ANNAMALAI UNIVERSITY

(Affiliated Colleges)

203 - B.Sc. Physics
Programme Structure and Scheme of Examination (under CBCS)
(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

Part	Course Code	Study Components &Course Title	Credit	Hours	Maximum Marks		
					CIA	ESE	Total
		SEMESTER – I					
I	23UTAML11/ 23UHINL11/ 23UFREL11	Language-I: பொது தமிழ்– I: தமிழிலக்கிய வரலாறு-1/ Hindi-I/ French-I	3	6	25	75	100
II	23UENGL12	General English – I	3	6	25	75	100
III	23UPHYC13	Core – I: Properties of Matter and Acoustics	5	5	25	75	100
	23UPHYP14	Core –II: Practical –I: Physics Practical –I (Covering 23UPHYC13)	5	4	25	75	100
		Elective – I					
	23UCHEE15 23UCHEEP1	Chemistry for Physical Sciences–I Chemistry for Physical Sciences Practical –I	2 1	3 2	25 25	75 75	100 100
IV	23UTAMB16 23UTAMA16	Skill Enhancement Course – 1* NME-I/ Basic Tamil – I / Advanced Tamil - I	2	2	25	75	100
	23UPHYF17	Foundation Course: Introductory Physics	2	2	25	75	100
		Total	**23**	**30**			**800**
		SEMESTER – II					
I	23UTAML21/ 23UHINL21/ 23UFREL21	Language – II: பொது தமிழ் -II: தமிழிலக்கிய வரலாறு-2/ Hindi-II/ French-II	3	6	25	75	100
II	23UENGL22	General English – II	3	6	25	75	100
III	23UPHYC23	Core – III: Heat, Thermodynamics and Statistical Mechanics	5	5	25	75	100
	23UPHYP24	Core –IV: Practical II: Physics Practical –II(Covering 23UPHYC23)	5	4	25	75	100
	23UCHEE25	Elective-II: Chemistry for Physical Sciences-II	2	3	25	75	100
	23UCHEEP2	Chemistry for Physical Sciences Practical -II	1	2	25	75	100
IV	23UTAMB26 23UTAMA26	Skill Enhancement Course – 2* NME-II/ Basic Tamil – II / Advanced Tamil - II	2	2	25	75	100
	23USECG27	Skill Enhancement Course – 3: Internet and its Applications (Common Paper)	2	2	25	75	100
	23UNMSD01	Language Proficiency for employability: Overview of English Communication**	2	-	25	75	100
		Total	**25**	**30**			**900**

		SEMESTER – III					
I	23UTAML31/ 23UHINL31/ 23UFREL31	Language – III: பொது தமிழ் -III: தமிழக வரலாறும், பண்பாடும்/ Hindi-III/ French-III	3	6	25	75	100
II	23UENGL32	General English	3	6	25	75	100
III	23UPHYC33	Core – V: Optics and Laser Physics	5	5	25	75	100
	23UPHYP34	Core –VI: Physics Practical –III	5	5	25	75	100
	23UMATE35	Elective-III: Mathematics 1	3	4	25	75	100
IV	23UPHYS36	Skill Enhancement Course – 4: Home Electrical Installation	1	1	25	75	100
	23UPHYS37	Skill Enhancement Course – 5: Physics of Music	2	2	25	75	100
		Environmental Studies	-	1	-	-	-
		Total	**22**	**30**			**700**

		SEMESTER – IV					
I	23UTAML41/ 23UHINL41/ 23UFREL41	Language – IV: பொது தமிழ் -IV: தமிழும் அறிவியலும்/ Hindi-IV/ French-IV	3	6	25	75	100
II	23UENGL42	General English	3	6	25	75	100
III	23UPHYC43	Core – VII: Core Industry Module - Electricity, Magnetism and Electromagnetism	5	5	25	75	100
	23UPHYP44	Core –VIII: Physics Practical –IV	5	5	25	75	100
	23UMATE45	Elective-IV: Mathematics 2	3	3	25	75	100
IV	23UPHYS46	Skill Enhancement Course – 6: Astrophysics	2	2	25	75	100
	23UPHYS47	Skill Enhancement Course – 7: Basic Instrumentation Skill	2	2	25	75	100
	23UEVSG48	Environmental Studies	2	1	25	75	100
		Total	**25**	**30**			**800**

		SEMESTER – V					
III	23UPHYC51	Core – IX: General Mechanics and Classical Mechanics	4	5	25	75	100
	23UPHYC52	Core –X: Atomic and Nuclear Physics	4	5	25	75	100
	23UPHYC53	Core –XI Analog Electronics	4	5	25	75	100
	23UPHYD54	Core –XII Project with viva-voce	4	5	25	75	100
	23UPHYE55	Elective-V: Physics Practical - V	3	4	25	75	100
	23UPHYE56-1 23UPHYE56-2 23UPHYE56-3	Elective-VI: Communication Physics Energy Physics Lasers and Fiber Optics	3	4	25	75	100
IV	23UVALG57	Value Education	2	2	25	75	100
	23UPHYI58	Summer Internship^{++}	2	-	25	75	100
		Total	**26**	**30**			**800**

		SEMESTER – VI					
III	23UPHYC61	Core-XIII: Relativity and Quantum Mechanics	4	6	25	75	100
	23UPHYC62	Core –XIV: Solid State Physics	4	6	25	75	100
	23UPHYC63	Core –XV: Digital Electronics and Microprocessor 8085	4	6	25	75	100
	23UPHYE64	Elective-VII: Physics Practical VI	3	5	25	75	100
	23UPHYE65-1 23UPHYE65-2 23UPHYE65-3	Elective-VIII: Advanced Mathematical Physics Materials Science Nanoscience and Nanotechnology	3	4	25	75	100
IV	23UPHYF66	Professional Competency Skill: Problem Solving Skills in Physics, Aptitude and Reasoning	2	3	25	75	100
V	23UPHYX67	Extension Activity	1	-	100	-	100
		Total	**21**	**30**			**700**
		Grand Total	**142**				**4700**

Non-major (NME) Electives offered to other Departments

IV	23UPHYN16	Physics for Everyday Life	2	2	25	75	100
	23UPHYN26	Astrophysics	2	2	25	75	100

* PART-IV: NME / Basic Tamil / Advanced Tamil (Any one)
Students who have not studied Tamil upto 12th Standard and have taken any Language other than Tamil in Part-I, must choose Basic Tamil-I in First Semester & Basic Tamil-II in Second Semester.
Students who have studied Tamil upto 10th & 12th Standard and have taken any Language other than Tamil in Part-I, must choose Advanced Tamil-I in First Semester and Advanced Tamil-II in Second Semester.

** The course "23UNMSD01: Overview of English Communication" is to be taught by the experts from Naan Mudhalvan Scheme team. However, the faculty members of Department of English should coordinate with the Naan Mudhalvan Scheme team for smooth conduct of this course.

++Students should complete two weeks of internship before the commencement of V semester.

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credit and Hours Distribution System for all UG courses including Lab Hours

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part I	Language – Tamil	3	6
Part II	English	3	6
Part III	Core Theory, Practical & Elective Courses	13	14
Part IV	Skill Enhancement Course SEC-1 (NME-I)	2	2
	Foundation Course	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part I	Language – Tamil	3	6
Part II	English	3	6
Part III	Core Theory, Practical & Elective Courses	13	14
Part IV	Skill Enhancement Course -SEC-2 (NME-II)	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	**30**

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part I	Language - Tamil	3	6
Part II	English	3	6
Part III	Core Theory, Practical & Elective Courses	13	14
Part IV	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	-	1
		22	**30**

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part I	Language - Tamil	3	6
Part II	English	3	6
Part III	Core Theory, Practical & Elective Courses	13	13
Part IV	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	2	1
		25	**30**

Third Year

Semester-V

Part	List of Courses	Credit	No. of Hours
Part III	Core Theory, Practical, Project & Elective Courses	22	28
Part IV	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	-
		26	**30**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part III	Core Theory, Practical & Elective Courses	18	28
Part IV	Professional Competency Skill	2	2
Part V	Extension Activity	1	-
		21	**30**

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	22	18	92
Part IV	4	4	3	6	4	2	23
Part V	-	-	-	-	-	1	1
Total	23	23	22	25	26	21	**140**

***Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components Part IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

CREDIT DISTRIBUTION FOR U.G. PROGRAMME

Part	Course Details	No. of Courses	Credit per course	Total Credits
Part I	Tamil	4	3	12
Part II	English	4	3	12
Part III	Core Courses	15	4/5	68
	Elective Courses: Generic / Discipline Specific (3 or 2+1 Credits)	8	3	24
Part I, II and III Credits				116
Part IV	Skill Enhancement Courses / NME / Language Courses	7	1/2	15
	Professional Competency Skill Course	1	2	2
	Environmental Science (EVS)	1	2	2
	Value Education	1	2	2
	Internship	1	2	2
Part IV Credits				**23**
Part V	Extension Activity (NSS / NCC / Physical Education)	1	1	1
Total Credits for the UG Programme				**140**

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze(K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate(K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create(K6)	Check knowledge in specific or off beat situations, Discussion, Debating or Presentations	

Programme Outcomes: (These are mereguidelines. Faculty can create POs based on their curriculum or adopt from UGC or the University for their Programme)	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully; read and write analytically and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply the analytic thought to a body of knowledge; analyse and evaluate the proofs, arguments, claims, beliefs on the basis of empirical evidences; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach. **PO4: Problem solving:** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team

	PO8: Scientific reasoning: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Specific Outcomes: **(These are mere guidelines. Faculty can create POs based on their curriculum or adopt from UGC or University for their Programme)**	**PSO1: Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, and beliefs and apply diverse frames of reference to decisions and actions. **PSO 2**: **Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate start-ups and high potential organizations **PSO3**: **Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4**: **Contribution to Business World:** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5**: **Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit

Semester: I Part: III Core - I	**23UPHYC13** **PROPERTIES OF MATTER AND ACOUSTICS**	Credit: 5 Hours: 5

COURSE OBJECTIVES: *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.*

UNIT-I ELASTICITY: 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) [12 Hours]

UNIT-II BENDING OF BEAMS: 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 [12 Hours]

UNIT-III FLUID DYNAMICS: 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 [7 Hours]

VISCOSITY: Definition – streamline and turbulent flow – rate of flow of liquid in a capillary tube – Poiseuille's formula –corrections – terminal velocity and Stoke's formula– variation of viscosity with temperature [7 Hours]

UNIT-IV WAVES AND OSCILLATIONS: 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. [8 Hours]

Laws of transverse vibration in strings –sonometer – determination of AC frequency using sonometer – determination of frequency using Melde's string apparatus [4 Hours]

UNIT-V ACOUSTICS OF BUILDINGS AND ULTRASONICS:

Intensity of sound – decibel – loudness of sound –reverberation – Sabine's reverberation formula – acoustic intensity – factors affecting the acoustics of buildings. [5 Hours]

Ultrasonic waves: production of ultrasonic waves – Piezoelectric crystal method – magnetostriction effect – application of ultrasonic waves [5 Hours]

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
3. D. R. Khanna & R. S. Bedi, 1969, Textbook of Sound, Atma Ram & sons
4. Brijlal and N. Subrahmanyam, 1995, A Text Book of Sound, Second revised edition, Vikas Publishing House.
5. R.Murugesan,2012, Properties of Matter, S. Chand & Co.

REFERENCE BOOKS:

1. C.J. Smith, 1960, General Properties of Matter, Orient Longman Publishers
2. H.R. Gulati, 1977, Fundamental of General Properties of Matter, Fifth edition,R. Chand & Co.
3. A.P French, 1973, Vibration and Waves, MIT Introductory Physics, Arnold-Heinmann India.

WEBLINKS:

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/

COURSE OUTCOMES:

After attending the course, the student will be able to:

COURSE OUTCOMES	**CO1**	Relate elastic behavior in terms of three moduli of elasticity and working of torsion pendulum.
	CO2	Able to appreciate concept of bending of beams and analyze the expression, quantify, and understand nature of materials.
	CO3	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.
	CO4	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
	CO5	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 assimilate different methods of production of ultrasonic waves

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)**for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

	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

SEMESTER: I PART: III Core – II	**23UPHYP14** **PRACTICAL - I**	Credit:5 Hours: 4

COURSE OBJECTIVES: *Apply various physics concepts to understand Properties of Matter viz., elasticity, surface tension, viscosity, moment of inertia, acceleration due to gravity and sound waves in solids. Set up experimentation to verify theories, quantify and analyze.*

LIST OF EXPERIMENTS (Any Eight Experiments only)

1. Compound Pendulum - Determination of 'g' and 'k'.
2. Determination of moment of inertia of an irregular body.
3. Verification of parallel axes theorem on moment of inertia.
4. Verification of perpendicular axes theorem on moment of inertia.
5. Determination of Young's modulus by stretching of wire with known masses.
6. Verification of Hook's law by stretching of wire method.
7. Young's modulus – Non-uniform bending -Pin and microscope.
8. Young's modulus - Uniform bending –Pin and microscope.
9. Rigidity modulus -Torsional Pendulum -without masses.
10. Rigidity modulus -Static torsion -Mirror, Scale and telescope.
11. Surface tension and Interfacial surface tension - drop weight method.
12. Coefficient of viscosity of liquid - Graduated burette - Radius of capillary tube by using microscope.
13. Determination of critical pressure for streamline flow.
14. Determination of Poisson's ratio of rubber tube.
15. Sonometer – verification of laws of transverse vibrations of stretched strings.
16. Sonometer - Frequency of Tuning fork.

