HOLY CROSS COLLEGE (AUTONOMOUS) TIRUCHIRAPPALLI-620002

SCHOOL OF PHYSICAL SCIENCES

PG AND RESEARCH DEPARTMENT OF PHYSICS

CHOICE BASED CREDIT SYSTEM

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK (LOCF)

Programme Outcomes (POs)

PO 1	Demonstrate ability and attitude to acquire knowledge and skills in the advancing global scenario to apply them effectively and ethically for professional and social development.
PO 2	Involve in research and innovative endeavours and share their findings for the wellbeing of the society
PO 3	Work effectively in teams and take up leadership in multi-cultural milieu.
PO 4	Act with moral, ethical and social values in any situation.
PO 5	Excel as empowered woman to empower women.
PO 6	Participate in activities towards environmental sustainability goals as responsible citizens.
PO7	Pursue higher studies in the related fields of science, humanities and management.
PO8	Analyse and record the results obtained using experimental and analytical techniques in physical, chemical and biomedical laboratories
PO9	Develop a range of generic skills related to self-employment and entrepreneurship in areas related to Physical Sciences.

Programme Specific Outcomes (PSOs)

PSO1	Appraise the concepts of Physics in classical Mechanics, Quantum Mechanics, Modern Physics and Electrodynamics to observe and appreciate the diverse phenomena in nature.
PSO2	Apply the mathematical tools and theoretical concepts to solve complex physical problems.
PSO3	Propose new concepts with multidimensional and multidisciplinary approach to make human life easy & interesting.

(For Candidates admitted in the Academic year 2023-2024)
SCHOOL OF PHYSICAL SCIENCES

PG & RESEARCH DEPARTMENT OF PHYSICS UG
COURSE PATTERN
I B.Sc. PHYSICS

Semester	Part	Subject	Code	Hours	Credits
I	I	Language-General Tamil/ Hindi/ French	U23TL1GEN01/ U23HN1HIN01/ U23FR1FRE01	6	3
	II	General English	U23EL1GEN01	6	3
	III	Core Course 1 -Properties of Matter and Sound	U23PH1CCT01	5	5
		Core Course 2 – Core Practical 1	U23PH1CCP02	4	3
		Allied - Mathematics 1	U23MA1ALT01	5	5
	IV	Skill Enhancement Course - I (NME)	U23PH1SET01	2	2
		Foundation Course	U23PH1FCT01	2	2
		Value Education		-	-
		Total		**30**	**23**
II	I	Language-General Tamil/ Hindi/ French	U23TL2GEN02/ U23HN2HIN02/ U23FR2FRE02	5	3
	II	General English	U23EL2GEN02	5	3
	III	Core Course 3 – Heat, Thermodynamics and Statistical Physics	U23PH2CCT03	6	5
		Core Course 4 – Core Practical 2	U23PH2CCP04	4	3
		Allied - Mathematics 2	U23MA2ALT03	5	5
	IV	Skill Enhancement Course - II (NME)	U23PH2SET02	2	2
		Skill Enhancement Course - III (Generic) – Sustainable Rural Development and Student Social Responsibility	U23PH2SET03	2	2
		Massive Open Online Course (MOOC)	U23EX2ONC01		2(Extra)
		Value Education		1	-
		Internship – (30 hours)			2(Extra)
		Total		**30**	**23+4**
III	I	Language-General Tamil/ Hindi/ French	U23TL3GEN03/ U23HN3HIN03/ U23FR3FRE03	5	3
	II	General English	U23EL3GEN03	5	3
	III	Core Course 5 – Mechanics	U23PH3CCT05	6	5
		Core Course 6 – Core Practical 3	U23PH3CCP06	4	3
		Allied – Chemistry 1	U23CH3ALT03	4	3
		Allied – Chemistry Practicals 1	U23CH3ALP04	2	2
	IV	Skill Enhancement Course – IV Entrepreneurial Skill	U23PH3SET04	2	2
		Skill Enhancement Course – V Industry relations	U23PH3SET05	1	1
		Massive Open Online Course (MOOC)	U23EX3ONC02		2(Extra)
		Value Education		1	-
		Total		**30**	**22+2**

IV	I	Language-General Tamil/ Hindi/ French	U23TL4GEN04/ U23HN4HIN04/ U23FR4FRE04	5	3
	II	General English	U23EL4GEN04	5	3
	III	Core Course 7– Optics and Laser Physics	U23PH4CCT07	5	5
		Core Course 8– Core Practical 4	U23PH4CCP08	3	3
		Allied – Chemistry Practicals 2	U23CH4ALP05	2	2
		Allied – Chemistry 2	U23CH4ALT06	3	3
	IV	Skill Enhancement Course – VI (Discipline Specific)	U23PH4SET06	2	2
		Skill Enhancement Course – VII (Discipline Specific)	U23PH4SET07	2	2
		EVS	U23ES4EVS01	2	2
		Value Education		1	-
		Internship – (30 hours)			2(Extra)
		Total		**30**	**25+2**
V	III	Core Course 9 - Electricity, Magnetism and Electromagnetism	U23PH5CCT09	5	4
		Core Course 10 - Atomic and Nuclear Physics	U23PH5CCT10	5	4
		Core Course 11 - Analog and Communication Electronics	U23PH5CCT11	5	4
		Core Course 12– Core Practical 5	U23PH5CCP12	6	4
		Elective I		4	3
		Elective II		4	3
	IV	Value Education		1	-
		Internship- (30 hours)	U23PH5INT01	-	2
		Total		**30**	**24**
VI	III	Core Course 13 - Quantum Mechanics and Relativity	U23PH6CCT13	5	4
		Core Course 14–Core Practical 6	U23PH6CCP14	5	4
		Core Course 15 - Solid State Physics	U23PH6CCT15	4	2
		Project with viva voce	U23PH6DIS01	5	4
		Elective III		4	2
		Elective IV –		4	2
	IV	Value Education		1	2
		Professional Competency Skill Enhancement Course	U23PH6SET08	2	2
		RESCAPES	U23EX6RES01	-	2(Extra)
	V	Extension Activity	U23EA6SOC01	-	1
		Total		**30**	**23+2**
		Grand Total		**180**	**140+10 =150**

