforFieldwork/Projectwork:05.
4. Suggested Format for Fieldwork/Project work: *Title page, student details, index page,details of placevisited, observations, findings andacknowledgements*.
5. Unittests(IE).

(b) SuggestedCo-CurricularActivities

1. TrainingofstudentsbyrelatedFactory,industrialexperts.
2. Assignments(includingtechnicalassignmentslikeidentifyingtoolsinRefrigerators,Freezersand theirhandling,operationaltechniques withsafetyandsecurity)
3. Seminars,Groupdiscussions,Quiz,Debatesetc.(onrelatedtopics).
4. PreparationofvideosontoolsandtechniquesinLowTemperatures andapplications.
5. Collection of material/figures/photos related to substances used in Freezing Mixtures,theirPropertiesandavailabilityetc.,writingandorganizingtheminasystematicwayin afile.
6. VisitstoIceplantsandlabsinuniversities,researchorganizations, privatefirms, etc.
7. Makingyourownminirefrigeratorathome
8. Buildyourownwatercoolerwiththematerialsavailable athome.
9. Makinghandlaunchedliquidnitrogenrockets
10. ExperimentswithLiquidnitrogenandstrawberry/banana/lemon/onion/mushroom/eggetc. (*To betried under professional supervision only*).
11. Invitedlecturesandpresentations onrelatedtopicsbyfield/industrialexperts
12. Identification of different Ozone-depleting substances (ODS) that damage the ozonelayerin theupper atmosphere.
13. Demonstration to illustrate the greenhouse effect and the role of carbon dioxide as agreenhouse gas using plastic water bottles, flood light lamp, beakers and temperaturesensorsand observethe temperaturechanges.

https://edu.rsc.org/experiments/modelling-the-greenhouse-effect/1543.articlehttps://sealevel.jpl.nasa.gov/files/archive/activities/ts1hiac1.pdf

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B.Sc. (HONOURS) PHYSICS SINGLE MAJOR

SYLLABUS UNDER CBCS

w.e.f. 2023-24 (Revised in May 2023)

SEMESTER-V

COURSE 13B: SOLAR ENERGY AND ITS APPLICATIONS

Hours: 45 Credits: 33 hrs/week

COURSE OBJECTIVE:

The objective of the course on Solar Energy and Its Applications is to provide students with a comprehensive understanding of solar energy technologies, their principles, and their applications. The course aims to develop students' knowledge and skills in harnessing solar energy for various purposes, including electricity generation, heating, and cooling**.**

LEARNING OUTCOMES:

Aftersuccessfulcompletionofthecourse,thestudentwill beableto:

- ❖ UnderstandSunstructure,formsofenergycomingfromtheSunanditsmeasurement.
- ❖ Acquirea criticalknowledgeontheworkingofthermalandphotovoltaiccollectors.
- ❖ Demonstrateskills relatedtocallusculturethroughhandsonexperience
- ❖ Understandtestingproceduresandfault analysisofthermalcollectorsandPVmodules.
- ❖ ComprehendapplicationsofthermalcollectorsandPVmodules

Unit-I:Basic ConceptsofSolarEnergy 9hrs

Spectral distribution of solar radiation, Solar constant , zenith angle and Air-Mass, standardtime,localapparenttime,equationoftime,direct,diffuseandtotalradiations.Pyrheliometer-workingprinciple,directradiationmeasurement,Pyranometer-workingPrinciple,diffuseradiationmeasurement, Distinction betweenthe two meters.

Unit-II:SolarThermalCollectors9hrs

Solar Thermal Collectors-Introduction, Types of Thermal collectors, Flat plate collector – liquidheatingtype,Energybalanceequationandefficiency,Evacuatedtubecollector,collector overall heat loss coefficient, Definitions of collector efficiency factor, collectorheat-removal factor and collector flow factor, Testing of flat-plate collector, solar waterheatingsystem, naturaland forcedcirculation types.Concentratingcollectors,Solarcookers,Solardryers,Solardesalinators.