TEXT BOOKS:

1. C. C. Ouseph, U. J. Rao, V. Vijayendran (2018), *Practical Physics and Electronics*, S. Viswanathan, Printers & Publishers Private Ltd, Chennai
2. M. N. Srinivasan, S. Balasubramanian, R. Ranganathan (2015) *A Text Book of Practical Physics*, Sultan Chand & Sons, New Delhi

REFERENCE BOOKS:

1. Samir Kumar Ghosh (2000) *A Textbook of Advanced Practical Physics*, NCBA
2. Kolkatta
3. D. Chattopadyay, P.C.Rakshit(2011), *An Advanced Course in Practical Physics*,NCBA, Kolkatta,
4. C.L.Arora, B.Sc., *Practical Physics*,S. Chand and Company., New Delhi.
5. D.P.Khandelwal , *A Laboratory Manual of Physics for Undergraduate Classes*,VaniPublications.

6. B.Saraf et al, *Physics through Experiments,*Vikas Publications.
7. Harnaam Singh., *B.Sc., Practical Physics,*S. Chand and Company, New Delhi.
8. D C Tayal, *University Practical Physics,* Himalaya Publishing House.
9. Gupta & Kumar, *Practical Physics*, Pragati prakashan, Meerut

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSE OUTCOMES	**CO1**	Understand and determine accurately the length, radius by using screw gauge and vernier calipers.
	CO2	Grasp and find the Young's modulus, rigidity modulus of solid materials
	CO3	Recognize and estimate the surface tension and interfacial properties two immiscible liquids.
	CO4	Appreciate and measure the internal friction between the layers of the liquid.
	CO5	perform experiments in sonometer and verification of laws of transverse vibrations.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM(**M**) and LOW(**L**).

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

SEMESTER: I **Part: III**	**23UCHEE15** **CHEMISTRY FOR PHYSICAL SCIENCES– I**	**Credit : 2** **Hours : 3**

Objectives of the course	This course aim state provide knowledge on the • Basics of atomic orbitals, chemical bonds, hybridization • Concepts of thermodynamics and its applications. • Concepts of nuclear chemistry • Importance of chemical industries • Qualitative and analytical methods.
Course Outline	**UNIT-I** **Chemical Bonding and Nuclear Chemistry** Chemical Bonding**:** Molecular Orbital Theory-bonding, anti – bonding
	And non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and Nuclear reactions-group displacement law. Nuclear binding energy-Mass defect-calculations. Nuclear fission and nuclear fusion-differences–Stellar energy. Applications of radioisotopes–carbon dating, rock dating and medicinal applications.
	Unit-II **Industrial Chemistry** Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted Water gas, producer gas, CNG, LPG and oil gas (manufacturing Details not required). Silicones**:** Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple super phosphate.
	significance. Free energy change and its importance (noderivation). Conditions for spontaneity in terms of entropy and Gibbs free energy. Relation ship between Gibbs free energy and entropy.

	UNIT-III **Fundamental Concepts in Organic Chemistry** Hybridization: Orbital overlap, hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Electronic effects: Inductive effect and consequences on K_a and K_b of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric-examples. Reaction mechanisms: Types of reactions–aromaticity (Huckel'srule) – aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft'salkylationandacylation.Heterocycliccompounds:Preparation,propertie sofpyrroleandpyridine.
	UNIT-IV **Thermodynamics and Phase Equilibria** Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its
	Phase Equilibria**:** Phaserule – definition of termsinit. Applicationsof Phase rule to water system. Two component system-Reduced phase Rule and its application to asimple eutectic system (Pb-Ag).
	UNIT-V **Analytical Chemistry** Introductiontoqualitativeandquantitativeanalysis.Principlesofvolumetricanaly sis.Separationandpurificationtechniques–extraction,distillationand crystallization. Chromatography: principle and application of column, paper and thin Layer chromatography.
Extended Professional Component(isa Part of internal Component only, Not to be included In the external examination Question paper)	Questions related to the above topics, from various competitive Examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)

Skills acquired From this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. V.Veeraiyan, Textbook of Ancillary Chemistry; High mount publishing house,Chennai,firstedition,2009. 2. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur,2006. 3. S.ArunBahl,B.S.Bahl, Advanced Organic Chemistry; S.Chandand Company, NewDelhi, twentythirdedition,2012. 4. P.L.Soni,H.M.Chawla, Text Book of Organic Chemistry; Sultan Chand&sons,NewDelhi, twentyninth edition,2007.
Reference Books	5. P.L.Soni,Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, NewDelhi, twentieth edition,2007. 6. B.R.Puri,L.R.Sharma, M.S.Pathania, Text book Physical Chemistry; Vishal Publishing Co.,NewDelhi, forty seventh edition,2018. 7. B.K,Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition,2014.
Website and e-learning source	**1.** https://byjus.com/jee/chemical-bonding/ 2. https://en.wikipedia.org/wiki/Fuel 3. https://www.brainkart.com/article/Fundamentals-of-Organic-Chemistry_36450/ 4. https://chem.libretexts.org/Courses/BethuneCookman_University/B-CU%3A_CH-345_Quantitative_Analysis/Book%3A_Analytical_Chemistry_2.1_(Harvey)/06%3A_Equilibrium_Chemistry/6.02%3A_Thermodynamics_and_Equilibrium_Chemistry 5. https://en.wikipedia.org/wiki/Chromatography
Course Learning Outcomes (for Mapping with Pos and PSOs) **On completion of the course the students should be able to**	

CO1: Gain in-depth knowledge about the theories of chemical bonding, nuclear reactions and its applications.
CO2: Evaluate the efficiencies and uses of various fuels and fertilizers
CO3: Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.
CO4: Apply various thermodynamic principles, systems and phase rule.
CO5:Explain various methods to identify anappropriate method for the separation of chemical components

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PO's and CO's

SEMESTER: I Part: III	23UCHEEP1 **CHEMISTRY FOR PHYSICAL SCIENCE PRACTICAL – I**	**Credit : 1** **Hours : 2**

Objectives of the course	This course aims to provide knowledge on the • basics of preparation of solutions. • principles and practical experience of volumetric analysis
Course Outline	**VOLUMETRIC ANALYSIS** 1. Estimation of sodium hydroxide using standard sodium carbonate. 2. Estimation of hydrochloric acid using standard oxalic acid. 3. Estimation of ferrous sulphate using standard Mohr's salt. 4. Estimation of oxalic acid using standard ferrous sulphate. 5. Estimation of potassium permanganate using standardsodium hydroxide. 6. Estimation of magnesium using EDTA. 7. Estimation of ferrous ion using diphenyl amine as indicator.
Reference Books	V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principlesof Practical Chemistry; Sultan Chand & sons, Second edition, 1997.
Website and E-Learning Sources	1)http://www.federica.unina.it/agraria/analytical-chemistry/volumetricanalysis 2)https://chemdictionary.org/titration-indicator/
Course Learning Outcomes (for Mapping with POs and PSOs)On completion of the course the students should be able to CO 1: gain an understanding of the use of standard flask and volumetric pipettes, burette.CO 2: design, carry out, record and interpret the results of volumetric titration. CO 3: apply their skill in the analysis of water/hardness. CO4: analyze the chemical constituents in allied chemical products	

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution toPSOs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PO's and CO's

Note: Scheme for Practical Evaluation.

Volumetric Estimation – 75

Record – 10 marks
Procedure – 15marks
Results
< 2% - 50 marks
2-3% - 40 marks
3-4% - 30 marks
> 4% - 20 marks

Semester: I Part: IV	**23UPHYF17** (Foundation Course) **INTRODUCTORY PHYSICS**	Credit: 2 Hours: 2

COURSE OBJECTIVES: *To help students get an overview of Physics before learning their core courses. To serve as a bridge between the school curriculum and the degree programme.*

UNIT-I: Vectors, scalars – examples for scalars and vectors from physical quantities – addition, subtraction of vectors – resolution and resultant of vectors – units and dimensions– standard physics constants.

UNIT-II: Different types of forces–gravitational, electrostatic, magnetic, electromagnetic, nuclear –mechanical forces like, centripetal, centrifugal, friction, tension, cohesive, adhesive forces

UNIT-III: Different forms of energy– conservation laws of momentum, energy – types of collisions –angular momentum– alternate energy sources–real life examples.

UNIT-IV: Types of motion– linear, projectile, circular, angular, simple harmonic motions – satellite motion – banking of a curved roads – streamline and turbulent motions – wave motion – comparison of light and sound waves – free, forced, damped oscillations.

UNIT-V: Surface tension – shape of liquid drop – angle of contact – viscosity –lubricants – capillary flow – diffusion – real life examples– properties and types of materials in daily use-conductors, insulators – thermal and electric.

TEXTBOOKS:

1. D. S. Mathur, 2010, Elements of Properties of Matter, S. Chand & Co
2. Brijlal & N. Subrahmanyam, 2003, Properties of Matter, S. Chand & Co.

REFERENCEBOOKS:

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

COURSEOUTCOMES:

At the end of the course, the student will be able to:

COURSE OUTCOMES	**CO1**	Apply concept of vectors to understand concepts of Physics and solve problems
	CO2	Appreciate different forces present in Nature while learning about phenomena related to these different forces.
	CO3	Quantify energy in different process and relate momentum, velocity, and energy
	CO4	Differentiate different types of motions they would encounter in various courses and understand their basis
	CO5	Relate various properties of matter with their behaviour and connect them with different physical parameters involved.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM(**M**) and LOW(**L**).

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

Semester: II Part: III Core - III	**23UPHYC23** **HEAT, THERMODYNAMICS AND STATISTICAL MECHANICS**	Credit: 5 Hours: 5

COURSE OBJECTIVES: *The course focuses on understanding a basic in conversion of temperature in Celsius, Kelvin and Fahrenheit scales. Practical exhibition and explanation of transmission of heat in good and bad conductor. Relate the laws of thermodynamics, entropy in everyday life and explore the knowledge of statistical mechanics and its relation.*

UNIT-I CALORIMETRY: specific heat capacity – specific heat capacity of gases C_P & C_V– Mayer's relation – Joly's method for determination of C_V – Regnault's method for determination of C_P. [6 Hours]

LOW TEMPERATURE PHYSICS: Joule-Kelvin effect – porous plug experiment – Joule-Thomson effect –Boyle temperature – temperature of inversion – liquefaction of gas by Linde's Process – adiabatic demagnetisation. [6 Hours]

UNIT-II THERMODYNAMICS-I: zeroth law and first law of thermodynamics – P-V diagram – heat engine –efficiency of heat engine – Carnot's engine, construction, working and efficiency of petrol engine and diesel engines – comparison of engines. [12 Hours]

UNIT-III THERMODYNAMICS-II: second law of thermodynamics –entropy of an ideal gas – entropy change in reversible and irreversible processes – T-S diagram –thermodynamical scale of temperature – Maxwell's thermodynamical relations –Clausius-Clapeyron's equation (first latent heat equation) – third law of thermodynamics – unattainability of absolute zero – heat death. [12 Hours]

UNIT-IV HEAT TRANSFER: modes of heat transfer: conduction, convection, and radiation.

Conduction: thermal conductivity – determination of thermal conductivity of a good conductor by Forbe's method – determination of thermal conductivity of a bad conductor by Lee's disc method. [6 Hours]

Radiation: black body radiation (Ferry's method) – distribution of energy in black body radiation – Wien's law and Rayleigh Jean's law –Planck's law of radiation – Stefan's law – deduction of Newton's law of cooling from Stefan's law. [6 Hours]

UNIT-V STATISTICAL MECHANICS: Definition of phase-space – micro and macro states – ensembles –different types of ensembles – classical and quantum Statistics – Maxwell-Boltzmann statistics – expression for distribution function – Bose-Einstein statistics – expression for distribution function – Fermi-Dirac statistics –expression for distribution function – comparison of three statistics. [12 Hours]

TEXT BOOKS:

1. Brijlal & N. Subramaniam, 2000, Heat and Thermodynamics, S. Chand & Co.
2. Narayanamoorthy & Krishna Rao, 1969, Heat, Triveni Publishers, Chennai.
3. V. R. Khanna & R. S. Bedi, 1998 1st Edition, Textbook of Sound, Kedharnaath Publish & Co, Meerut
4. Brijlal and N. Subramanyam, 2001, Waves and Oscillations, Vikas Publishing House, New Delhi.
5. Ghosh, 1996, Text Book of Sound, S. Chand & Co.
6. R. Murugeshan & Kiruthiga Sivaprasath, Thermal Physics, S. Chand & Co.

REFERENCE BOOKS:

1. J. B. Rajam & C.L. Arora, 1976, Heat and Thermodynamics, 8th edition, S. Chand & Co. Ltd.
2. D.S. Mathur, Heat and Thermodynamics, Sultan Chand & Sons.
3. Gupta, Kumar, Sharma, 2013, Statistical Mechanics, 26th Edition, S. Chand & Co.
4. Resnick, Halliday&Walker,2010, Fundamentals of Physics, 6th Edition.
5. Sears, Zemansky, Hugh D. Young, Roger A. Freedman, 2021 University Physics with Modern Physics 15th Edition, Pearson.