Elective Courses offered by Department of Physics

Sem	Part		Course	Title of the Course	Code
I	**III**	For Maths	ELECTIVE	Allied Physics I	U23PH1ECT01
II	**III**	For Maths	ELECTIVE	Allied Physics II	U23PH2ECT02

Non- Major Elective Courses offered by the Department of Physics

Sem	Part	Course	Title of the Course	Code
I	**IV**	SEC I (Non Major Elective I)	Physics for everyday Life	U23PH1SET01
II	**IV**	SEC II (Non Major Elective II)	Astrophysics	U23PH2SET02

(For Candidates admitted in the Academic year 2023-2024)

Course Title	MAJOR CORE 1: PROPERTIES OF MATTER AND SOUND
Code	U23PH1MCT01
Course Type	THEORY
Semester	I
Hours/Week	4
Credits	3
Marks	100

CONSPECTUS

To Study of the properties of matter leads to information which is of practical value to both the physicist and the engineers. It gives us information about the internal forces which act between the constituent parts of the substance. Students who undergo this course are successfully bound to get a better insight and understanding of the subject.

Course Objectives:

1. To recall and enumerate the properties of matter and sound.
2. To understand the fundamental concepts of properties of matter, nature of simple harmonic motion, travellin and standing wave systems and characteristics of sound.
3. To apply Physics principles such as bending of beams, viscosity, surface tension, simple harmonic motion an reverberation to explain the natural physical processes and related technological advances.
4. To analyze the real time problems employing Physics principles along with elementary Mathematics.

UNIT I: ELASTICITY **12 Hrs**

Hooke's law – stress-strain diagram – elastic constants–Poisson's ratio–relation between elastic constants and Poisson's ratio – work done in stretching and twisting a wire –twisting couple on a cylinder – rigidity modulus by static torsion–torsional pendulum(with and without masses).

Extra reading / Key words: *Elastomers, Fracture mechanics*

UNIT II: BENDING OF BEAMS **12 Hrs**

Cantilever– expression for Bending moment – expression for depression at the loaded end of the cantilever– oscillations of a cantilever – expression for time period –experiment to find Young's modulus –non-uniform bending–experiment to determine Young's modulus by Koenig's method –uniform bending – expression for elevation –experiment to determine Young's modulus using microscope.

Extra reading / Key words: *Gravitational constant, Gravitational field and gravitational potential*

UNIT III: FLUID DYNAMICS **12 Hrs**

Surface tension: definition – molecular forces– excess pressure over curved surface – application to spherical and cylindrical drops and bubbles – determination of surface tension by Jaegar's method–variation of surface tension with temperature.

Viscosity:definition–streamlineandturbulentflow–rateofflowofliquid in a capillary tube – Poiseuille's formula –corrections –terminal velocity and Stoke's formula– variation of viscosity with temperature.

Extra reading / Key words: *Flow of liquid, Neumann's triangle, Rankine's method*

UNIT IV: WAVESANDOSCILLATIONS **12 Hrs**

Simple Harmonic Motion(SHM) – differential equation of SHM – graphical representation of SHM – composition of two SHM in a straight line and at right angles–Lissajous's figures-free, damped, forced vibrations–resonance and Sharpness of resonance.

Laws of transverse vibration in strings –sonometer – determination of AC frequency using sonometer– determination of frequency using Melde's string apparatus.

Extra reading / Key words: *Coherent state, Displacement operator*

UNIT V: ACOUSTICSOFBUILDINGS AND ULTRASONICS **12 Hrs**

Intensity of sound–decibel–loudness of sound –reverberation–Sabine's reverberation formula – acoustic intensity – factors affecting the acoustics of buildings.

Ultrasonic waves: production of ultrasonic waves – Piezoelectriccrystalmethod–magnetostrictioneffect– applicationofultrasonicwaves.

Extra reading / Key words: *Musical note, Echo, Decibel meter*

TEXT BOOKS

1. D.S. Mathur, 2010, Elements of Properties of Matter, S. Chand &Co., (2010).
2. Brij Lal & N. Subrahmanyam, Properties of Matter, S. Chand & Co., (2003).
3. D.R. Khanna &R.S. Bedi, Text book of Sound, Atma Ram &sons, (1969)
4. BrijLal and N. Subrahmanyam, A Text Book of Sound, Second revised edition, Vikas Publishing House, (1995).
5. R. Murugesan, Properties of Matter, S. Chand & Co., (2012).