Unit-III:FundamentalsofSolarCells 9hrs

Semiconductorinterface,Types,homojunction,heterojunctionandSchottkybarrier,advantagesanddrawbacks,Photovoltaiccell,equivalentcircuit,outputparameters,conversion efficiency, quantum efficiency, Measurement of I-V characteristics, series andshuntresistance,theireffectonefficiency,Effectoflightintensity,inclinationandtemperatureon efficiency

Unit-IV:TypesofSolarcellsandModules9hrs

Typesofsolarcells,Crystallinesiliconsolarcells,I-Vcharacteristics,poly-Sicells,Amorphoussiliconcells,Thinfilmsolarcells-CdTe/CdSandCuInGaSe2/CdScellconfigurations, structures, advantages and limitations, Multi junction cells – Double andtriple junction cells. Module fabrication steps, Modules in series and parallel, Bypass andblockingdiodes

Unit–V:SolarPhotovoltaicSystems9hrs

Energy storage in PV systems, Energy storage modes, electrochemical storage, Batteries,Primary and secondary, Solid-state battery, Molten solvent battery, lead acid battery anddrybatteries,Mechanical storage– Flywheel,Electrical storage –Supercapacitor

References:

1. SolarEnergyUtilizationbyG.D.Rai,KhannaPublishers
2. Solar Energy- Fundamentals, design, modelling and applications by G.N. Tiwari, NarosaPublications, 2005.
3. Solar Energy-Principles of thermal energy collection & storage by S.P. Sukhatme, TataMc-GrawHill Publishers, 1999.
4. Science and Technology of Photovoltaics, P. Jayarama Reddy, CRC Press(Taylor&Francis Group),Leiden&BSPublications,Hyderabad,2009.
5. SolarPhotovoltaics-Fundamentals,technologiesandapplications,ChetanSinghSolanki,PHILearningPvt.Ltd.,
6. Websourcessuggestedbytheteacherconcernedandthecollegelibrarianincludingreadingmaterial.
   (a) https://courses.edx.org/c4x/DelftX/ET.3034TU/asset/solar_energy_v1.1.pdf
   (b) https://www.sku.ac.ir/Datafiles/BookLibrary/45/John%20A.%20Duffie,%20William%20A.%20Beckman(auth.)-Solar%20Engineering%20of%20Thermal%20Processes,%20Fourth%20Edition%20(2013).pdf

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SEMESTER-V

PRACTICAL COURSE 13B: SOLAR ENERGY AND ITS APPLICATIONS

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

The objective of the practical course on Solar Energy and Its Applications is to provide students with hands-on experience and practical skills in working with solar energy systems, performing measurements and analysis, and implementing solar energy projects. The course aims to develop students' proficiency in solar energy system installation, maintenance, performance analysis, and practical application.

LEARNING OUTCOMES:

On successful completion of this practical course, studentshall beable to:

1. Listoutandidentifyvariouscomponentsofsolarthermalcollectorsandsystems,solarphotovoltaic modules and systems.
2. Learntheproceduresformeasurementofdirect,globalanddiffusesolarradiation,I-Vcharacteristics andefficiencyanalysisofsolar cells andmodules.
3. Demonstrateskillsacquiredinevaluatingtheperformanceofsolarcell/moduleinconnectingthem appropriatelytoget required poweroutput.
4. Acquire skills in identification and elimination of the damaged panels without affectingtheoutput power in amodule/ array.
5. Perform proceduresandtechniquesrelatedtogeneralmaintenanceofsolarthermalandphotovoltaic modules.

Practical(Laboratory)Syllabus:

1. Measurementofdirectradiationusingpyrheliometer.
2. Measurementofglobalanddiffuseradiationusingpyranometer.
3. Evaluationofperformanceofaflatplatecollector
4. Evaluationofsolarcell/ moduleefficiencybystudyingtheI–Vmeasurements.
5. Determinationofseriesandshunt resistanceofasolarcell /module.
6. Determinationofefficiencyoftwosolarcells /modulesconnectedinseries.
7. Determinationofefficiencyoftwosolar cells/modulesconnectedinparallel.
8. Studytheeffectofinputintensityontheperformanceofsolarcell/ module.
9. Studytheinfluenceof cell/ moduletemperatureontheefficiency.
10. Studytheeffectofcell/moduleinclinationon theefficiency.