WEBLINKS:

1. https://youtu.be/M_5KYncYNyc
2. https://www.youtube.com/watch?v=4M72kQulGKk&vl=en

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Acquires knowledge on how to distinguish between temperature and heat. Introduce him/her to the field of thermometry and explain practical measurements of high temperature as well as low temperature physics. Student identifies the relationship between heat capacity and specific heat capacity. The study of Low temperature Physics sets the basis for the students to understand cryogenics, superconductivity, superfluidity and Condensed Matter Physics
	CO2	Derive the efficiency of Carnot's engine. Discuss the implications of the laws of Thermodynamics in diesel and petrol engines
	CO3	Able to analyze performance of thermodynamic systems viz efficiency by problems. Gets an insight into thermodynamic properties like enthalpy, entropy
	CO4	Study the process of thermal conductivity and apply it to good and bad conductors. Quantify different parameters related to heat, relate them with various physical parameters and analyse them
	CO5	Interpret classical statistics concepts such as phase space, ensemble, Maxwell-Boltzmann distribution law. Develop the statistical interpretation of Bose-Einstein and Fermi-Dirac. Apply to quantum particles such as photon and electron

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

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

SEMESTER: II PART: III Core – IV	**23UPHYP24** **PRACTICAL - II**	Credit:5 Hours: 4

COURSE OBJECTIVES: *Apply various physics concepts to understand Properties of Matter viz., elastic properties, thermal properties, acceleration due to gravity and sound waves in solids. Set up experimentation to verify theories, quantify and analyze.*

LIST OF EXPERIMENTS (Any Eight Experiments only)

1. Young's modulus non-uniform bending – Optic lever.
2. Young's modulus uniform bending - Optic lever.
3. Young's modulus-Cantilever – depression – dynamic method-Mirror, Scale and Telescope.
4. Searle's double bar pendulum- Determination of Young's modulus, Rigidity modulus.
5. Determination of Young's modulus by Koenig's method – (or unknown load) and Poisson's ratio.
6. Rigidity modulus and moment of inertia -Torsional Pendulum - with identical masses.
7. Determination of moment of inertia and 'g' using bifilar pendulum.
8. Determination of co-efficient of viscosity by Stokes' method – terminal velocity.
9. Sonometer - Relative density of a solid and liquid.
10. Sonometer - Frequency of AC mains - Steel and Brass wires.
11. Specific heat capacity of liquid - Newton's law of cooling.
12. Determination of thermal conductivity of good conductor by Lee's disc method.
13. Determination of specific heat of liquid by Joule's electrical heating method (applying radiation correction by Barton's correction/graphical method),
14. To verify the laws of transverse vibration using Melde's apparatus.
15. To compare the mass per unit length of two strings using Melde's apparatus.

TEXT BOOKS:

1. C.C. Ouseph, U.J. Rao, V. Vijayendran, *Practical Physics and Electronics,* S. Viswanathan, Printers & Publishers Private Ltd, Chennai,2018.
2. M.N.Srinivasan, S. Balasubramanian, R.Ranganathan, *A Text Book of Practical Physics,* Sultan Chand & Sons, New Delhi, 2015.

REFERENCE BOOKS:

1. Samir Kumar Ghosh, *A Textbook of Advanced Practical Physics*, NCBA, Kolkatta, 2000
2. D. Chattopadyay, P.C.Rakshit, *An Advanced Course in Practical Physics*, NCBA,

COURSEOUTCOMES:

At the end of the course, the student will be able to:

COURSE OUTCOMES	**CO1**	Understand and determine accurately the elevation, depression of a loaded wooden bar using travelling microscope.
	CO2	Grasp and find the Young's modulus, rigidity modulus of some selected solid materials
	CO3	Recognize and estimate the density and frequency of AC supply using sonometer.
	CO4	Appreciate and measure the thermal properties such as specific heat and thermal conductivity of solids.
	CO5	perform experiments in potentiometer, Melde's apparatus, and deflection magnetometer

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM(**M**) and LOW(**L**).

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

SEMESTER: II Part: III	23UCHEE25 Chemistry for Physical Sciences– II	Credit: 2 Hours: 3

Objectives of the course	This course aims at providing knowledge on the • Co-ordination Chemistry and Water Technology • Carbohydrates and Amino acids • basics and applications of electrochemistry • basics and applications of kinetics and catalysis • Various photochemical phenomenon
Course Outline	**UNIT I** **Co-ordination Chemistry and Water Technology** Co-ordination Chemistry: Definition of terms-IUPAC Nomenclature - Werner'stheory - EAN rule - Pauling's theory – Postulates - Applications to $[Ni(CO)4]$, $[Ni(CN)4]^{2-}$,$[Co(CN)6]^{3-}$ Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis. Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques- BOD, COD.
	Unit II **Carbohydrates and Amino acids** Carbohydrates: Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose –fructose interconversion. Properties of starch and cellulose. Amino acids: Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only).

	UNIT III **Electrochemistry** Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials -electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications - electroplating - Nickel and chrome plating – Types of cells - fuel cells-corrosion and its prevention.
	UNIT IV **Kinetics and Catalysis** Order and molecularity. Integrated rate expression for I and II (2A □ Products) order reactions. Pseudo first order reaction, methods of determining order of a reaction – Half-life period – Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation.
	UNIT V **Photochemistry** Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).

Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. V.Veeraiyan, Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition,2009. 2. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur,2006. 3. Arun Bahl, B.S.Bahl, Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition, 2012. 4. P.L.Soni, H.M.Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.
Reference Books	1. P.L.Soni, Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007. 2. R.Puri, L.R.Sharma, M.S.Pathania, Text book Physical Chemistry; Vishal Publishing Co., New Delhi, forty seventh edition, 2018. 3. B.K,Sharma, Industrial Chemistry; Meerut, sixteenth edition, 2014. GOEL publishing house,

Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)On completion of the course the students should be able to

CO 1: write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology

CO 2: explain the preparation and property of carbohydrate, amino acids and nucleic acids.

CO 3: apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.

CO 4: identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.

CO 5: outline the various type of photochemical process.

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage ofCourse Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PO's and CO's

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

SEMESTER: II **Part: III**	**23UCHEEP2** **Chemistry for Physical Sciences** **Practical – II**	**Credit: 1** **Hours: 2**

Objectives of the course	This course aims to provide knowledge on • identification of organic functional groups • different types of organic compounds with respect to their properties. • determination of elements in organic compounds..
	SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS The analysis must be carried out as follows: (a) Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose]. (b) Detection of elements (N, S, Halogens). (c) To distinguish between aliphatic and aromatic compounds. (d) To distinguish – Saturated and unsaturated compounds.
Reference Books	V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principlesof Practical Chemistry; Sultan Chand & sons, Second edition, 1997.
Course Learning Outcomes (for Mapping with POs and PSOs)On completion of the course the students should be able to CO 1: gain an understanding of the use of standard flask and volumetric pipettes, burette.CO 2: design, carry out, record and interpret the results of volumetric titration. CO 3: apply their skill in the analysis of water/hardness. CO4: analyze the chemical constituents in allied chemical products	

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution toPSOs	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Level of correlation between CO's and PO's

Scheme of Valuation:
Max.Marks:100
Int.Marks:25
Ext.Marks:75
Record:15 marks
Preliminary Tests:10 marks
Detection Of elements:10 marks
Detection of functional group:10 marks
Identification of compound:10 marks
Confirmatory Tests:5 marks
Report:5 marks
Systamatic Procedure:10 marks

Semester: I Part: IV	**23UPHYN16** Skill Enhancement Course-1 (NME - I) **PHYSICS FOR EVERYDAY LIFE**	CREDIT: 2 Hours: 2

Course Objectives

1. *To understand the basics of measurements and mechanics.*
2. *To learn the principle of Pressure cooker, Refrigerator and Air-conditioner.*
3. *To know the construction and working of domestic electrical appliances.*
4. *To study the fundamentals of laser and its applications.*
5. *To understand the different biomedical instruments.*

UNIT- I: MEASUREMENTS & MECHANICS 6 Hours

Fundamental quantities - System of Units - CGS - FPS - MKS and SI - Vernier caliper - Screw gauge and their utility-Newton's law of motion- Lever mechanism – Pulleys - Force -Weight - Work - Energy - Power - Horsepower - Circular Motion - Banking of curved tracks.

UNIT-II: THERMO AND HYDRODYNAMICS 6 Hours

Variation of boiling point with pressure - Pressure cooker - First and Second law of thermodynamics - Refrigerator - Air Conditioner - Principle and construction - Bernoulli Theorem-Applications.

UNIT - III: ELECTRICAL APPLIANCES 6 Hours

Electric iron Box - Electric Fan - Construction and Working of Ceiling and Table fans - Water Heater -Types - Function - Wet Grinder - Mixer Grinder - Principle and Design.

UNIT- IV: LASER 6 Hours

Power of a Lens-Human eye - Defects of vision – Laser - Spontaneous emission - Stimulated emission - Meta stable state - Population inversion - Pumping - Laser Characteristics- Ruby Laser - Applications of Laser-Laser cutting - Welding- Drilling -Lasers in Surgery - Lasers in ophthalmology.

UNIT- V: MEDICAL INSTRUMENTS 6 Hours

Digital thermometer - Digital BP apparatus - One touch Glucometer – thermal scanner - pulse oximeter - pH meter - BMI calculator – Ventilator Principle - description - function and recording of ECG - EMG and EEG - artificial pacemaker.

Course Outcomes:

After completion of the course, the student should be able to understand:

1. *the basics of measurements and mechanics in daily life*
2. *the principle of Pressure cooker, Refrigerator and Air conditioner.*
3. *the construction and working of domestic electrical appliances.*
4. *the fundamentals of laser and its applications.*
5. *the different biomedical instruments used in clinics.*

Text Books:

Unit 1& Unit 2

1. N. Subrahmanyam and BrijLal , Principles of Physics, S.Chand &Co., Ltd, Chennai.
2. Plus one Physics Book,TN state Board and NCERT Books.
3. D. Jayaraman, K. Ilangovan, Thermal Physics Statistical Mechanics , S.
   a. Viswanathan, Printers & Publishers Private Ltd, Chennai , 2016.
4. BrijLal and N Subrahmanyam, Heat and Thermodynamics, S Chand & Company Pvt Ltd , New Delhi , 2016.

Unit 3

1. Bali, S.P. 2005, *Consumer Electronics*, Pearson Education, New Delhi.
2. TN State Board, *Basic Electrical Engineering, Vocational Theory, Plus One Textbook,* TN Stat Board.

Unit 4

1. Murugeshan, R. 2016, *Optics & Spectroscopy*, S. Chand Co. Ltd, New Delhi.

Unit 5

1. Arumugam M, 2011, *Biomedical Instrumentation,* Anuradha Publications, Kumbakonam.
2. Yuvaraj, V. 2020, *Instrumentation Techniques,* Sri Krishna Publications.

Reference Books

1. Hallidy D. Rensick, R. and Walker, J. 2001, *Fundamentals of Physics*, 6th Edition, Wiley, NY.
2. Brij Lal and N Subrahmanyam, 2016, *Heat and Thermodynamics* , S Chand & Company Pvt Ltd, New Delhi .
   R. Murugeshan, 2016, *Optics & Spectroscopy*, S. Chand Co. Ltd, New Delhi.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM(**M**) and LOW(**L**).

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

SEMESTER: II PART: IV	**23UPHYN26** **Skill Enhancement Course -2 (NME -II)** **ASTROPHYSICS**	Credit: 2 Hours: 2

Course Objective: *This course intends to introduce principles of astrophysics describing the science of formation and evolution of stars and interpretation of various heavenly phenomena and provide an understanding of the physical nature of celestial bodies along with the instrumentation and techniques used in astronomical research.*

1. *To understand the principle of telescopes and their operation and parameters, types of telescopes, detectors and image processing and advanced space telescopes.*
2. *To grasp the ideas behind Solar system, inter planetary distances, meteors, meteorites, comets, asteroids, belt, cloud, gravitational waves and recent advances in astrophysics.*
3. *To recognize the Physics behind Eclipses and types of eclipses, solar and lunar eclipse, structure of the Sun.*
4. *To appreciate the Stellar Evolution process, birth & death of star, pulsars, black holes, supernovae, Galaxies, dark matter, evolving universe.*
5. *To do any three of the activities mentioned in the Unit V*

UNIT-I **TELESCOPES:** Optical telescopes – magnifying power, brightness, resolving power and f/a ratio – types of reflecting and refracting telescopes – detectors and image processing – radio telescopes – Hubble space telescope.

UNIT-II **SOLAR SYSTEM:** Bode's law of planetary distances – meteors, meteorites, comets, asteroids – Kuiper belt – Oort cloud – detection of gravitational waves – recent advances in astrophysics.

UNIT-III **ECLIPSES:** Types of eclipses – solar eclipse – total and partial solar eclipse – lunar eclipse – total and partial lunar eclipse – transits.

THE SUN: Physical and orbital data – solar atmosphere – photosphere – chromosphere – solar corona – prominences – sunspots – 11year solar cycle – solar flares.

UNIT-IV **STELLAR EVOLUTION:** H-R diagram – birth & death of low mass, intermediate mass and massive stars – Chandrasekar limit – white dwarfs – neutron stars – pulsars – black holes – supernovae.

GALAXIES: classification of galaxies – galaxy clusters –interactions of galaxies, dark matter and super clusters – evolving universe.