REFERENCE BOOKS

1. C.J. Smith, General Properties of Matter, Orient Longman Publishers, (1960).
2. H.R. Gulati, Fundamental of General Properties of Matter, Fifth edition, R. Chand &Co., (1977).
3. A.PFrench,VibrationandWaves,MITIntroductoryPhysics,Arnold-Heinmann India (1973)

WEB REFERENCES

1. https://www.biolinscientific.com/blog/what-are-surfactants-and-how-do-they-work
2. http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.html
3. https://www.youtube.com/watch?v=gT8Nth9NWPM
4. https://www.youtube.com/watch?v=m4u-SuaSu1s&t=3s
5. https://www.biolinscientific.com/blog/what-are-surfactants-and-how-do-they-work
6. https://learningtechnologyofficial.com/category/fluid-mechanics-lab/
7. http://www.sound-physics.com/
8. http://nptel.ac.in/courses/112104026/

COURSEOUTCOMES:

The Learner will be able to

CO No	Course Outcomes	Cognitive level
CO 1	Relate elastic behavior in terms of three modulii of elasticity and working of torsion pendulum.	K1
CO 2	Able to appreciate concept of bending of beams and analyze The expression, quantify and understand nature of materials.	K2
CO 3	Explain the surface tension and viscosity of fluid and support the interesting phenomena associated with liquid surface, soap films provide an analogue solution to many engineering problems.	K3
CO 4	Analyze simple harmonic motions mathematically and apply them. Understand the concept of resonance and use it to evaluate the frequency of vibration. Set up experiment to evaluate frequency of ac mains	K4
CO 5	Understand the concept of acoustics, importance of constructing buildings with good acoustics. Able to apply their knowledge of ultrasonics in real life, especially in medical field and as similate different methods of production of ultrasonic waves	K5

PO –CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	M	S	M	S
CO2	M	S	S	S	M	M	S	M	S	S
CO3	S	M	S	M	S	S	M	S	S	S
CO4	S	S	S	S	S	M	S	M	M	M
CO5	M	M	S	S	M	S	S	S	S	M

(For Candidates admitted in the Academic year 2023-2024)

Course Title	MAJOR CORE2: CORE PRACTICALS- I
Code	U23PH1MCP02
Course Type	Practical
Hours/Week	4
Credits	2
Marks	100

CONSPECTUS

To apply the basic principles of properties of matter and Optics by doing the relevant experiments.

COURSE OBJECTIVES

Apply various physics concepts to understand Properties of Matter, set up experimentation to verifytheories, quantify and analyse, able to do error analysis and correlate results.

Any twelve only:

1. Determination of rigidity modulus without mass using Torsional pendulum.
2. Determination of rigidity modulus with masses using Torsional pendulum.
3. Determination of moment of inertia of an irregular body.
4. Verification of parallel axes theorem on moment of inertia.
5. Verification of perpendicular axes theorem on moment of inertia.
6. Determination of moment of inertia and g using Bifilar pendulum.
7. Determination of Young's modulus by stretching of wire with known masses.
8. Verification of Hook's law by stretching of wire method.
9. Determination of Young's modulus by uniform bending – load depression graph.
10. Determination of Young's modulus by non-uniform bending – scale & telescope.
11. Determination of Young's modulus by cantilever – load depression graph.
12. Determination of Young's modulus by cantilever – oscillation method
13. Determination of Young's modulus by Koenig's method – (or unknown load)

14. Determination of rigidity modulus by static torsion.
15. Determination of Y, n and K by Searle's double bar method.
16. Determination of surface tension & interfacial surface tension by drop weight method.
17. Determination of co-efficient of viscosity by Stokes' method – terminal velocity.
18. Determination of critical pressure for streamline flow.
19. Determination of Poisson's ratio of rubber tube.
20. Determination of viscosity by Poiseullie's flow method.
21. Determination radius of capillary tube by mercury pellet method.
22. Determination of g using compound pendulum

(For Candidates admitted in the Academic year 2023-2024)

Course Title	FOUNDATION COURSE: INTRODUCTORY PHYSICS
Code	U23PH1MCT01
Course Type	Theory
Semester	I
Hours /Week	2
Credits	2
Marks	100

CONSPECTUS

To help students get an overview of Physics before learning their core courses. To serve as a bridgebetween the school curriculum and the degree program.

COURSE OBJECTIVES

1. To recall the basic physics concepts like force, motion and energy.
2. To understand the various forces and to learn the phenomena related to them.
3. To apply concept of vectors to understand concepts of Physics and solve problems.
4. To analyze and differentiate various properties of matter with their behavior and connect themwith different physical parameters involved.

UNIT I: **6 Hrs**

vectors, scalars –examples for scalars and vectors from physical quantities – addition, subtraction ofvectors – resolution and resultant of vectors – units and dimensions– standard physics constants

Extra Reading/Keywords: Force, Torque and Velocity.

UNIT II: FORCE **6 Hrs**

Different types of forces–gravitational, electrostatic, magnetic, electromagnetic, nuclear –mechanicalforces like, centripetal, centrifugal, friction, tension, cohesive, adhesive forces

Extra Reading/Keywords: Newton's laws of motion, Gravitational constant.