LabReferences:

1. Solar Photo voltaic- Alab training manual, C.S. Solanki et al., Foundation Books Publishers,2012.
2. Laboratory Manual on Solar thermal experiments, HP Garg, TC Kandpal, NarosaPublishingHouse2000.
3. Web sources suggested by the teacher

concerned.https://renewablelab.niu.edu/experiments/solarPanelDevelopment of simple solar hot water collector:https://www.youtube.com/watch?v=WP8H5IOTwYUhttps://www.instructables.com/Solar-Water-Heater-From-Scratch/

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PRACTICAL COURSE 13B: SOLAR ENERGY AND ITS APPLICATIONS

STUDENT ACTIVITIES

Co-Curricular Activities

(a) Mandatory:(*Trainingofstudents byteacherinfieldrelatedskills: (lab:10+field:05*)

1. **For Teacher**: Training of students by the teacher in the in the laboratory/field for not lessthan 15 hours on the field techniques/skills related to measurement of direct, diffused andglobal solar radiation; demonstration of procedures used in the performance evaluation ofsolar flat plate collectors, solar photovoltaic cells and modules measurement of differentparametersin thecalculation ofefficiency.

2. **ForStudent**:Studentsshallvisittosolarthermalandphotovoltaiclaboratoriesinuniversities/researchorganizations/nearbyindustriestoobserveandunderstandthetechniques and procedures used for evaluation of solar collector, solar cell and moduleefficiencies. They shall write their observations and submit to the teacher hand-writtenFieldwork/Project worknot exceeding10 pages in thegiven format.
3. MaxmarksforFieldwork/Project work:05.
4. Suggested Format for Fieldwork/Project work: *Title page, student details, index page,detailsof placevisited, observations,findings andacknowledgements*.
5. Unittests(IE).

(b) SuggestedCo-CurricularActivities

1. Training of students by related industrial/ technical experts using guest lectures/ invitedtalks.
2. Assignments (including technical assignments like identifying components of a solar hotwaterandsolarphotovoltaicsystemsandtheirhandling,operationaltechniquesandmaintenanceprocedureswith safetyand security)
3. Seminars,Groupdiscussions,Quiz,Debatesetc.onrelatedtopics.
4. Preparationofvideosonthermalandphotovoltaicsystemsandtechnicalprocedures.
5. Collection of brochures/figures/photos related to products and applications of solar energyandorganizingthem in asystematicwayin afile.
6. Making a (i) solar panel (ii) solar light (iii) solar cooker (iv) solar oven (v) solar inverter atHome.
7. Visits to nearby solar thermal system as well as solar photovoltaic power stations,firms,researchorganizations etc.

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SYLLABUS UNDER CBCS

w.e.f. 2023-24 (Revised in May 2023)

SEMESTER-V

COURSE 12C: APPLICATIONS OF ELECTRICITY AND MAGNETISM

Hours: 45 Credits: 33 hrs/week

COURSE OBJECTIVE:

The objective of the course on Applications of Electricity and Magnetism is to provide students with a comprehensive understanding of the practical applications of electricity and magnetism in various fields. The course aims to develop students' knowledge and skills in applying electrical and magnetic principles to real-world problems and technologies.

LEARNINGOUTCOMES:

Students aftersuccessfulcompletionofthecoursewillbeableto:

1. Identifyvariouscomponents present inElectricity&ElectronicsLaboratory.
2. Acquireacriticalknowledgeofeachcomponentanditsutility(likeresistors,capacitors,inductors, power sources etc.).
3. Demonstrate skills of constructing simple electronic circuits consisting of basic circuitelements.
4. Understandtheneed&FunctionalityofvariousDC&ACPowersources.
5. Comprehendthedesign,applicationsandpracticesofvariouselectrical&Electronicdevices andalso their trouble shooting.

Unit-I: Introduction to Passive Elements 9hrs

a) Passive elements

Resistor - Types of Resistors, Color coding, Combination of Resistors – Series combination (Voltage division), Parallel combination (Current division), Ohms Law and its limitation. Inductor - Principle, EMF induced in an Inductor, Energy stored in Inductor, Phase relation between V and I, Combinations of Inductors, Types of Inductors. Capacitor - Principle, Charging and discharging of a Capacitor, Types of Capacitors, Color coding

b) Applications of Passive elements:

Applications of a Resistor as a heating element in heaters and as a fuse element. Open circuit, Short circuit, Applications of Inductors, Application of choke in a fan and in a radio tuning circuit, Series resonance circuit as a Radio tuning circuit. Applications of Capacitor in power supplies, motors (Fans) etc**.**

Unit-II Power Sources (Batteries) 9hrs

a) Power sources:

Types of power sources-DC & AC sources, Different types of batteries, Rechargeable batteries –Lead acid batteries, Li-ion batteries **Series, Parallel& Series-Parallel configuration of batteries**,

b) Network Theorems for DC circuits

Thevenin's theorem, Norton's theorem, Maximum Power transfer theorem, Constant Voltage source-Constant Current Source-Applications of Current sources & Voltage sources, SMPS used in computers.