UNIT-V **ACTIVITIES IN ASTROPHYSICS:**

(Any ***three*** activities to be done compulsorily**)**

i. Basic construction of telescope
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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Niclolas. A. Pananides and Thomas Arny, (1979), *Introductory Astronomy,* Addison Wesley Publ. Co.
2. Mujiber Rahman, A. *Concepts to Astrophysics,* SciTech Publications, Chennai.
3. Abell, Morrison and Wolf, 1987, *Exploration of the Universe,* 5th ed., Saunders College Publ.
4. Carrol and Ostlie, 2007, *Introduction to Modern Astrophysics,* 2nd ed., Pearson International.
5. William J. Kaufmann, III, 1993, *Universe* Freeman & Company, W. H.
6. Abhyankar, K.D. 2001, *Astrophysics: Stars and Galaxies* Universities Press

COURSEOUTCOMES:

At the end of the course, the student will be able to:

COURSE OUTCOMES	**CO1**	Understand the principle of telescopes and their operation and parameters, types of telescopes, detectors and image processing and advanced space telescopes.
	CO2	Grasp the ideas behind Solar system, inter planetary distances, meteors, meteorites, comets, asteroids, belt, cloud, gravitational waves and recent advances in astrophysics.
	CO3	Recognize the Physics behind Eclipses and types of eclipses, solar and lunar eclipse, structure of the Sun.
	CO4	Appreciate the Stellar Evolution process, birth & death of star, pulsars, black holes, supernovae, Galaxies, dark matter, evolving universe.
	CO5	perform any three of the activities related to the astrophysics.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM(**M**) and LOW(**L**).

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

SEMESTER: III PART: III CORE: V	23UPHYC33 OPTICS AND LASER PHYSICS	Credit:5 Hours :5

COURSE OBJECTIVES	To provide an in-depth understanding of the basics of various phenomena in geometrical and wave optics; To explain the behaviour of light in prism and lens To know the basic construction of eye pieces; To understand the differences in the important phenomena namely interference, diffraction and Polarization and apply the knowledge in day to day life; To understand the working and applications of laser
UNITS	**COURSE DETAILS**
UNIT-I	**LENS AND PRISMS:** *Lens*: aberrations: spherical aberration, chromatic aberrations, coma, and astigmatism– curvature of the field – distortion – chromatic aberrations methods. *Prism*: dispersion, deviation, aberrations - applications rainbows and halos, constant deviation spectroscope. *Eyepieces*: advantage of an eyepiece over a simple lens – Huygen's and Ramsden's eyepieces, construction and working –merits and demerits of the eyepiece. *Resolving power*: Rayleigh's criterion for resolution – limit of resolution for the eye – resolving power of, (i) Prism (ii) grating (iii) telescope
UNIT-II	**INTERFERENCE:** division of wave front, Fresnel's biprism – fringes with white light – division of amplitude: interference in thin films due to, (i) reflected light, (ii) transmitted light – colours of thin films applications – air wedge – Newton's rings. *Interferometers* : Michelson's interferometer – applications, (i) determination of the wavelength of a monochromatic source of light, (ii) determination of the wavelength and separation D_1 and D_2 lines of sodium light, (iii) determination of a thickness of a mica sheet.
UNIT-III	**DIFFRACTION:** Fresnel's assumptions – zone plate – action of zone plate for an incident spherical wave front – differences between a zone plate and a convex lens –Fresnel type of diffraction – diffraction pattern due to a straight edge – positions of maximum and minimum intensities – diffraction due to a narrow slit –Fraunhofer type of diffraction – Fraunhofer diffraction at a single slit – plane diffraction grating– experiment to determine wavelengths – width of principal maxima.
UNIT-IV	**POLARISATION:** optical activity – optically active crystals –polarizer and analyser–double refraction – optic axis, principal plane – Huygens's explanation of double refraction in uniaxial crystals –polaroids and applications – circularly and elliptically polarized light –quarter wave plate – half wave plate – production and detection of circularly and elliptically polarized lights – Fresnel's explanation – specific rotation – Laurent half shade polarimeter– experiment to determine specific rotatory power.
UNIT-V	**LASERS:** general principles of lasers – properties of lasers action – spontaneous and stimulated emission – population inversion – optical pumping – He-Ne laser (principle and working) – CO_2 laser (principle and working) semiconductor laser – laser applications – holography.
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars — webinars – industry inputs – social accountability – patriotism

TEXT BOOKS	1. Subramaniam. N and Brijlal, 2014, Optics, 25thEd, S.Chand and Co. 2. P.R.Sasikumar, 2012, Photonics, PHI Pvt Ltd, New Delhi. 3. V.Rajendran, 2012, Engineering Physics, TATA McGraw Hill.
REFERENCEBOOKS	1. Sathyaprakash, 1990, Optics, VII edition, Ratan Prakashan Mandhir, New Delhi. 2. Ajoy Ghatak, 2009, Optics, 4thEdition, PHI Pvt Ltd, New Delhi. 3. D.Halliday,R.Resnick and J. Walker, 2001, Fundamentals of Physics,6th edition, Willey, New York. 4. Jenkins A. Francis and White, 2011, Fundamentals of Optics, 4th edition, McGraw Hill Inc., NewDelhi.
WEB RESOURCES	1. https://science.nasa.gov/ems/ 2. https://www.youtube.com/watch?v=tL3rNc1G0qQandlist=RDCMUCzwo7UlGkb-8Pr6svxWo-LAandstart_radio=1andt=2472 3. https://science.nasa.gov/ems/ 4. https://imagine.gsfc.nasa.gov/educators/gammarabursts/imagine/index.html 5. http://www.thephysicsmill.com/2014/03/23/sky-blue-lord-rayleigh-sir-raman-scattering/

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSE OUTCOMES	**CO1**	Outline basic knowledge of methods of rectifying different defects in lenses, articulate technological applications of eyepieces
	CO2	Discuss the principle of superposition of wave, use these ideas to understand the wave nature of light through working of interferometer
	CO3	Extend the knowledge about nature of light through diffraction techniques; apply mathematical principles to analyse the diffraction.
	CO4	Interpret basic formulation of polarization and gain knowledge about polarimeter, appraise its usage in industries
	CO5	Relate the principles of optics to field of Laser and understand their operation and application in industries

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM (**M**) and LOW (**L**).

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

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

SEMESTER: III PART: III CORE: VI	23UPHYP34 PHYSICS PRACTICAL –III	Credit:5 Hours :5

COURSE OBJECTIVES	1. To demonstrate various optical phenomena principles, working, apply with various materials and interpret the results. 2. To Construct circuits to learn about the concept of electricity, current, resistance in the path of current, different parameters that affect a circuit. Set up experiments, observe, analyse and assimilate the concept. 3. To perform basic experiments on characteristics of electronic devices.

Minimum of Eight Experiments from the list:

1. Determination of refractive index of prism using spectrometer.
2. Determination of radius of curvature of lens by forming Newton's rings.
3. Verification of Newton's formula for a lens separated by a distance.
4. Determination of refractive index using Laser.
5. Calibration of low range voltmeter using potentiometer
6. Measurement of low resistance using Potentiometer
7. Determination of field (H) along the axis of a current carrying circular coil.
8. Determination of specific resistance of the material of the wire using PO box.
9. Determination of figure of merit (Current and Voltage sensitivity) of BG or spot galvanometer.
10. Comparison of EMF of two cells using BG or spot galvanometer.
11. AC circuits with L C R - Series and parallel resonance.
12. Bridge rectifier using diodes
13. Characteristics of a transistor – (CB mode).
14. Study of gate ICs – OR, AND, NOT and EXOR

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

SEMESTER: III PART: III ELECTIVE: III	23UMATE35 MATHEMATICS 1	Credit:3 Hours :4

Learning Objective: To understand higher mathematical concepts which are applied to solve problems in Physics and similar situations	
UNITS	**COURSE DETAILS**
UNIT-I	**MATRICES:** types of matrices – symmetric, Hermitian, unitary and orthogonal matrices– characteristic equation of a matrix – Eigen values and Eigen vectors of a matrix – Cayley-Hamilton theorem – inverse of matrix by Cayley-Hamilton theorem – similarity transformations – diagonalization of 2x2 real symmetric matrices.
UNIT-II	**VECTOR CALCULUS:** vector differentiation – directional derivatives –definitions and Physical significance of gradient, divergence, curl – Laplace operators– vector identities – line, surface and volume integrals – statement, proof and simple problems for Gauss's divergence theorem, Stoke's theorem, Green's theorem.
UNIT-III	**ORTHOGONAL CURVILINEAR COORDINATES:** tangent basis vectors – scale factors – unit vectors in cylindrical and spherical coordinate systems –gradient of a scalar –divergence and curl of a vector –Laplacian in these coordinate systems.
UNIT-IV	**FOURIER SERIES:** periodic functions –Dirichlet's conditions – general Fourier series – even and odd functions and their Fourier expansions – Fourier cosine and sine – half range series – change of length of interval. Fourier analysis of square wave, saw-tooth wave, half wave/full wave rectifier wave forms.
UNIT-V	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (PDE):** PDE for transverse vibrations in elastic strings (one dimensional wave equation) –one dimensional heat flow equation – solutions to these PDE's by method of separation of variables – problems based on boundary conditions and initial conditions.
TEXT BOOKS	1. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India. 2. Mathematical Physics – P. K. Chattopadhyay, New Age International Publishers. 3. Mathematical Physics – B. D. Gupta. 4. Mathematical Physics – H. K. Das, S. Chand and Co, New Delhi.
REFERENCE BOOKS	1. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill. 2. Engineering Mathematics III- B, M. K. Venkataraman, 3. Applied Mathematics for Scientists and Engineers, Bruce R. Kusseand Erik A. Westwig, 2nd Ed, WILEY-VCH Verlag, 2006. 4. Vector space and Matrices – J. C. Jain, Narosa Publishing House Pvt. Ltd.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: III PART: IV SEC : IV	23UPHYS36 SKILL ENHANCEMENT COURSE-4 HOME ELECTRICAL INSTALLATION	Credit:1 Hours :1

COURSE OBJECTIVE: The students will get knowledge of electrical instruments, installations and domestic wiring techniques with safety precautions and servicing.

UNIT-I SIMPLE ELECTRICAL CIRCUITS: Charge, current, potential difference, resistance – simple electrical circuits – DC ammeter, voltmeter, ohmmeter – Ohm's law – difference between DC and AC – advantages of AC over DC – electromagnetic induction - transformers – inductors/chokes – capacitors/condensers – impedance – AC ammeter, voltmeter –symbols and nomenclature.

UNIT-II TRANSMISSION OF ELECTRICITY: Production and transmission of electricity – concept of power grid – Series and parallel connections – technicalities of junctions and loops in circuits –transmission losses (qualitative) – roles of step-up and step-down transformers – quality of connecting wires – characteristics of single and multicore wires.

UNIT-III ELECTRICAL WIRING: Different types of switches – installation of two-way switch – role of sockets, plugs, sockets - installation of meters – basic switch board – electrical bell – indicator – fixing of tube lights and fans – heavy equipment like AC, fridge, washing machine, geyser – provisions for inverter – gauge specifications of wires for various needs.

UNIT-IV POWER RATING AND POWER DELIVERED: Conversion of electrical energy into different forms – work done by electrical energy – power rating of electrical appliances – energy consumption – electrical energy unit in kWh – calculation of EB bill – Joule's heating – useful energy and energy loss – single and three phase connections – Measures to save electrical energy – energy audit.

UNIT-V SAFETY MEASURES: Insulation for wires – colour specification for mains, return and earth – Understanding of fuse and circuit breakers – types of fuses: kit-kat, HRC, cartridge, MCB, ELCB – purpose of earth line – lighting arrestors – short circuiting and over loading – electrical safety – tips to avoid electrical shock – first aid for electrical shock – fire safety for electric current.

TEXTBOOKS:

1. Wiring a House: 5th Edition by Rex Cauldwell, (2014).
2. Black & Decker Advanced Home Wiring, 5th Edition: Backup Power - Panel Upgrades - AFCI Protection - "Smart" Thermostats, by Editors of Cool Springs Press, (2018).
3. Complete Beginners Guide to Rough in Electrical Wiring: by Kevin Ryan (2022).

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSE OUTCOMES	**CO1**	Understand the use of electrical meters, passive devices
	CO2	Know the production and transmission of electricity
	CO3	Appreciate domestic wiring and household appliances
	CO4	Be aware of power rating and energy calculations
	CO5	To realize the precautions and safety measures while handling electricity.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: III PART: IV SEC - V	23UPHYS37 SKILL ENHANCEMENT COURSE-5 PHYSICS OF MUSIC	Credit:2 Hours :2

Objectives

This course enables the students

1. To impart knowledge on the role of physics in music.
2. To develop understanding of basic music devices.
3. To have a better understanding of musical noted
4. To learn the principle of musical instruments.

UNIT – I Basic of Sound **Hours: 6**

Vibrations of atoms of matter– Propagation of sound waves in air, other media, fluids & solids – Definition and Unit - Velocity, Frequency, Wavelength, Time period, Intensity - Classification of sound on frequency and velocity– Human & Animal sound perception– Mechanism of ear and hearing – Psychoacoustics.

UNIT – II Mechanism of vibrating System **Hours: 7**

Simple harmonic motion – Tuning fork– amplitude, phase, energy - Energy loss – Damping - Dissipation – Power – Standing and Propagating waves– Laws of vibration in stretched strings– one-dimensional medium – Open and Closed organ pipes – over tones, Harmonics – Quality of sound: pitch, timber, loudness – octaves, Musical notes.