UNIT III: ENERGY **6 Hrs**

Different forms of energy– conservation lawsof momentum, energy – typesof collisions –angular momentum– alternate energy sources–real life examples

Extra Reading /Keywords: Stress, Strain.

UNIT IV **6 Hrs**

Types of motion– linear, projectile, circular, angular, simple harmonic motions – satellite motion – banking of a curved roads – stream line and turbulent motions – wave motion – comparison of light and sound waves – free, forced, damped oscillations

Extra Reading /Keywords: Resonance, Sonometer.

UNIT V: **6 Hrs**

surface tension – shape of liquid drop – angle of contact – viscosity –lubricants – capillaryflow – diffusion – real life examples– properties and types of materials in daily use- conductors, insulators – thermal and electric.

Extra Reading /Keywords: Molecular forces, Streamline and Turbulent flow.

TEXT BOOKS

1. D.S.Mathur, 2010, Elements of Properties of Matter,S.Chand &

Co 2.BrijLal & N. Subrahmanyam, 2003, Properties of Matter,

S.Chand &Co.

SUGGESTED READINGS

1. H.R. Gulati, 1977, Fundamental of General Properties of Matter,Fifth edition, S.Chand & Co.

WEB REFERENCES

1. http://hyperphysics.phy- astr.gsu.edu/hbase/permot2.htmlhttps://science.nasa.gov/ems/
2. https://eesc.columbia.edu/courses/ees/climate/lectures/radiation_hays/

COURSEOUTCOMES:

The Learner will be able to:

CO No.	Course Outcomes	Cognitive Level
CO 1	apply concept of vectors to understand concepts of Physics and solve problems	K1
CO 2	appreciate different forces present in Nature while learning about phenomena related to these different forces.	K2
CO 3	quantifyenergy in different process and relate momentum,velocity and energy.	K3
CO 4	differentiate different types of motions they would encounterin various courses and understand their basis	K4
CO 5	relate various properties of matter with their behavior and connect them with different physical parameters involved.	K5

(For Candidates admitted in the Academic year 2023-2024)

Course Title	ALLIED PHYSICS -PAPER I (for Mathematics)
Code	U23PH1ALT01
Course Type	Theory
Semester	I
Hours /Week	4
Credits	3
Marks	100

CONSPECTUS

To impart basic principles of Physics that which would be helpful for students who have taken programmes other than Physics.

COURSE OBJECTIVES

1. To understand about materials and their behaviors and apply it to various situations in laboratory and real life .
2. To understand the various thermodynamical process , electrical current and circuits and applyingconcepts in real life.

3.To understand operations using Boolean algebra and acquire elementary idea s of IC circuits.

UNIT I : WAVES, OSCILLATIONS AND ULTRASONICS 12 hrs

Simple harmonic motion (SHM) – composition of two SHMs at right angles (periods in the ratio 1:1) –Lissajous figures – uses – laws of transverse vibrations of strings – determination of AC frequency using sonometer (steel and brass wires) – ultrasound – production – piezoelectric method -application of ultrasonics: medical field – lithotripsy, ultrasonography – ultra sonoimaging- ultrasonics in dentistry physiotherapy, opthalmology – advantages of noninvasive surgery – ultrasonics in greenchemistry.

UNIT II: PROPERTIES OF MATTER 12 hrs

Elasticity: elastic constants – bending of beam – theoryof non- uniform bending – determination of Young's modulus by non-uniform bending – energy stored in a stretched wire – torsion of a wire – determination of rigidity modulus by torsional pendulum

Viscosity: streamline and turbulent motion – critical velocity – coefficient of viscosity – Poiseuille's formula – comparison of viscosities – burette method,

Surface tension: definition – molecular theory– droplets formation–shape, size and lifetime – COVID

transmission through droplets, saliva – drop weight method – interfacial surface tension

UNIT III: HEAT AND THERMODYNAMICS 12hrs

Joule-Kelvin effect – Joule- Thomson porous plug experiment – theory – temperature of inversion – liquefaction of Oxygen– Linde's process of liquefaction of air– liquid Oxygen for medical purpose– importance of cryocoolers – thermodynamic system – thermodynamic equilibrium – laws of thermodynamics – heat engine – Carnot's cycle – efficiency – entropy – change of entropy in reversible andirreversible process.

UNIT IV: ELECTRICITY AND MAGNETISM: 12hrs

Potentiometer – Principle – Measurement of thermo emf using potentiometer –magnetic field due to a current carrying conductor – Biot-Savart's law – field along the axis of the coil carrying current – peak, average and RMS values of ac current and voltage – power factor and current values in an AC circuit – types of switches in household and factories– Smart wifi switches- fuses and circuit breakers in houses

UNIT V: DIGITAL ELECTRONICS AND DIGITAL INDIA 12hrs

Logic gates, OR, AND, NOT, NAND, NOR , EXOR logic gates – universal building blocks – Boolean algebra – De Morgan's theorem – verification – overview of Government initiatives: software technological parks under MeitY, NIELIT- semiconductor laboratories under Dept. of Space – an introduction to Digital India

TEXT BOOKS

1. Brijlal and N. Subramanyam (1994), Waves and Oscillations, Vikas Publishing House, New Delhi.
2. Brijlal and N. Subramaniam (1994), Properties of Matter, S. Chand & Co., New Delhi.
3. J.B. Rajam and C.L. Arora (1976). Heat and Thermodynamics (8th edition), S. Chand & Co., NewDelhi.
4. R. Murugesan(2005), Optics and Spectroscopy, S. Chand & Co, New Delhi.
5. A. Subramaniyam, AppliedElectronics2ndEdn., National Publishing Co.,Chennai.