Unit-III Alternating & Direct Currents (9hrs

a) A.C Generator, Construction and its working principle, Types of AC Generators, DC Generator, Construction and its working principle, advantages and disadvantages, Applications, Types of DC Generators, Losses associated with DC generators, Differences between DC and AC generators

b) Transformers- Construction and its working principle, EMF equation, Open circuit and short circuit tests, Types of Transformers - Step-down and Step-up Transformers, Relation between primary turns and secondary turns of the transformer with emf, Use of a Transformer in a regulated Power supplies, Single phase motor – working principle, Applications of motors (like water pump, fan etc).

Unit-IV Modulation Circuits 9hrs

a) Need for modulation, Types of modulation, Amplitude modulation, modulation index, Waveforms, Power relations, Demodulation, Diode detector, AM transmitter, AM Receiver, Frequency modulation, modulation index, Waveforms, FM Transmitter, FM Receiver

b) Transmitters and Receivers:

AM transmitter, AM Receiver, Frequency modulation, modulation index, Waveforms, FM Transmitter, FM Receiver

Unit-V Applications of EM Induction&Power Supplies 9hrs

a) DC motor – Construction and operating principle, Calculation of power, voltage and current in a DC motor, Design of a simple Motor (for example Fan) with suitable turns of coil

b) Working of a DC regulated power supply, Construction of a 5 volts regulated power supply, Design of a step-down(ex:220-12V) and step-up(ex:120-240V) transformers-Simple Design ofFM Radio circuit using LCR series resonance (tuning) circuit, Checking the output voltage of a battery eliminator using a Multimeter.(Trouble shooting), Design of a simple 5 voltsDC charger, Power supply for computers(SMPS)

References:

1. Grob's Basic Electronics by Mitchel Schultz , TMH or McGraw Hill
2. Electronic and Electrical Servicing by Ian Robertson Sinclair, John Dunton, Elsevier Publications
3. Troubleshooting Electronic Equipment by R.S.Khandapur ,TMH
4. Web sources suggested by the teacher concerned and the college librarian including reading material.

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w.e.f. 2023-24 (Revised in May 2023)
SEMESTER-V
PRACTICAL COURSE 12C: APPLICATIONS OF ELECTRICITY AND MAGNETISM

Hours: 30 Credits: 12 hrs/week

PRACTICALSYLLABUS

COURSE OBJECTIVE:

The objective of the practical course on Applications of Electricity and Magnetism is to provide students with hands-on experience and practical skills in applying electrical and magnetic principles to real-world applications. The course aims to develop students' proficiency in working with electrical circuits, electromagnetic devices, and related technologies through practical experimentation and project-based activities.

LEARNING OUTCOMES:

On successful completion of this practical course, studentshall beable to:

1. Listout,identifyandhandlevariousequipmentinElectrical&Electronicslaboratory.
2. Learntheproceduresof designingsimpleelectricalcircuits.
3. Demonstrateskills ontheutilityofdifferentelectricalcomponentsanddevices.
4. Acquire the skills regarding the operation, maintenance and troubleshooting of variousDevicesin thelab.
5. UnderstandthedifferentapplicationsofElectromagneticinduction.

Practical(Laboratory)Syllabus:

1. Acquaintingwiththesolderingtechniques
2. DesignandConstructionofa5VoltsDC unregulatedpowersupply
3. ConstructionofaStepdownTransformerandmeasurementofitsoutputvoltage.Andtocomp areit with the calculated value.
4. Connect two or three resistors or capacitors or inductors and measure the Series,Parallel Combination values using a Multimeter and compare the values with theCalculatedvalues.
5. Use the Digital Multimeter and Analog Multimeter to measure the output voltage of anAC&DC powersupplyandalso thevoltageand frequencyofaACsignalusingCRO.
6. Use the Multimeter to check the functionality of a Diode and Transistor. Also testwhetherthe given transistor is PNP or NPN.
7. Construct a series electric circuit with R, L and C having an AC source and study

thefrequencyresponseofthis circuit. Find theResonanceFrequency.