UNIT – III Musical Tone **Hours: 7**

Pure and simple tones – sine and cosine waves– Superposition of simple tones - Well-defined frequencies, Wavelengths, Amplitudes & Phases– Partial tones – Assembly of pure tones– Mix of different frequencies & amplitudes – Resonances– Sound envelope.

UNIT - IV Production of Musical Sounds **Hours: 7**

Human voice, Mechanism of vocal sound production – Larynx (sound box)

Basic principle of instruments - Stringed Instruments: Plucked & bowed, guitar, mandolin, violin and piano. Wind instruments: Whistles, Flute, Saxophone, Pipe organ and Bag pipes. Percussion instruments: Pates, Membranes, Drums. Electronic Instruments: keyboards, electric guitars, rhythm pads. Analog and Digital sound synthesizers – computer generated music.

UNIT - V Recording of Music and Sound **Hours: 7**

Edison phonograph – cylinder & disk records – magnetic wire and tape recorders – digital recording (e.g. to CD, DVD, etc.)– analog transducers, condenser, dynamic microphones, loudspeaker – complex sound fields – near & far fields of acoustic– spectral analysis techniques – continuous & discrete Fourier transforms(qualitative), digital signal processing(qualitative) – digital filtering – specifications of recording studios

Course Outcomes

On completion of the course students

1. Develop basic understanding of sound.
2. Obtain knowledge and principle of Music.
3. Know about Musical tones.
4. Learn the key factors of Music Systems
5. Acquire knowledge recording of music

Text book

1. A text book of Sound – Brijlal and Subramaniyam S. Chand Publications. Revised (2018)
2. A text book of Oscillations, Waves and Acoustics – M. Ghosh and D. Bhattacharya S.Chand Publication Revised (2016)
3. Physics and Music: The Science of Musical Sound by Harvey White (2014)
4. Good Vibrations – The Physics of Music by Barry Parker, (2009)

Supplementary Reading

1. The History of Musical Instruments by Curt Sachs, (2006)
2. Physics and Music: Essential Connections and Illuminating Excursions by Kinko Tsuji and Stefan C. Müller (2021)

SEMESTER: III **PART: IV**	**23UEVSG38** **ENVIRONMENTAL STUIDES**	**Credit:-** **Hours :1**

SEMESTER: IV PART: III CORE: VII	23UPHYC43 CORE INDUSTRY MODULE ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM	Credit:5 Hours :5

COURSE OBJECTIVES	To understand the principle of Capacitors and thermoelectricity To classify materials based on their electrical and magnetic properties. To analyze the working principles of electrical instruments. To understand the behaviour of dc, ac and transient currents. To know about the propagation of electromagnetic waves.
UNITS	**COURSE DETAILS**
UNIT-I	**CAPACITORS AND THERMO ELECTRICITY:** capacitor –principle – capacitance of spherical and cylindrical capacitors – capacitance of a parallel plate capacitor (with and without dielectric slab) – effect of dielectrics –Carey Foster bridge – temperature coefficient of resistance – Seebeck effect – laws of thermo emf – Peltier effect – Thomson effect – thermoelectric diagrams –uses of thermoelectric diagrams – thermodynamics of thermo couple - determination of Peltier and Thomson coefficients.
UNIT-II	**MAGNETIC EFFECTS OF CURRENT:** Biot and Savart's law – magnetic induction due to circular coil – magnetic induction due to solenoid – force on a current element by magnetic field – force between two infinitely long conductors – torque on a current loop in a field - moving coil galvanometer – damping correction – Ampere's circuital law – differential form – divergence of magnetic field – magnetic induction due to toroid.
UNIT-III	**MAGNETISM AND ELCTROMAGNETIC INDUCTION:** magnetic induction B – magnetization M - relation between B, H and M – magnetic susceptibility – magnetic permeability – experiment to draw B-H curve – energy loss due to hysteresis - Importance of hysteresis curves – Faraday and Lenz laws –vector form – self-induction – coefficient of self-inductance of solenoid – Anderson's method – mutual induction – coefficient of mutual inductance between two coaxial solenoids – coefficient of coupling
UNIT-IV	**TRANSIENT AND ALTERNATING CURRENTS:** growth and decay of current in a circuit containing resistance and inductance – growth and decay of charge in a circuit containing resistance and capacitor – growth and decay of charge in an LCR circuit (expressions for charge only) – peak, average and rms values of ac – LCR series and parallel circuits – resonance condition – Q factor – power factor.
UNIT-V	**MAXWELLS EQUATIONS AND ELECTROMAGNETIC WAVES:** Maxwell's equations in vacuum, material media– physical significance of Maxwell's equations – displacement current – plane electromagnetic waves in free space – velocity of light – Poynting vector–electromagnetic waves in a linear homogenous media – refractive index.
UNIT-VI	**PROFESSIONAL COMPONENTS:**expert lectures –seminars — webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. Murugeshan. R., - Electricity and Magnetism, 8thEdn, 2006, S.Chandand Co, New Delhi. 2. Sehgal D.L., Chopra K.L, Sehgal N.K., - Electricity and Magnetism, Sultan Chand and Sons, New Delhi. 3. M. Narayanamurthy and N. Nagarathnam, Electricity and Magnetism, 4th Edition, National Publishing Co., Meerut.

REFERENCE BOOKS	1. Brijlal and Subramanian, Electricity and Magnetism, 6th Edn.,RatanandPrakash, Agra. 2. Brijlal, N.Subramanyan and Jivan Seshan, Mechanics and Electrodynamics (2005), Eurasia Publishing House (Pvt.) Ltd., New Delhi. 3. David J. Griffiths, Introduction to Electrodynamics, 2nd Edn. 1997, Prentice Hall of India Pvt. Ltd., New Delhi. 4. D. Halliday, R. Resnik and J. Walker - Fundamentals of Physics, 6th Edn., Wiley, NY, 2001.
WEB RESOURCES	1. https://www.edx.org/course/electricity 2. https://www.udemy.com/courses/ electricity 3. https://www.edx.org/course/magnetism 4. http://www.hajim.rochester.edu/optics/undergraduate/courses.html

METHOD OF EVALUATION:

Continuous InternalAssessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Describe capacitors, various thermo-electric effects and their properties.
	CO2	Apply Biot and Savart law to study the magnetic effect of electric current.
	CO3	Use Faraday and Lenz laws in explaining self and mutual inductance.
	CO4	Analyze the time variation of current and potential difference in AC circuits.
	CO5	Relate different physical quantities used to explain magnetic properties of materials and describe electromagnetic wave.

MAPPING WITH PROGRAM OUT COMES:

Map course out comes **(CO)** for each course with programme outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: IV PART: III CORE: VIII	23UPHYP44 PHYSICS PRACTICAL –IV	Credit:5 Hours :5

COURSE OBJECTIVES	1. To demonstrate various optical phenomena principles, working, apply with various materials and interpret the results. 2. To Construct circuits to learn about the concept of electricity, current, resistance in the path of current, different parameters that affect a circuit. Set up experiments, observe, analyse and assimilate the concept. 3. To perform basic experiments on characteristics of electronic devices.

Minimum of Eight Experiments from the list:

1. Determination of refractive index of liquid using hollow prism and spectrometer
2. Determination of dispersive power of a prism.
3. Determination of thickness of a wire using air wedge.
4. Determination of refractive index of a given liquid by forming liquid lens
5. Spectrometer – Grating – Normal incidence - Wave length of Mercury spectral lines.
6. Determination of wavelengths, particle size using Laser/Monochromatic source.
7. Determination of resolving power of Diffraction grating using Laser
8. Determination of diameter of the wire using Laser.
9. Calibration of ammeter using potentiometer.
10. Determination of resistance and specific resistance using Carey Foster's bridge.
11. Comparison of capacitance using BG/ spot galvanometer
12. Zener diode – voltage regulation
13. Characteristics of a transistor – (CE mode)
14. Verification of De Morgan's theorem using ICs.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

SEMESTER: IV PART: III ELECTIVE: IV	23UMATE45 MATHEMATICS 2	Credit:3 Hours :3

UNIT-I: TRIGONOMETRY

Expansions of $\sin^n\theta$, $\cos^n\theta$, $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ – Expansions of $\sin\theta$, $\cos\theta$, $\tan\theta$ in terms of θ

Unit-I: Chap: 6 (6.1,6.1.1 to 6.1.3)

UNIT-II: PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations, elimentary partial differential equations-Lagranges equations.

Unit-II: Chap:6 (6.1,6.1.1, 6.4).

UNIT-III: VECTOR DIFFRENTIATION

Vector functions- Scalar and vector point functions- Directional derivatives –Unit vector normal to a surface – angle between the surfaces-divergence, Gradient of a scalar point function- Divergence and curl of a vector point function.

Unit-III Section 8.1,8.2,8.3, 8.4).

UNIT-IV: VECTOR INTEGRATION

Green's theorem in the plane-Gauss divergence theorem- [without proofs] ,Stoke's theorem (Statement only)

Unit-IV: Section (8.6.1, to 8.6.3).

UNIT-V: FINITE DIFFERENCES

Operator E, Relation between Δ, ∇ and E – Interpolation – Newton – Gregory forward & backward formulae for interpolation-Lagrange's interpolation formula for unequal intervals(without proof) .

Unit-V: Sec(5.1,5.2).

TEXT BOOK:

1.P. Duraipandian and S. Udayabaskaran(1997), "Allied Mathematics", Vol I & II. Chennai: Muhil Publishers.

Unit-I: Chap: 6 (6.1,6.1,1 to 6.1.3), Vol I,
Unit-II: Chap:6 (6.1,6.1.1,6.4), Vol II,
Unit-IIISec(8.1,8.2,8.3,8.4),Vol I,
Unit-IV:Sec(8.6.1, - 8.6.3), Vol I,
Unit-V:Sec(5.1,5.2), Vol II.

REFERENCE BOOKS:

1. P. Balasubramanian and K. G. Subramanian. 1997, "Ancillary Mathematics", Vol I & II. New Delhi: Tata McGraw Hill.
2. S.P.Rajagopalan and R.Sattanathan(2005), "Allied Mathematics", Vol I & II. New Delhi: Vikas Publications.
3. P. R. Vittal (2003), "Allied Mathematics",Chennai: Marghan Publications.
4. P.Kandhasamy, K. Thilagavathy (2003), "Allied Mathematics" Vol I & II, New Delhi: Tata McGraw Hill.

Course Outcomes:

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

CO1: Attain knowledge on finding the expansions of trigonometric functions and concept of hyperbolic and inverse hyperbolic functions.
CO2: Provide a basic knowledge of Partial Differential equations and develops knowledge on handle practical problems.
CO3: Adopt techniques in solving problems involving vector and scalar functions
CO4: Provide skills on finding derivatives and gradients on vector differentiation and Integration.
CO5: Understand the applications of differentiation and integration in real life situation.

Outcome Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	2	3	3	2
CO3	3	3	3	3	2
CO4	3	3	3	3	2
CO5	2	3	3	3	2

1-Low 2-Moderate 3- High

SEMESTER: IV PART: IV Skill Enhancement Course – 6:	23UPHYS46 SKILL ENHANCEMENT COURSE – 6: ASTROPHYSICS	Credit:2 Hours :2

Course Objective: This course intends to introduce principles of astrophysics describing the science of formation and evolution of stars and interpretation of various heavenly phenomena and provide an understanding of the physical nature of celestial bodies along with the instrumentation and techniques used in astronomical research.

1. To understand the principle of telescopes and their operation and parameters, types of telescopes, detectors and image processing and advanced space telescopes.
2. To grasp the ideas behind Solar system, inter planetary distances, meteors, meteorites, comets, asteroids, belt, cloud, gravitational waves and recent advances in astrophysics.
3. To recognize the Physics behind Eclipses and types of eclipses, solar and lunar eclipse, structure of the Sun.
4. To appreciate the Stellar Evolution process, birth & death of star, pulsars, black holes, supernovae, Galaxies, dark matter, evolving universe.
5. To do any three of the activities mentioned in the Unit V

UNIT-I- TELESCOPES: Optical telescopes – magnifying power, brightness, resolving power and f/a ratio – types of reflecting and refracting telescopes – detectors and image processing – radio telescopes – Hubble space telescope.

UNIT-II- SOLAR SYSTEM: Bode's law of planetary distances – meteors, meteorites, comets, asteroids – Kuiper belt – Oort cloud – detection of gravitational waves – recent advances in astrophysics.

UNIT-III - ECLIPSES: Types of eclipses – solar eclipse – total and partial solar eclipse – lunar eclipse – total and partial lunar eclipse – transits.

THE SUN: Physical and orbital data – solar atmosphere – photosphere – chromosphere – solar corona – prominences – sunspots – 11 year solar cycle – solar flares.

UNIT-IV - STELLAR EVOLUTION: H-R diagram – birth & death of low mass, intermediate mass and massive stars – Chandrasekar limit – white dwarfs – neutron stars – pulsars – black holes – supernovae.

GALAXIES: classification of galaxies – galaxy clusters –interactions of galaxies, dark matter and super clusters – evolving universe.