SUGGESTED READINGS

1. Resnick Halliday and Walker(2018).Fundamentals of Physics(11thedition),John Willey and Sons,Asia Pvt. Ltd., Singapore.
2. V.R. Khanna and R.S. Bedi (1998),TextbookofSound1stEdn. Kedharnaath Publish & Co, Meerut.
3. N.S. Khare and S.S. Srivastava (1983), Electricity and Magnetism10thEdn.,AtmaRam & Sons,New Delhi.
4. D.R. Khanna and H.R. Gulati(1979).Optics, S. Chand &Co. Ltd., New Delhi.
5. V.K. Metha (2004).Principles of electronics6th Edn. S. Chand and company

WEB REFERENCES

1. https://youtu.be/M_5KYncYNyc
2. https://youtu.be/ljJLJgIvaHY
3. https://youtu.be/7mGqd9HQ_AU

4. https://youtu.be/h5jOAw57OXM
5. https://learningtechnologyofficial.com/category/fluid- mechanics-lab/
6. http://hyperphysics.phy- astr.gsu.edu/hbase/permot2.htmlhttps://www.youtube.com/watch?v=gT8Nth9NWPMhttps://www.youtube.com/watch?v=9mXOMzUruMQ&t=1shttps://www.youtube.com/watch?v=m4u-
7. SuaSu1s&t=3shttps://www.biolinscientific.com/blog/what-are- surfactants-and-how-do-they-work

COURSE OUTCOMES:

The Learner will be able to:

CO1	Explain types of motion and extend their knowledge in the study of various dynamic motions analyze and demonstrate mathematically. Relate theory with practical applications in medical field.
CO2	Explain their knowledge of understanding about materials and their behaviors and apply itto various situations in laboratory and real life. Connect droplet theory with Corona transmission.
CO3	Comprehend basic concept of thermodynamics concept of entropy and associated theoremsable to interpret the process of flow temperature physics in the background of growth of this technology.
CO4	Articulate the knowledge about electric current resistance, capacitance in terms of potential electric field and electric correlate the connection between electric field and magnetic field and analyze them mathematically verify circuits and apply the concepts to construct circuits and study them.
CO5	Interpret the real life solutions using AND, OR, NOT basic logic gates and intend their ideas to universal building blocks. Infer operations using Boolean algebra and acquire elementary idea s of IC circuits. Acquire information about various Govt. programs/ institutions in this field.

(For Candidates admitted in the Academic year 2023-2024)

Course Title	CORE COURSE 3: HEAT, THERMODYNAMICS AND STATISTICAL PHYSICS
Code	U23PH2CCT03
Course Type	Theory
Semester	II
Hours/Week	6
Credits	5
Marks	100

CONSPECTUS

To understand the fundamental concepts of Heat, Thermodynamics and Statistical Physics.

COURSE OBJECTIVES

1. To remember the laws of thermodynamics, properties of gas and different types of heat transmission.
2. To understand the basics of kinetic theory of gases, working of heat engines and ensembles in statistical physics.
3. To apply the laws of thermodynamics in engines, statistical physics in three distributions and low temperature physics in real time applications.
4. To analyze temperature - entropy relation and the three statistical distribution.

UNIT I: KINETIC THEORY OF GASES 18 Hrs.

Introduction- concepts of ideal gas-Postulates of kinetic theory of gases- pressure exerted by gas- Gas equation- Gas laws- Brownian motion-degrees of freedom - Equipartition of energy – C_P, C_V, Specific heat capacity of gases – Meyer's relation- Relation between molar specific heats and degrees of freedom- Specific heats of Mono, Di and polyatomic gas- Behaviour of specific heat at low temperature- Van der Waals' Equation of State - Estimation of critical constants- Mean free path- Clausius expression for mean free path- Application to atmospheric physics.

Extra reading/Key words: *Change of pressure with height, Critical point*

UNIT II: THERMODYNAMICS **18 Hrs.**

Thermodynamic system-Zeroth law of thermodynamics-Thermodynamic Equilibrium- Internal energy-First law of thermodynamics-Significance of the first law-Specific heat of a gas- Carnot's ideal heat engine– Carnot's theorem- Second law of thermodynamics- Internal combustion engine–Entropy – Change of entropy in reversible cycle and irreversible process – T-S Diagram–Maxwell's thermodynamic relations–Clausius and Claypeyron latent heat equations using Maxwell's relations-Thermodynamic potentials.

Extra Reading/Keywords: *Energy, State coordinates*

UNIT III: LOW TEMPERATURE PHYSICS **18 Hrs.**

Joule's Law of perfect gas – Expression for Joule's coefficient - Joule-Thomson effect- porous plug experiment: liquefaction of gases- principle of regenerative cooling- Linde's process-principle of cascaded cooling- adiabatic demagnetization-Peltier effect-practical applications of low temperatures: Refrigeration - refrigerating machines- electro flux refrigerator – Coefficient of performance - Air conditioning machines – Equipment used in air conditioners – Classifications: Summer, Winter, Unitary and Central air conditioners – Criteria for air conditioners – Super fluidity (Qualitative) – Liquid Nitrogen - Solid carbon dioxide and its applications (dry ice).