8. Construct a Parallel electric circuit with R, L & C having an AC source and study thefrequencyresponseof this circuit.Find the resonant frequency.
9. Testwhetheracircuitis aOpencircuitorShortCircuitbymeasuringcontinuitywithaMultimeterand recordyourreadings.

I. LabReferences:

1. LaboratoryManualforIntroductoryElectronicsExperimentsbyMaheshwari,L.K.Anand,M .M.S., New AgeInternational (P)Ltd.
2. Electricity-Electronics Fundamentals: A Text-lab Manual by Paul B. Zbar,JosephSloop,&Joseph G. Sloop , McGraw-Hill Education
3. LaboratoryManual Basic ElectricalEngineeringbyUmesh Agarwal, NotionPress
4. Basic Electrical and Electronics Engineering by S.K. Bhattacharya, PearsonPublishers.
5. Websourcessuggestedbytheteacherconcerned.

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SEMESTER-V
PRACTICAL COURSE 12C: APPLICATIONS OF ELECTRICITY AND MAGNETISM
STUDENT ACTIVITIES

Co-CurricularActivities:

(a) Mandatory:(*Trainingofstudents byteacherinfieldrelatedskills:(lab:10+field:05*)

1. **For Teacher**: Training of students by the teacher (if necessary, by a local expert) inlaboratory/field for not less than 15 hours on the understanding of various electronic&electrical components and devices. And also understand the functional knowledge ofthese components and devices so that the student can safely handle these electroniccomponents.

2. **For Student**: Students shall (individually) visita local Radio, TV or Mobile repair shopto understand the testing and soldering techniques and different electronic componentsin the devices that we use daily life. And also to understand the troubleshooting andworking of domestic appliances such as cell phone chargers, fan, electric iron, heater,inverter,microoven,washingmachineetc.(Or)StudentsshallalsovisitthePhysics/Electron ics or Instrumentation Labs of nearby local institutions and can getadditionalknowledgebyinteractingwiththetechnicalpeopleworkingthere.(Or)Students shall also visit the local motor winding shop to understand the motorwinding and working of different types of motors. After the observations, a hand-written Fieldwork/Project worknot exceeding10 pagesin the given format to besubmittedto theteacher.
3. MaxmarksforFieldwork/Projectwork:05.
4. Suggested Format for Fieldwork/Project work: *Title page, student details, index page,details of placevisited, observations, findings andacknowledgements*.
5. Unittests(IE).

(b) <u>SuggestedCo-CurricularActivities</u>

1. Trainingofstudentsbyrelatedindustrialexperts.
2. Assignments (including technical assignments like identifying various electrical andelectronic components &devices and their handling, operational techniques with safetyandsecurity)
3. Seminars,Groupdiscussions,Quiz,Debatesetc.(onrelatedtopics).
4. PreparationofvideosontoolsandtechniquesinElectrical&ElectronicAppliancesindailylife.
5. CollectionofmaterialfiguresphotosrelatedtoElectricalproductslikeHeaters,Motors,Fans etc.andwritingand organizingthemin asystematicwayinafile.
6. Visitsto nearby electricalor electronic industries or laboratoriesin universities,researchorganizations, private firms, etc.

7. Invitedlecturesandpresentations onrelatedtopicsbyfield/industrialexperts

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w.e.f. 2023-24 (Revised in May 2023)

SEMESTER-V

COURSE 13C: ELECTRONIC INSTRUMENTATION

Hours: 45 Credits: 33 hrs/week

COURSE OBJECTIVE:

The objective of the course on Electronic Instrumentation is to provide students with a comprehensive understanding of various electronic instruments used for measurement, data acquisition, and control applications. The course aims to develop students' knowledge and skills in the design, operation, calibration, and application of electronic instruments.

LEARNINGOUTCOMES:

Studentsaftersuccessfulcompletionofthecoursewill beableto:

1. IdentifyvariousfacilitiesrequiredtosetupabasicInstrumentationLaboratory.
2. AcquireacriticalknowledgeofvariousElectricalInstruments usedintheLaboratory.
3. Demonstrate skills of using instruments like CRO, Function Generator, Multimeter etc.throughhands on experience.
4. Understand the Principle and operation of different display devices used in the displaysystems and different transducers
5. Comprehend the applications of various biomedical instruments in daily life like B.P.meter, ECG, Pulse oximeter etc. and know the handling procedures with safety andsecurity.