UNIT-V- ACTIVITIES IN ASTROPHYSICS: (Any ***three*** activities to be done compulsorily**)**

i. Basic construction of telescope
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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Niclolas. A. Pananides and Thomas Arny, (1979), *Introductory Astronomy,* Addison Wesley Publ. Co.
2. Mujiber Rahman, A. *Concepts to Astrophysics,* SciTech Publications, Chennai.
4. Abell, Morrison and Wolf, 1987, *Exploration of the Universe,* 5th ed., Saunders College Publ.
5. Carrol and Ostlie, 2007, *Introduction to Modern Astrophysics,* 2nd ed., Pearson International.
6. William J. Kaufmann, III, 1993, *Universe* Freeman & Company, W. H.
7. Abhyankar, K.D. 2001, *Astrophysics: Stars and Galaxies* Universities Press

COURSEOUTCOMES:

At the end of the course, the student will be able to:

COURSE OUTCOMES	**CO1**	Understand the principle of telescopes and their operation and parameters, types of telescopes, detectors and image processing and advanced space telescopes.
	CO2	Grasp the ideas behind Solar system, inter planetary distances, meteors, meteorites, comets, asteroids, belt, cloud, gravitational waves and recent advances in astrophysics.
	CO3	Recognize the Physics behind Eclipses and types of eclipses, solar and lunar eclipse, structure of the Sun.
	CO4	Appreciate the Stellar Evolution process, birth & death of star, pulsars, black holes, supernovae, Galaxies, dark matter, evolving universe.
	CO5	perform any three of the activities related to the astrophysics.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: IV PART: IV Skill Enhancement Course –7	23UPHYS47 SKILL ENHANCEMENT COURSE – 7: BASIC INSTRUMENTATION SKILL	Credit:2 Hours :2

COURSE OBJECTIVES:

To get exposure to various aspects of instruments and their usage through hands-on mode, a *field visit* to an instrumentation facility / production and quality checking unit may be arranged.

This course enables the students:

1. To acquire knowledge about basic electrical instruments and their qualities, performance parameters of moving coil instruments and electronic voltmeter, and practical applications of analog multimeter.
2. To understand the construction and working of a very important instrument, CRO, to visualize the electrical waveforms and use it for various measurements of signal parameters.
3. To get to know the working principle of signal generators, distortion meters and their practical usage in testing amplifiers, filter circuits etc.
4. To appreciate the significance of LCR bridges, quality factor meter, state-of-the-art digital LCR bridges.
5. To acquire ideas of digital instruments, advantages of digital over analog instruments, principle working of digital multimeter and its usage.

UNIT I: BASIC OF MEASUREMENT:

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. Electronic Voltmeter: Advantage- Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters – (*practical demo of m. c. g type analog multimeter)*

UNIT II: CATHODE RAY OSCILLOSCOPE:

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), Time base operation, synchronization. Front panel controls. use of CRO for the measurement of voltage (dc and ac frequency, time period) – *experimental demo of various features of CRO.*

UNIT III: SIGNAL GENERATORS AND ANALYSIS INSTRUMENTS:

Block diagram, explanation, and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis- *demo of use of Function generators.*

UNIT IV: IMPEDANCE BRIDGES & Q-METERS:

Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges.

UNIT V: DIGITAL INSTRUMENTS:

Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter Digital Multimeter: Block diagram and working of a digital multimeter-Working – *demonstration of using DMM.*

TEXTBOOKS:

1. A textbook in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.
7. PHY 605 (SEC) Basic Instrumentation Skills (Skill Enhancement Course) (KBCNMU) - Prof. (Dr.) R. S. Khadayate, Dr. U. S. Jagtap, June 2020 - Prashant Publications- ISBN 9789390862955.

REFERENCE BOOKS:

1. Electronic *Instrumentation* and Measurement Techniques – 1985. by William D. *Cooper*, Albert D. Helfrick.
2. Electronic Instrumentation and Measurements 3E by David A. Bell, Oxford University press.
3. A Course in Electrical and Electronic Measurements and Instrumentation by A K Sawhney, Dhanpat Rai & co.,
4. Electrical and Electronic Measurements and Instrumentation by R. K. Rajput, S. Chand & Co Ltd.,
5. A Course in Electrical and Electronic Measurements and Instrumentation by J. B. Gupta, S. K. Kataria and sons.,

WEBLINKS:

1. **https://selfstudyinstitute.com/basicinstrumentationskills/**
2. **https://education.ni.com/teach/resources/1282/measurements-and-instrumentation**
3. **https://education.ni.com/teach/resources/1014/student-projects-for-measurements-and-instrumentation**
4. **https://www.pw.live/online-course-physics-wallah-gate-Instrumentation**

COURSEOUTCOMES:

At the end of the course, the student will be able to:

COURSE OUTCOMES	**CO1**	explain about basic electrical instruments and their qualities, performance parameters of moving coil instruments and electronic voltmeter, and practical applications of analog multimeter.
	CO2	understand the construction and working of a very important instrument, CRO, to visualize the electrical waveforms and use it for various measurements of signal parameters.
	CO3	get to know practically the working principle of signal generators, distortion meters and their practical usage in testing amplifiers, filter circuits etc.
	CO4	appreciate the significance of LCR bridges, quality factor meter, state-of-the-art digital LCR bridges.
	CO5	acquire practical ideas of digital instruments, advantages of digital over analog instruments, principle working of digital multimeter and its usage.

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: IV **PART: IV** **EVS**	**23UEVSG48** **ENVIRONMENTAL STUDIES**	**Credit:2** **Hours :1**

SEMESTER: V PART: III CORE: IX	23UPHYC51 GENERAL MECHANICS AND CLASSICAL MECHANICS	Credit:4 Hours :5

COURSES OBJECTIVES: This course allows the students:

1. To have a basic understanding of the laws and principles of mechanics.
2. To apply the concepts of forces existing in the system.
3. To understand the forces of physics in everyday life.
4. To visualize conservation laws.
5. To apply Lagrangian equation to solve complex problems.

UNIT-I LAWS OF MOTION: Newton's Laws– forces – equations of motion – frictional force – motion of a particle in a uniform gravitational field – types of everyday forces in Physics.
Gravitation: Classical theory of gravitation–Kepler's laws, Newton's law of gravitation – Determination of G by Boy's method – Earth-moon system – weightlessness – earth satellites – parking orbit – earth density – mass of the Sun – gravitational potential – velocity of escape – satellite potential and kinetic energy –Einstein's theory of gravitation – introduction –principle of equivalence – experimental tests of general theory of relativity – gravitational red shift – bending of light – perihelion of mercury. [12 Hours]

UNIT-II CONSERVATION LAWS OF LINEAR AND ANGULAR MOMENTUM: conservation of linear and angular momentum – Internal forces and momentum conservation – center of mass – examples – general elastic collision of particles of different masses – system with variable mass – examples – conservation of angular momentum – torque due to internal forces – torque due to gravity – angular momentum about center of mass – proton scattering by heavy nucleus. [12 Hours]

UNIT-III CONSERVATION LAWS OF ENERGY: Introduction – significance of conservation laws – law of conservation of energy concepts of work- power – energy – conservative forces – potential energy and conservation of energy in gravitational and electric field – examples – non-conservative forces – general law of conservation of energy. [12 Hours]

UNIT-IV RIGID BODY DYNAMICS: translational and rotational motion – angular momentum – moment of inertia – general theorems of moment of inertia – examples – rotation about fixed axis – kinetic energy of rotation – examples – body rolling along a plane surface – body rolling down an inclined plane – gyroscopic precision – gyrostatic applications. [12 Hours]

UNIT-V LAGRANGIAN MECHANICS: generalized coordinates –degrees of freedom – constraints - principle of virtual work and D' Alembert's Principle –Lagrange's equation from D' Alembert's principle – application –simple pendulum – Atwood's machine. [12 Hours]

TEXT BOOKS:

1. J.C. Upadhyaya, 2019, Classical Mechanics, Himalaya Publishing house, Mumbai.
2. P. Durai Pandian, Laxmi Durai Pandian, Muthamizh Jayapragasam,2005, Mechanics, 6th revised edition, S. Chand & Co.
3. D. S. Mathur & P. S. Hemne, 2000, Mechanics, Revised Edition, S. Chand & Co.
4. Narayanamurthi, M. & Nagarathnam. N, 1998, Dynamics. The National Publishing, Chennai.
5. Narayanamurthi, M. and Nagarathnam, N, 1982, Statics, Hydrostatics and Hydrodynamics, The National Publishers, Chennai.

REFERENCEBOOKS:

1. Goldstein Herbert, 1980, Classical Mechanics. U.S.A: Addison and Wesley.
2. Halliday, David & Robert, Resnick, 1995, Physics Vol. I. New Age, International, Chennai.

3. Halliday, David Robert Resnick, and Walker Jearl, 2001, Fundamentals of Physics, John Wiley, New Delhi

WEBLINKS:

1. https://youtu.be/X4_K-XLUIB4
2. https://nptel.ac.in/courses/115103115
3. https://www.youtube.com/watch?v=p075LPq3Eas
4. https://www.youtube.com/watch?v=mH_pS6fruyg
5. https://onlinecourses.nptel.ac.in/noc22_me96/preview
6. https://www.youtube.com/watch?v=tdkFc88Fw-M
7. https://onlinecourses.nptel.ac.in/noc21_me70/preview

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Understand the Newton's Law of motion, understand general theory of relativity, Kepler's laws and realize the basic principles behind planetary motion
	CO2	Acquire the knowledge on the conservation laws
	CO3	Apply conservation law and calculate energy of various systems, understand, and differentiate conservative and non-conservative forces
	CO4	Gain knowledge on rigid body dynamics and solve problems based on this concept
	CO5	Appreciate Lagrangian system of mechanics, apply D' Alemberts principle

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the3-point scale of STRONG(**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: V PART: III CORE: X	23UPHYC52 ATOMIC AND NUCLEAR PHYSICS	Credit:4 Hours :5

COURSE OBJECTIVES	To make students understand the development of atom models, quantum numbers, coupling schemes and analysis of magnetic moments of an electron; To gain knowledge on excitation and ionization potentials, splitting of spectral lines in magnetic and electric fields; To get knowledge on radioactive decay; To know the concepts used in nuclear reaction; to understand the quark model of classification of elementary particles.
UNITS	**COURSE DETAILS**
UNIT-I	**VECTOR ATOM MODEL:** introduction to atom models – vector atom model – electron spin –spatial quantisation– quantum numbers associated with vector atom model – L-S and J-J coupling – Pauli's exclusion principle – magnetic dipole moment due to orbital motion and spin motion of the electron – Bohr magnetron – Stern-Gerlach experiment – selection rules – intensity rule.
UNIT-II	**ATOMIC SPECTRA:** origin of atomic spectra – excitation and ionization potentials – Davis and Goucher's method – spectral terms and notations – fine structure of sodium D-lines – Zeeman effect –Larmor's theorem – quantum mechanical explanation of normal Zeeman effect – anomalous Zeeman effect (qualitative explanation) –Paschen-Back effect – Stark effect.
UNIT-III	**RADIOACTIVITY:** discovery of radioactivity – natural radio activity – properties of alpha rays, beta rays and gamma rays – Geiger-Nuttal law – alpha particle spectra –Gammow's theory of alpha decay (qualitative study) – beta ray spectra – neutrino theory of beta decay – nuclear isomerism – internal conversion.
UNIT-IV	**NUCLEAR REACTIONS:** conservation laws of nuclear reaction – Q-value equation for a nuclear reaction – threshold energy – scattering cross section – artificial radio activity – application of radio isotopes – classification of neutrons – models of nuclear structure – liquid drop model – shell model.
UNIT-V	**ELEMENTARY PARTICLES:** classification of elementary particles – fundamental interactions – elementary particle quantum numbers – Conservation laws and symmetry – quarks – quark model (elementary ideas only) – discovery of cosmic rays – primary and secondary cosmic rays – latitude effect– altitude effect.
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars — webinars – industry inputs – social accountability.
TEXT BOOKS	1. R. Murugesan, Modern Physics, S. Chand and Co**. (**All units**)** (Units I and II-Problems) 2. Brijlal and N. Subrahmanyam, Atomic and Nuclear Physics, S. Chand and Co. (All units) 3. J. B. Rajam, Modern Physics, S. Chand and Co. 4. Sehgal and Chopra, Modern Physics, Sultan Chand, New Delhi 5. Arthur Beiser– Concept of Modern Physics, McGraw Hill Publication, 6th Edition.
REFERENCE BOOKS	1. Perspective of Modern Physics, Arthur Beiser, McGraw Hill. 2. Modern Physics, S. Ramamoorthy, National Publishing and Co.