Extra Reading/Keywords: *Temperature of inversion, Heat capacity*

UNIT IV: TRANSMISSION OF HEAT **18 Hrs.**

Introduction-Transmission of heat-Thermal conductivity – Rectilinear flow of heat– experimental methods to determine the coefficient of thermal conductivity– Forbes's method and Lee's disc method – Kirchoff's law, Stefan's law and Newton's law of cooling – Blackbody radiation – Energy distribution in the black body spectrum- Rayleigh Jean's formula – Wien's law – Planck's radiation formula - Solar constant - Angstrom's Pyrheliometer - temperature of the Sun - Applications of conduction, convection and radiation.

Extra Reading/Keywords: *Conduction, Heat transfer*

UNIT V: STATISTICAL PHYSICS **18 Hrs.**

Introduction-probability-principle of equal a priori probability-permutations and combinations-thermodynamic probability-microstate and macrostate-constraints on a system-Ensemble and average properties-fundamental postulates of statistical mechanics- statistical

Ensembles– microcanonical, canonical and grand canonical ensembles –three kinds of particles

-Basics of Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distribution.

Extra Reading/Keywords: *Degenerate gases, photon gas*

TEXT BOOKS

1. Brijlal and Subramaniam, Heat Thermodynamics and Statistical Physics, S. Chand & Co. New Edition (2012).
2. S.C. Garg, R.M. Bansal, C.K. Ghosh, Thermal Physics: with Kinetic Theory, Thermodynamics and Statistical Mechanics, McGraw Hill, (2020).
3. R.B. Singh , Thermal and Statistical Physics, New Age International Private Limited, (2020).
4. Dr. Priyanka Kanwal, Ravi Kant Sharma, Dr. Balbir Kumar, Thermal Physics & Statistical Mechanics, S Vinesh & Co, (2020).
5. K.K. Pathak, Poppy Hazarika, Thermal Physics, Vishal Publishing Co. (2020).

SUGGESTED READINGS

1. F. Reif, Fundamentals of Statistical and Thermal Physics, Sarat Book House (2010).
2. Mark Zemansky, Richard Dittman, Heat and Thermodynamics, McGraw Hill, (2017).
3. Herbert B Callen**,** Thermodynamics and an Introduction to Thermo statistics, Wiley (2006).
4. D. Jeyaraman. Dr. K. Ilangovan and S. Visvanathan, Thermal Physics & Statistical Mechanics, (2009).

WEB REFERENCES

1. https://www.cleariitmedical.com/2019/05/physics-notes-kinetic-theory-of- gases.html.
2. http://astro1.panet.utoledo.edu/~khare/teaching/phys2130h-spring- 2008/notes/chapter19-svk.pdf.
3. https://www.khanacademy.org/science/physics/thermodynamics.
4. https://www.livescience.com/50776-thermodynamics.html.
5. https://www.kanchiuniv.ac.in/phy/THERMAL%20PHYSICS%20MATERIAL_KR.pdf.
6. https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical- mechanics-of-particles-fall-2013/lecture-notes/.
7. https://nptel.ac.in/courses/112/108/112108149/.

COURSE OUTCOMES:

The Learner will be able to:

Cos	CO Description	Cognitive Level
CO1	recall the properties of gas, laws of thermodynamics and heat transmission.	K1
CO2	understand the concepts of thermodynamics and statistical Physics.	K2
CO3	apply the thermodynamical laws, concepts of low temperature and statistical physics to real time scenario.	K3
CO4	analyze the degrees of freedom in different gas molecules, T-S diagram and comparison of three statistical distributions.	K4

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	**H**	**L**	**M**	**M**	**L**	**H**	**H**	**M**	**M**
CO 2	**H**	**M**	**M**	**M**	**M**	**H**	**H**	**M**	**M**
CO 3	**M**	**M**	**M**	**M**	**M**	**L**	**H**	**H**	**H**
CO 4	**M**	**M**	**M**	**M**	**M**	**L**	**H**	**H**	**H**

CO - PSO Mapping

	PSO1	PSO2	PSO3
CO 1	**H**	**M**	**M**
CO 2	**H**	**H**	**M**
CO 3	**H**	**H**	**H**
CO 4	**H**	**H**	**H**

(For Candidates admitted in the Academic year 2023-2024)

Course Title	CORE COURSE 4 : CORE PRACTICALS 2
Code	U23PH2CCP04
Course Type	Practical
Semester	II
Hours/Week	4
Credits	3
Marks	100

CONSPECTUS:

To apply the basic principles of heat, sound waves and optics by doing the relevant Experiments.

COURSE OBJECTIVES:

1. To understand the fundamental laws of heat, sound and optics.
2. To understand the basic concepts of heat, sound and optics by doing simple experiments with Sonometer, prism and Air wedge.
3. To apply their knowledge gained about the concept of heat, sound, and optics.
4. To analyze the characteristics and applications of electronic devices such as diodes and transistors.