UNIT-I Introduction to Instruments (9Hrs

a) Basic of measurements:

Instruments accuracy, precision, sensitivity, resolution, range, errors in measurement, Classification of Instruments, Analog instruments & Digital Instruments, Construction and working of an Analog Multimeter and Digital Multimeter (Block diagram approach), DC Voltmeter and AC Voltmeter, Sensitivity, 3½ display and 4½ display Digital Multimeter, Sources of errors in the Measurement of resistance, voltage and current, Specifications of Multimeter and their significance.

b) Balancing and damping Moving iron instruments & PMMC instruments.

UNIT-II Oscilloscope (9Hrs

a) Cathode ray oscilloscope – Principle and block diagram of CRO - Cathode Ray Tube – functioning – various controls

b) Applications CRO: Measurement of voltage (dc and ac), frequency & time period, Different types of oscilloscopes and their uses, Digital storage Oscilloscope

UNIT-III Transducers and Bridges (9Hrs

a) Linear Variable Differential Transformer (LVDT), Resistive, Capacitive & Inductive transducers, Piezo-electric transducer.

b) DC Bridge -Wheatstone's bridge, AC Bridges - Measurement of Inductance and Capacitance – Maxwell's bridge, Schering Bridge, Measurement of frequency – Wien's bridge.

UNIT-IV ADCand DAC& Display Instruments (9Hrs

a) A/D & D/A converters - Binary ladder, A/D converters –successive approximation type.

b) Introduction to Display devices, LED Displays, Seven Segment Displays, Construction and operation (Display of numbers), Types of SSDs (Common Anode & Common Cathode type), Limitations of SSDs, Liquid Crystal Displays, Principle and working, Applications of LCD modules.

UNIT-V Amplifiers, Oscillators & Biomedical Instruments (9Hrs

a) Amplifiers – Classification of amplifiers, Coupling amplifiers – RC Coupled amplifier – frequency response characteristics (no derivation), Feedback in Electronic circuits – Positive and Negative feedback, expressions for gains, advantages of negative feedback, Barkhausen criteria, RC phase shift oscillator.

b) Basic operating principles and uses of (i) ECG machine (ii) Radiography (iii) Ultrasound scanning (iv) Ventilator (v) Pulse oximeter.

REFERENCE BOOKS:

1. Electronic Instrumentation by H.S.Kalsi ,TMH Publishers
2. Electronic Instrument Hand Book by Clyde F. Coombs ,McGraw Hill
3. Introduction to Biomedical Instrumentation byMandeep Singh, PHI Learning.
4. Electronic Instrumentation – WD Cooper
5. Electrical and Electronic Instrumentation – AK Sawhany
6. A text book in electrical technology by B.L.Thereja (S.Chand&Co)
7. *Biomedical Instrumentation* and Measurements by Leslie *Cromwell ,Prentice Hall India.*
8. Electronic Measurements and Instrumentation by Kishor, K Lal, Pearson, New Delhi
9. Electrical and Electronic Measurements by Sahan, A.K., Dhanpat Rai, New Delhi
10. Electronic Instruments and Measurement Techniques by Cooper, W.D. Halfrick, A.B., PHI Learning, New Delhi
11. Web sources suggested by the teacher concerned and the college librarian including reading material.

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w.e.f. 2023-24 (Revised in May 2023)

SEMESTER-V

PRACTICAL COURSE 13C: ELECTRONIC INSTRUMENTATION

Hours: 30 Credits: 12 hrs/week

COURSE OBJECTIVE:

The objective of the practical course on Electronic Instrumentation is to provide students with hands-on experience in using electronic instruments for measurement, data acquisition, and control applications. The course aims to develop students' practical skills in operating, calibrating, and troubleshooting electronic instruments commonly used in scientific, engineering, and industrial settings.

LEARNING OUTCOMES:

1. Familiarize students with a range of electronic instruments, including multimeters, oscilloscopes, signal generators, and data acquisition systems.
2. Learn the basic operation, functions, and features of each instrument.
3. Gain hands-on experience in connecting, configuring, and using different instruments for various measurement tasks.
4. Develop proficiency in performing common electrical measurements, such as voltage, current, resistance, frequency, and temperature measurements.
5. Learn specialized measurement techniques, including impedance measurements, time and frequency measurements, and power measurements.
6. Gain practical experience in selecting appropriate measurement techniques and instruments for specific applications.