	3. Laser and Non-Linear Optics by B. B. Laud, Wiley Easter Ltd., New York,1985. 4. Tayal, D.C.2000 – Nuclear Physics, Edition, Himalaya Publishing House, Mumbai. 5. Irving Kaplan (1962) Nuclear Physics, Second Edition, Oxford and IBH Publish and Co, New Delhi. 6. J.B. Rajam– Atomic Physics, S. Chand Publication, 7th Edition. 7. Roy and Nigam, – Nuclear Physics (1967) First edition, Wiley Eastern Limited, New Delhi.
WEB RESOURCES	1. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html 2. https://makingphysicsfun.files.wordpress.com/2015/01/photoelectric-effect.pptx 3. https://www.khanacademy.org/science/physics/quantum-physics/in-in-nuclei/v/types-of-decay 4. https://www.khanacademy.org/science/in-in-class-12th-physics-india/nuclei

METHOD OF EVALUATION:

Continuous InternalAssessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSEO UTCOMES	**CO1**	Define Pauli's exclusion principle and know about Vector atom model and different coupling sachems.
	CO2	Outline origin of atomic spectra, explain Zeeman effect –Paschen-Back effect – Stark effect.
	CO3	Explain the properties of alpha beta and gamma rays and their spectra
	CO4	Explain liquid drop model and the shell mode of a nucleus outline the artificial radioactivity and applications of radio isotope.
	CO5	Understand the concept of elementary particles know about quarks and cosmic rays.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: V PART: III CORE: XI	23UPHYC53 ANALOG ELECTRONICS	Credit:4 Hours :5

Course Objectives:

1. To understand the fundamental principles of semiconductors, p-n junction and special diodes
2. To acquire knowledge on transistor, its Characteristics and transistor amplifier
3. To understand the feedback principle, oscillators, and multivibrators
4. To understand the operation and significance of some special semiconductor devices
5. To acquire knowledge on Operational Amplifier and its applications

Unit I: Semiconductor diodes: **Hours: 12**

PN junction theory - V-I characteristics of a PN junction diode - Half wave rectifier - Full wave rectifier -Bridge rectifier - Efficiency - filters - capacitor filter- choke input filter- pi filter - Zener diode - Characteristics - voltage regulator - LED - V-I characteristics – advantages - applications - photo diode - characteristics - applications.

Unit II: Transistor Amplifier **Hours: 12**

Transistor - Modes of operations -Characteristics of CB & CE - Two port representation of a transistor - h parameter - AC equivalent circuit using h parameters - analysis of amplifiers using h parameters (CE only) - RC coupled amplifier - transformer coupled amplifier - power amplifier - classification of amplifiers - Class A, Class B and Class C - Push pull amplifier – Emitter follower.

Unit III: Oscillators and Multivibrators **Hours: 12**

Feedback principle - negative feedback effect and Barkhaussen criterion - Phase shift and Wien Bridge oscillators using transistors – Expression for frequency- Multivibrators- Astable, Monostable and Bistable multivibrators using transistors.

Unit IV: Special Semiconductor Devices **Hours: 12**

Clipping and clamping circuits - Differentiating circuit - Integrating circuit - Working and Characteristics of FET, MOSFET - MOS Capacitor - UJT - UJT relaxation oscillator - SCR - SCR as a switch and rectifiers (half wave and full wave)

Unit V: Operational Amplifier **Hours: 12**

Operational Amplifier- characteristics - parameters - Inverting amplifier – non-inverting amplifier - Voltage follower - Adder - Subtractor - Integrator – Differentiator- log and antilog amplifier - comparator - square wave generator - Schmitt trigger.

Course Outcomes:

On completion of the course the students will be able to:

1. work with semiconductors, p-n junction and special diodes
2. know the transistor, its Characteristics and transistor amplifier
3. apply feedback principle, understand oscillators and multivibrators
4. understand the operation and importance of some special semiconductor devices
5. acquire idea on Operational Amplifier IC and its applications

Books for Study:

1. Gupta and Kumar (2002), *Handbook of Electronics*, Pragati Prakashan, Meerut.

2. Mehta, V.K. Rohit Mehta (2006), *Principles of Electronics* S. Chand & Co.

3. Bagde M. K. and Singh S.P. (1990), *Elements of Electronics*, S. Chand & Co., New Delhi.

4. Subramanyam A. (1997), *Applied Electronics*, National Publishing Co.

5. Ramakant A. Gayakwad, (1994), *OP - AMPs and Linear Integrated Circuits*, Prentice Hall of India.

Books for Reference:

1. Mittal. G.K. (1993), *Electronic Devices*, G.K. Publishers Pvt. Ltd.,

2. Theraja, B.L. (2008), *Basic Electronics* S. Chand & Co.,

3. Ambrose and Vincent Devaraj, *Solid State Electronics*, Meera Publication.

4. Sedha, R.S. (1990), *Applied Electronics*, S. Chand & Co.

5. Milman Halkias, *Integrated Electronics*, McGraw Hill

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: V PART: III CORE: XII	23UPHYD54 PROJECT WITH VIVA-VOCE	Credit:4 Hours :5

To ensure innovation and relevance, project guides should assign projects and propose project titles that reflect the current research trends or social issues. Project guides should not mentor more than five students in a group project. A student may work on projects in collaboration with an industry/ research partner with the approval of the Guide and the HOD. The student will have a guide from the department and an expert from the partner organisation. The student will have to meet the guide regularly to assess the progress. The students may also undertake the Project work in his own department with the permission of the Guide and HOD if an industry / external organization could not accommodate a student for project work. The project report / dissertation must contain minimum of about 20 pages**,** with certificate page with a provision for Faculty in charge/ internal, HOD signature and External examiner signature.

Evaluation of the Project:

The evaluation of the Project shall be according to the scheme given below

S. No.	Component	Marks	Total	Grand Total
1	Internal Marks given by Project Guide	25	25 (Internal)	100 Marks
2	Originality of approach	10	75 (External)	
3	Relevance of the Topic	10		
4	Involvement	10		
5	Viva-voce	20		
6	Presentation of Report	25		

The evaluation of the project shall be done by external examiner in consultation with either guide or internal examiner according to the scheme given above. Each candidate shall be evaluated separately. There shall be a maximum of 25 candidates per session with two sessions per day.

(Refer to regulations for Additional Information)

SEMESTER: V PART: III ELECTIVE: V	23UPHYE55 PHYSICS PRACTICAL - V	Credit:3 Hours :4

COURSE OBJECTIVES	1. To demonstrate various optical phenomena principles, working, apply with various materials and interpret the results. 2. To Construct circuits to learn about the concept of electricity, current, resistance in the path of current, different parameters that affect a circuit. Set up experiments, observe, analyse and assimilate the concept. 3. To perform basic experiments on characteristics of electronic devices and microprocessor programming.

Minimum of Eight Experiments from the list:

1. Spectrometer– Grating – Minimum Deviation - Wave length of Mercury spectral lines.
2. Spectrometer – (i-d) curve.
3. Determination of Cauchy's Constants.
4. Potentiometer – Resistance and Specific resistance of the coil.
5. Determination of M and B_H – using Deflection and vibration magnetometer- Tan A position
6. BG / Spot Galvanometer – Figure of Merit – Charge Sensitivity.
7. RC coupled CE transistor amplifier - single stage.
8. Hartley oscillator – using transistor.
9. FET - characteristics.
10. Operational amplifier - inverting amplifier and Summing amplifier
11. 5V, IC Regulated power supply.
12. NAND as universal building block.
13. Microprocessor 8085 – addition (8 bit only)
14. Microprocessor 8085 – subtraction (8 bit only)

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

Semester: V Part: III ELECTIVE: VI	**23UPHYE56-1** **COMMUNICATION PHYSICS**	CREDIT: 3 H/W: 4

COURSE OBJECTIVES:

The major target is to study the various types of modulation and electronic communication methods.

1. To learn the wireless radio communication and modulation methods and receiver principles.
2. To acquire the physical idea behind optical fiber communication, transmission losses and advantages over conventional copper cables.
3. To explore the different types of Radar equipment and their operation.
4. To get to know the satellite communication, transponder assembly, Indian satellites.
5. To learn about mobile cellular communication 4G, fax, VSAT, IPTV, and Wireless fidelity.

UNIT-I RADIO TRANSMISSION AND RECEPTION: Transmitter – modulation types of modulation – amplitude modulation – limitations of amplitude modulation – frequency modulation – comparison of FM and AM – demodulation- essentials in demodulation – receivers: AM radio receivers – types of AM radio receivers – stages of superheterodyne radio receiver, advantages – FM receiver – difference between FM and AM receivers. [10 Hours]

UNIT-II FIBER OPTIC COMMUNICATION: Introduction – basic principle of fiber optics – advantages – construction of optical fiber – classification based on the refractive index profile – classification based on the number of modes of propagation – losses in optical fibers – attenuation–advantages of fiber optic communication. [10 Hours]

UNIT-III RADAR COMMUNICATION: Introduction - basic radar system –radar range – antenna scanning – pulsed radar system – search radar – tracking radar – moving target indicator Doppler effect-MTI principle – CW Doppler radar. [10 Hours]

UNIT-IV SATELLITE COMMUNICATION: Introduction history of satellites – satellite communication system – satellite orbits – basic components of satellite communication system – commonly used frequency in satellite – communication –multiple access communication – satellite communication in India. [10 Hours]

UNIT-V MOBILE COMMUNICATION: Introduction – concept of cell –basic cellular mobile radio system – cell phone – facsimile – important features of fax machine – application of facsimile – VSAT (very small aperture terminals) modem IPTV (internet protocol television) -Wi-Fi-4G (basic ideas). [10 Hours]

TEXTBOOKS:

1. V. K. Metha, Principles of Electronics, S. Chand & Co Ltd., 2013
2. Anokh Singh and Chopra A. K. Principles of communication Engineering, S. Chand & Co, 2013

REFERENCE BOOKS:

1. J. S. Chitode, Digital Communications, 2020, Unicorn publications
2. Senior John. M, Optical Fiber Communications: Principles and Practice, 2009, Pearson Education.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to

CO1	understand the wireless radio communication and modulation methods and receiver principles.
CO2	Know the physical idea behind optical fiber communication, transmission losses and advantages over conventional copper cables.
CO3	recognize the different types of Radar equipment and their operation.
CO4	explain the satellite communication, transponder assembly, Indian satellites.
CO5	Describe mobile cellular communication 4G, fax, VSAT, IPTV, Wireless fidelity.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

Semester: V Part: III ELECTIVE: VI	**23UPHYE56-2** **ENERGY PHYSICS**	CREDIT: 3 H/W: 4

Learning Objective: To get the understanding of the conventional and non-conventional energy sources, their conservation and storage systems.	
UNITS	**COURSE DETAILS**
UNIT-I	**INTRODUCTION TO ENERGY SOURCES:** Energy consumption as a measure of prosperity – world energy future – energy sources and their availability – conventional energy sources – non-conventional and renewable energy sources – comparison – merits and demerits.
UNIT-II	**SOLAR ENERGY:** solar energy Introduction – solar constant – solar radiation at the Earth's surface – solar radiation geometry – Solar radiation measurements – solar radiation data –solar energy storage and storage systems – solar pond – solar cooker – solar water heater – solar greenhouse – types of greenhouses – solar cells.
UNIT-III	**WIND ENERGY:** introduction –nature of the wind – basic principle of wind energy conversion – wind energy data and energy estimation – basic components of Wind Energy Conversion Systems (WECS) – advantages and disadvantages of WECS – applications – tidal energy
UNIT-IV	**BIOMASS ENERGY:** introduction – classification – biomass conversion technologies –photosynthesis – fermentation - biogas generation – classification of biogas plants – anaerobic digestion for biogas – wood gasification – advantages and disadvantages.
UNIT-V	**ENERGY STORAGE:** Importance of energy storage- batteries - lead acid battery -nickel-cadmium battery – fuel cells – types of fuel cells – advantages and disadvantages of fuel cells – applications of fuel cells - hydrogen storage.
TEXT BOOKS	1. G.D.Rai, Non-Conventional Sources of Energy, Khanna Publishers, 2009, 4thEdn. 2. S P Sukhstme, J K Nayak, Solar Energy, Principles of Thermal Collection and Storage, McGraw Hill, 2008, 3rdEdn. 3. D P Kothari, K P Singal, RakeshRajan, PHI Learning Pvt Ltd, 2011, 2ndEdn.

REFERENCE BOOKS	1. John Twidelland Tony Weir, Renewable Energy Resources, Taylor and Francis, 2005, 2ndEdn. 2. S.A. Abbasi and Nasema Abbasi, Renewable Energy sources and their environmental impact, PHI Learning Pvt. Ltd, 2008. 3. M. P. Agarwal, Solar Energy, S. Chand and Co. Ltd., New Delhi,1982 4. H. C. Jain, Non-Conventional Sources of Energy, Sterling Publishers,1986.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

Semester: V Part: III ELECTIVE: VI	**23UPHYE56-3** **LASERS AND FIBER OPTICS**	CREDIT: 3 H/W: 4

COURSE OBJECTIVES:

The main motto is to study the various types of Lasers and working of fiber optic communication which are of great importance.

1. To know the principle of Laser mechanism.
2. To study the different varieties of Laser and their operation.
3. To recognize the applications Laser in in industry and medical fields.
4. To learn more about transmission of signal fiber optic cable, different types of fiber and their characteristics.
5. To discuss the cable losses, cable splicing equipment.