LIST OF EXPERIMENTS:

1. Determination of specific heat by cooling – graphical method.
2. Determination of thermal conductivity of bad conductor by Lee's disc method.
3. Velocity of sound through a wire using Sonometer.
4. Frequency of AC using Sonometer.
5. To verify the laws of transverse vibration using Sonometer.
6. Determination of Refractive Index of material of a prism using Spectrometer.
7. Characteristics of P-N Junction Diode
8. Study of Logic gates using discrete components – AND, OR & NOT
9. Determination of thickness of a wire by forming Air Wedge.
10. Study of Zener diode characteristics.

WEB REFERENCES

1. http://ov-au.vlabs.ac.in/optics/Spectrometer_Refractive_Index/experiment.html
2. http://vlabs.iitkgp.ernet.in/be/exp5/index.html#

COURSE OUTCOMES:

The Learner will be able to:

COs	CO Description	Cognitive Level
CO1	recall the basic ideas of heat, sound and light.	K1
CO2	understand the basic principles of heat and sound by performing simple experiments.	K2
CO3	utilize the acquired knowledge to experiment and validate theories.	K3
CO4	analyse the experimental data and correlate the results.	K4

(For Candidates admitted in the Academic year 2023-2024)

Course Title	ALLIED PHYSICS II (for Mathematics)
Code	U23PH2ECT02
Course Type	Theory
Semester	II
Hours /Week	4
Credits	3
Marks	100

CONSPECTUS

To understand the basic concepts of optics, modern Physics, concepts of relativity and Quantum physics, semiconductor physics and electronics.

COURSE OBJECTIVES

1. To remember the basic concepts of modern physics.
2. To understand the basic concepts of atomic models and relativity.
3. To understand the concepts of nuclear physics and semiconductors.
4. To understand the real time use cases.

UNIT I: OPTICS **12hrs**

Interference – interference in thin films –colors of thin films – air wedge – determination of diameter of a thin wire by air wedge – diffraction – normal incidence – experimental determination of wavelength using diffraction grating – polarization – polarization by double refraction – optical activity – application in sugar industries.

Extra reading/Key words: Q*uantum optics, optical instruments*

UNIT II: ATOMIC PHYSICS **12hrs**

Atom models – Bohr atom model – mass number – atomic number – nucleons – vector atom model – various quantum numbers – Pauli's exclusion principle – electronic configuration – Bohr magneton – Stark effect –Zeeman effect (elementary ideas only) – photoelectric effect – Einstein's photoelectric equation – applications of photoelectric effect: solar cells.

Extra reading/Key words: *Quantum Phenomena, Interactions*

UNIT III: NUCLEAR PHYSICS **12hrs.**

Nuclear models – liquid drop model – magic numbers – shell model – nuclear energy – mass defect – binding energy – radioactivity – uses – half life – mean life - radio isotopes and uses – controlled and uncontrolled chain reaction – nuclear fission – energy released in fission – chain reaction – critical reaction – critical size- atom bomb – nuclear reactor – nuclear fusion – thermonuclear reactions – differences between fission and fusion.

Extra reading/Key words: *Fusion in Sun, Nuclear Power*

UNIT IV: RELATIVITY **12hrs.**

Frame of reference – postulates of special theory of relativity – Galilean transformation equations Lorentz transformation equations – derivation – length contraction – time dilation – twin paradox mass-energy equivalence

Extra reading/Key words: *Concept of space and time, Black holes*

UNIT V: SEMICONDUCTOR PHYSICS **12hrs.**

Introduction - p-n junction diode – forward and reverse biasing – characteristic of diode – zener diode – characteristic of zener diode – voltage regulator – full wave bridge rectifier – construction and working – advantages

Extra reading/Key words: *Photonic crystals, semiconductors in nanoscale*

TEXT BOOKS

1. R.Murugesan , Allied Physics, S.Chand & Co, New Delhi (2005).
2. K.Thangaraj and D.Jayaraman, Allied Physics, Popular Book Depot, Chennai(2004).
3. Brijlal and N.Subramanyam, Textbook of Optics, S.Chand & Co, New Delhi(2002).
4. R. Murugesan, Modern Physics, S.Chand & Co, New Delhi (2005).
5. A.Subramaniyam Applied Electronics, 2nd Edn., National Publishing Co., Chennai.

SUGGESTED READINGS

1. Resnick Halliday and Walker, Fundamentals of Physics, 11th Edn., John Willey andSons, Asia Pvt.Ltd, Singapore (2018).
2. D.R.Khanna and H.R.Gulati, Optics, S.Chand & Co.Ltd, New Delhi(1979).
3. A.Beiser Concepts of Modern Physics, Tata McGraw Hill Publication, New Delhi(1997).
4. Thomas L. Floyd Digital Fundamentals, 11th Edn, Universal Book Stall, New Delhi (2017).
5. V.K.Metha, Principles of electronics, 6th Edn, S.Chand and Company, New Delhi(2004).