PRACTICAL SYLLABUS

1. Familiarization of digital multimeter and its usage in the measurements of (i) resistance (ii) current, (iii) AC & DC voltages
2. Measure the AC and DC voltages, frequency using a CRO and compare the values measured with other instruments like Digital multimeter.
3. Formation of Sine, Square wave signals on the CRO using Function Generator and measure their frequencies. Compare the measured values with actual values.
4. Display the numbers from 0 to 9 on a single Seven Segment Display module by applying voltages.
5. Displacement transducer-LVDT
6. A.C - Impedance and Power Factor.

7. Maxwell's Bridge – Determination of Inductance.
8. Measurement of body temperature using a digital thermometer and list out the error and corrections.
9. Measurement of Blood Pressure of a person using a B.P. meter and record your values and analyze them.
10. Display the letters **a** to **h** on a single Seven Segment Display module by applying voltages.
11. Get acquainted with an available ECG machine and study the ECG pattern to understand the meaning of various peaks
12. Observe and understand the operation of a Digital Pulseoxymeter and measure the pulse rate of different people and understand the working of the meter.

VI. Lab References:

1.Electronic Measurement and Instrumentation by J.P. Navani. ,S Chand & Co Ltd

2.Principles of Electronic Instrumentation by A De Sa, Elsevier Science Publ.

3. Electronic Measurements and Instrumentation by S.P.Bihari, YogitaKumari, Dr. Vinay Kakka, Vayu Education of India .

4.Laboratory Manual For Introductory Electronics Experiments by Maheshwari, New Age International (P) Ltd., Publishers.

5.Electricity-Electronics Fundamentals: A Text-lab Manual by Paul B. Zbar ,Joseph Sloop, & Joseph G. Sloop , McGraw-Hill Education.

6.Web sources suggested by the teacher concerned.

B.Sc. (HONOURS) PHYSICS SINGLE MAJOR

SYLLABUS UNDER CBCS

w.e.f. 2023-24 (Revised in May 2023)

SEMESTER-V

PRACTICAL COURSE 13C: ELECTRONIC INSTRUMENTATION

STUDENT ACTIVITIES

Co-CurricularActivities

(a) Mandatory:(*Trainingofstudents byteacherinfieldrelatedskills:(lab:10+field:05*)

1. **For Teacher**: Training of students by the teacher in the in the laboratory/field for notless than 15 hours on the field techniques/skills of understanding the operation,Maintenance and utility of various electrical and electronic instruments both in theLaboratoryaswell asindailylife.

   For Student: Students shall (individually)visit a local electrical and electronics shop orsmall firm to familiarize with the various electrical and electronic instruments available inthemarketandalsotounderstandtheirfunctionality,principleofoperationandapplications as well as the troubleshooting of these instruments.(Or) Student shall visit adiagnostic centre and observe the ECG machine and the ECG pattern(Or) Student shallvisit a diagnostic centre and observe the CT scan and MRI scan.(Or) Student shall visit amobilesmartphonerepairshopandobservethedifferentcomponentsonthePCB(Motherboard), different ICs (chips) used in the motherboard and trouble shooting oftouchscreen in smart phones.

   Observations shall be recorded in a hand-written Fieldwork/Project work not exceeding 10pagesin thegiven format to besubmittedto the teacher.
2. MaxmarksforFieldwork/Project work:05.
3. Suggested Format for Fieldwork/Project work: *Title page, student details, index page,detailsof placevisited,observations, findings andacknowledgements*.
4. Unittests(IE)

(b) SuggestedCo-CurricularActivities

1. Trainingofstudentsbyrelatedindustrial/ technicalexperts.
2. Assignments (including technical assignments like identifying different measuringinstruments and tools and their handling, operational techniques with safety andsecurity.
3. Seminars,Groupdiscussions,Quiz,Debatesetc.(onrelatedtopics).
4. Makingyourownstethoscopeat home.
5. Makingsevensegmentdisplayathome.
6. Preparationofvideosontoolsandtechniquesinvariousbranchesofinstrumentation.
7. Collection of material/figures/photos related to products of Measuring Instruments,Display Modules and Biomedical Instruments and arrange them in a systematic way inafile.
8. Visits to Instrumentation Laboratories of local Universities or Industries like Cement,ChemicalorSugarPlantsetc.oranynearbyresearchorganizations,private firms,etc.
9. InvitedlecturesandpresentationsonrelatedtopicsbyTechnical /industrialexperts

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