WEB REFERENCES

1. https://www.berkshire.com/learning-center/delta-p-facemask/https://www.youtube.com/watch?v=QrhxU47gtj4https://www.youtube.com/watch?time_continue=318&v=D38BjgUdL5U&feature=emb_logo
2. https://www.youtube.com/watch?v=JrRrp5F-Qu4
3. https://www.validyne.com/blog/leak-test-using-pressure-transducers/
4. https://www.atoptics.co.uk/atoptics/blsky.htm -
5. https://www.metoffice.gov.uk/weather/learn-about/weather/optical-effects

COURSE OUTCOMES:

The Learner will be able to:

COs	CO Description	Cognitive Level
CO 1	explain the concepts of light, atomic, nuclear and semiconductor physics	K1
CO 2	discuss the theory of relativity and different atomic and nuclear models	K2
CO 3	apply the learned concepts for real time situations	K3
CO 4	analyse the characteristics of junction and zener diode	K4

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO-1	H	L	M	M	L	H	H	M	M
CO-2	H	M	M	M	M	H	H	M	M
CO-3	M	M	M	M	M	L	H	M	H
CO-4	M	M	M	M	M	L	H	H	M

CO - PSO MAPPING

CO/PSO	PSO1	PSO2	PSO3
CO-1	H	M	M
CO-2	H	H	M
CO-3	H	H	H
CO-4	H	H	H

(For Candidates admitted in the Academic year 2023-2024)

Course Title	**ASTROPHYSICS**
Code	**U23PH2SET02**
Course Type	**Skill Enhancement Course – II (NME)**
Semester	**II**
Hours/Week	**2**
Credits	**2**
Marks	**100**

CONSPECTUS

To introduce the wonders of the Universe and to make the students to understand the physical nature of celestial bodies, different layers of the Sun, planets and our Milky Way galaxy.

COURSE OBJECTIVES:

1. To understand the classification and formation of galaxies.
2. To understand the formation of asteroids, meteors, comets and planets.
3. To understand the origin, structures of the Sun and the phenomenon of solar and lunar eclipses.
4. To understand the types of telescope.

UNIT I: GALAXIES AND STELLAR EVOLUTION 6 Hrs.

Classification of galaxies - galaxy clusters - Milky way galaxy - interactions of galaxies, dark matter and superclusters. Life cycle; Stellar Processes (Nuclear) and spectral classification of Stars O, B, A, F, G, K, M.

Extra reading/Key words: *black hole, super novea*

UNIT II: CELESTIAL BODIES 6 Hrs.

Asteroids- Origin, Nature and Orbits of Asteroids Meteors - Meteor showers and sporadic meteors Comets - Periodic comets, Brightness variation in Comets Planets- Surface features of planets and their moons.

Extra reading/Key words: *Kuiper belt, oort cloud*

UNIT III: THE SUN AND ECLIPSES 6 Hrs.

Origin of the solar system - Internal structure and surface features of sun – solar atmosphere – photosphere-chromosphere – solar corona – prominences – sunspots – solar cycle – solar flares. Eclipses - types of eclipses.
– solar and lunar eclipse.

Extra reading/Key words: *total and partial lunar, solar eclipse*

UNIT IV: TELESCOPES

Optical telescopes - magnifying power, brightness, resolving power and f/a ratio – types of reflecting and refracting telescopes - radio telescopes - basic overview of Hubble space telescope.

Extra reading/Key words: *space, solar telescope*

UNIT V: ACTIVITIES IN ASTROPHYSICS

(i) Model of telescopes
(ii) Develop models to demonstrate eclipses/planetary motion
(iii) Night sky observation
(iv) Conduct case study pertaining to any topic in this paper
(v) Visit to any one of the National Observatories
(vi) Any three activities to be done compulsorily.

Extra reading/Key words: *Dobsonian telescopes, Aerial telescopes*

TEXT BOOKS

1. BaidyanathBasu, An introduction to Astrophysics, Second printing, Prentice – Hall of India (P) Ltd, New Delhi (2001).
2. Prof. S. Kumaravelu and Prof. Susheela Kumaravelu "Astronomy", revised edition 2013
3. K.S.Krishnaswamy, Astrophysics – a modern perspective, New Age International (P) Ltd, New Delhi. (2002)
4. Shylaja, B.S. &Madhusudan, H.R Eclipse: A Celestial Shadow Play, Orient BlackSwan, (1999).

SUGGESTED READINGS

1. A.E. Roy and D. Clarke, Astronomy structure of the Universe. Adam Hilger Pub.(1989).
2. Samuel Galsstone, Source Book of Space Sciences, D.Van Nostrand Co. Inc. (1965).
3. V.B. Bhatia, Textbook of Astronomy and Astrophysics with elements of cosmology, Alpha Science International Ltd.(2001).
4. J.V. Narlikar, The Structure of the Universe, Oxford University Press, (1977).

WEB REFERENCES

1. https://study.com/learn/lesson/formation-universe-history-timeline.html
2. https://cesar.esa.int/upload/201807/the_suns_structure_booklet.pdf
3. https://study.com/learn/lesson/asteroid-meteorites-comets-characteristics-description-differences.html
4. https://www.space.com/15892-hubble-space-telescope.html

5. https://spaceplace.nasa.gov/eclipses/en/

COURSE OUTCOMES:

The Learner will be able to

CO No	Course Outcomes	Cognitive level
CO1	recall the classification of galaxies, layers of Sun, types of eclipses and types of telescopes.	**K1**
CO2	explore the formation of galaxy, Asteroids Meteors, comets, planets and the phenomenon of eclipses and purpose of telescope.	**K2**
CO3	apply the gained knowledge to reason out the causes of sun spot, solar flares eclipses, comets, asteroids and meteors.	**K3**
CO4	analyze the characteristics of various celestial bodies	**K4**