UNIT-I FUNDAMENTALS OF LASER: Basic principles: spontaneous and stimulated emission – Einstein's coefficient – pumping mechanism: optical, electrical and laser pumping – population inversion – two and three level laser system – resonator configuration – quality factor – threshold condition – concept of Q-switching–Theory of mode locking– cavity dumping. [10 Hours]

UNIT-II TYPES OF LASERS: Solid state laser: ruby laser, Nd: YAG laser, Nd: Glass laser– semiconductor laser: intrinsic semiconductor laser, doped semiconductor laser, injection laser – dye laser – chemical laser: HCL laser, DF- CO_2, CO chemical laser. Gas laser: neutral atom gas laser (He-Ne laser), CO_2 laser, Copper vapour laser. [10 Hours]

UNIT-III APPLICATIONS OF LASER: Application of laser in metrology – optical communication – material processing: laser instrumentation of material processing, powder feeder, laser heating, laser welding, laser melting – medical application – Laser instrumentation for surgeries–laser in astronomy. [10 Hours]

UNIT-IV FIBER OPTICS: Basic components of optical fiber communication – principles of light propagation through fiber – total internal reflection – optical fiber – coherent bundle – numerical aperture and skew mode – phase shift and attenuation during total internal reflection – types of fiber: single mode and multi-mode fiber – step index and graded index fiber – fiber optic sensors – application of fiberoptics. [10 Hours]

UNIT-V CHARACTERISTICS AND FABRICATION OF OPTICAL FIBER: Fiber characteristics: mechanical and transmission characteristics – absorption loss and scattering loss measurements – dispersion – connectors and splicers – fiber termination – optical time domain reflectometer (OTDR) and its uses – fiber material – fiber fabrication – fiber optic cables design. [10 Hours]

TEXTBOOKS:

1. B.B. Laud - Laser and Non-linear Optics, New Age International Publications Third Edition, New Delhi.
2. An Introduction to laser, theory, and applications by Avadhunulu, M. N. - S. Chand & Co, New Delhi
3. J. Wilson and J.F.B. Hawkes. 'Introduction to Optoelectronics', Pearson Education, 2018.

REFERENCE BOOKS:

1. Alphan Sennaroglu, "Photonics and Laser Engineering: Principles, Devices and Applications" McGraw-Hill Education, 2010.

2. K. R. Nambiar, “Lasers: Principles, Types and Applications”, New Age International,2004.
3. Optics, Ajoy Ghatak, McGraw-Hill Education (India) Pvt, Ltd, 6thEdn., 2017.

COURSEOUTCOMES:

Upon successful completion of this course, students will be able to

CO1	know the principle of Laser mechanism.
CO2	study the different varieties of Laser and their operation.
CO3	recognize the applications Laser in in industry and medical fields.
CO4	know more about transmission of signal fiber optic cable, different types of fiber and their characteristics.
CO5	speak about the cable losses, cable splicing equipment.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: V PART: IV	23UVALG57 VALUE EDUCATION	Credit:2 Hours :2

SEMESTER: V PART: IV	23UPHYI58 SUMMER INTERNSHIP	Credit:2 Hours :-

Students could learn by doing in the workplace external to the educational Institutions. Internships involve working in Business establishment, Local industry, Government Departments, NGOs, Arts and Crafts on the job experience at different service organisations. All Internships should be properly guided and inducted for focused learning.

After the fourth semester, students should do an internship in the summer holidays. The student must undergo some hands-on training in a company or an industry/ organization during their summer break. When they return to college for their fifth semester, they must submit an internship report of what they did and learned during their internship, along with a diary of their daily activities, a certificate of attendance from their employer, internship report (see template given below) and take a vivo-voce exam about their internship experience. The internship will count as a credit for their fifth semester and will be reflected in their grade card.

(Refer to regulations for Additional Information)

SEMESTER: VI PART: III CORE: XIII	23UPHYC61 RELATIVITY AND QUANTUM MECHANICS	Credit:4 Hours :6

COURSE OBJECTIVES:

This course enables the students.

1. To understand the fundamentals of relativity and general theory of relativity.
2. To Acquire knowledge about concepts of matter waves, phase and group velocity
3. To formulate Heisenberg's uncertainty principle
4. To derive Schrodinger time independent, dependent wave equation and apply to various applications.
5. To interpret the concepts of operators and angular momentum in quantum mechanics.

UNIT – I: SPECIAL THEORY OF RELATIVITY Hours: 12

Frame of references – Galilean transformations – The Michelson-Morley Experiment – Postulates of Special Theory of relativity - Lorentz Transformation equations - Length contraction – Time dilation – Relativity of simultaneity – Variation of mass with velocity – Einstein's Mass-Energy equivalence- Relativistic Momentum- Energy Relation.

UNIT–II: TRANSFORMATION RELATION AND GENERAL THEORY OF RELATIVITY Hours: 11

Transformation of velocity, mass, energy and momentum – four vector – invariance under transformation – Lorentz transformation and velocity addition equations in terms of hyperbolic functions.

Inertial and Gravitational mass – Principle of equivalence – Experimental evidences for General theory of Relativity.

UNIT - III: WAVE MECHANICS Hours: 11

Inadequacies of classical mechanics –Origin of Quantum theory – Black Body radiation – Planck.s Law – Einstein's photoelectric equation – Compton Effect – Pair production - Matter waves – Expression for De Broglie wave length – Phase velocity and group velocity – Relation between phase and group velocity – Davisson and Germer's experiment – Heisenberg's Uncertainity principle – Illustration of Gama Ray Microscope.

UNIT – IV: OPERATOR AND SCHRODINGER EQUATION Hours:12

Physical Significance of wavefunction – Properties of wave function– Schrodinger time independent wave equation – time dependent wave equation — Linear Operator - Eigen values and Eigen functions –Hermitian Operator – Properties of Hermitian operators - operators for position, linear Momentum, angular momentum components –commutator algebra –commutator between these operators –Expectation values of position and momentum – Ehrenfest theorem.

Unit - V: SOLUTIONS OF SCHRODINGER WAVE EQUATION Hours: 14

One Dimension: Free particle – Particle in a box – Potential well finite depth - Linear Harmonic oscillator – Energy levels – Barrier penetration problem –Derivation of kinetic energy - Quantum mechanical tunnelling –

Higher Dimension: Rigid rotator – Hydrogen atom (separation of variables)

COURSE OUTCOMES:

On completion of the course students

1. Gain knowledge in concepts of special theory of relativity and Einstein's mass energy relation
2. To learn the importance of transformation equations and also to differentiate between special and general theory of relativity
3. Obtain ideas about dual nature of matter and understand Heisenberg's uncertainty principle.
4. Derive Schrodinger wave equations and to get exposed to operators and their commutation relations
5. Understand application of Schrodinger wave equations in one dimension and higher dimension.

TEXT BOOKS:

1. Modern Physics by R. Murugeshan and Kiruthiga Sivaprasath, S. Chand &Co. 17th Revised Edition, 2014.
2. Mechanics and Relativity by Brijlal Subramanyam, S.Chand& Co., New Delhi, (1990).
3. Quantum Mechanics by Gupta, Kumar and sharma, JaiPrakash Nath Publications.
4. Quantum Mechanics by Sathyaprakash, Pragati Prakashan, Meerut.
5. Quantum Mechanics by V.K.Thankappan, New Age International (P) Ltd.Publishers, New Delhi (2003).

REFERENCE BOOKS:

1. A Text book of Quantum mechanics by P.M.Mathews and S.Venkatesan, TataMcGraw - Hill, New Delhi (2005).
2. Quantum mechanics by K.K.Chopra and G.C. Agrawal, Krishna Prakasam Media(P) Ltd., Meerut First Edition(1998).
3. Concepts of modern physics by A. Beiser. Tata McGraw - Hill, 6thedition, NewDelhi(2002).
4. Introduction to Modern Physics by H. S. Mani and G. K. Mehtha, Affiliated East-West Press (1998).
5. Quantum mechanics by Ajoy Ghatak and Loganathan, Macmillan India Pvt. Ltd.
6. Quantum Mechanics,V.Murugan, Pearson Education, India, 2014.

WEBLINKS:

1. http://hyperphysics.phy-astr.gsu.edu/hbase/qapp.html
2. https://swayam.gov.in/nd2_arp19_ap83/preview
3. https://swayam.gov.in/nd1_noc20_ph05/preview
4. https://www.khanacademy.org/science/physics/special-relativity/minkowski-spacetime/v/introduction-to-special-relativity-and-minkowski-spacetime-diagrams

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: VI **PART: III** **CORE: XIV**	**23UPHYC62** **SOLID STATE PHYSICS**	**Credit:4** **Hours :6**

COURSE OBJECTIVES:

1. To understand the different types of bonding in solids
2. To acquire knowledge about lattice dynamics
3. To acquire knowledge on the basics of magnetic phenomena on materials and various types of magnetizations.
4. To know the properties of dielectric materials.
5. To know the properties of ferroelectric and superconducting materials.

UNIT-IBONDING IN SOLIDS, CRYSTAL STRUCTURE: Types of bonding –ionic bonding – bond energy of NaCl molecule –covalent bonding – metallic bonding – hydrogen bonding – Van-der-Waals bonding – crystal lattice – lattice translational vectors – lattice with basis – unit cell – Bravais' lattices – Miller indices – procedure for finding them –packing of BCC and FCC structures – structures of NaCl and diamond crystals –reciprocal lattice – reciprocal lattice vectors – properties – reciprocal lattices to SC, BCC and FCC structures,

UNIT-II ELEMENTARY LATTICE DYNAMICS: Lattice vibrations and phonons: linear monoatomic and diatomic chains. acoustical and optical phonons –qualitative description of the phonon spectrum in solids – Dulong and Petit's Law – Einstein and Debye theories of specific heat of solids – T3 law (qualitative only)–properties of metals – classical free electron theory of metals (Drude-Lorentz) – Ohm's law – electrical and thermal conductivities – Wiedemann-Franz' law –Sommerfeld's quantum free electron theory (qualitative only) – Einstein's theory of specific heat capacity.

UNIT-III MAGNETIC PROPERTIES OF SOLIDS: Permeability, susceptibility, relation between them – classification of magnetic materials – properties of dia, para, ferro, ferri and antiferromagnetism – Langevin's theory of diamagnetism – Langevin's theory of paramagnetism – Curie-Weiss law – Weiss theory of ferromagnetism (qualitative only) – Heisenberg's quantum theory of ferromagnetism – domains – discussion of B-H curve –hysteresis and energy loss – soft and hard magnets – magnetic alloys.

UNIT-IV DIELECTRIC PROPERTIES OF MATERIALS: Polarization and electric susceptibility –local electric field of an atom – dielectric constant and polarisability – polarization processes: electronic polarization– calculation of polarisability – ionic, orientational and space charge polarization –internal field – Clausius-Mosotti relation –frequency dependence of dielectric constant – dielectric loss – effect of temperature on dielectric constant – dielectric breakdown and its types.

UNIT-V FERROELECTRIC & SUPERCONDUCTING PROPERTIES OF MATERIALS: Ferroelectric effect: Curie-Weiss Law – ferroelectric domains, P-E hysteresis loop – elementary band theory: Kronig-Penny model – band gap (no derivation) – conductor, semiconductor (P and N type) and insulator –conductivity of semiconductor – mobility – Hall effect – measurement of conductivity (four probe method) - Hall coefficient.
Superconductivity: experimental results –critical temperature –critical magnetic field – Meissner effect –type-I and type-II superconductors – London's equation and penetration depth – isotope effect – idea of BCS theory (no derivation)

COURSE OUTCOMES:

On completion of the course students

1. Gain knowledge in types of bonding, miller indices, crystal structures.
2. To learn the importance of dynamics of crystal lattice.

3. Obtain ideas about various magnetic properties of solids.
4. Understand the dielectric properties of materials.
5. Understand ferroelectric and superconducting properties of materials.

TEXT BOOKS:

1. Introduction to Solid State Physics, Kittel, Willey Eastern Ltd (2003).
2. Solid state Physics, Rita John,1st edition, Tata McGraw Hill publishers (2014).
3. Solid State Physics , R L Singhal, Kedarnath Ram Nath& Co., Meerut (2003)
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
5. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
6. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
7. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
8. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
9. Solid State Physics, M.A. Wahab, 2011, Narosa Publishing House, ND

REFERENCE BOOKS:

1. Puri & Babber – Solid State Physics – S. Chand &Co. New Delhi.
2. Kittel - Introduction to solid state physics, Wiley and Sons, 7th edition.
3. Raghavan - Materials science and Engineering, PHI
4. Azaroff - Introduction to solids, TMH
5. S. O. Pillai - Solid State Physics, Narosa publication
6. A.J. Dekker - Solid State Physics, McMillan India Ltd.
7. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India

WEBLINKS:

1. https://nptel.ac.in/courses/115105099/
2. https://nptel.ac.in/courses/115106061/

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: VI **PART: III** **CORE: XV**	**23UPHYC63** **DIGITAL ELECTRONICS AND MICROPROCESSOR 8085**	**Credit:4** **Hours :6**

COURSE OBJECTIVES: To learn types of number systems used in computers, Boolean algebra and identities, digital circuits for addition and subtraction, flip-flops, registers, counters. To get the knowledge on fundamentals of 8085 architecture, instruction sets and simple programs.

UNIT-I Decimal, binary, hexadecimal number systems and their conversions –binary addition, binary subtraction using 1's & 2's complement methods – Boolean laws – De-Morgan's theorem –basic logic gates -universal logic gates (NAND & NOR) –standard representation of logic functions (SOP & POS) – minimization techniques (Karnaugh map: 2, 3, 4 variables).

UNIT-II Adders, half &full adder –subtractors, half &full subtractor –parallel binary adder – magnitude comparator – multiplexers (4:1) &demultiplexers (1:4), encoder (8-line-to-3- line) and decoder (3-line-to-8-line), BCD to seven segment decoder.

UNIT-III Flip-flops: S-R Flip-flop, J-K Flip-flop, T and D type flip-flops, master-slave flip-flop, truth tables, registers: - serial in serial out and parallel in and parallel out – counters asynchronous: -mod-8, mod-10, synchronous - 4-bit & ring counter – general memory operations, ROM, RAM (static and dynamic), PROM, EPROM, EEPROM, IC – logic families: TTL logic, – Programmable Logic Array (PLA).

Unit IV: Architecture **Hours: 12**

Architecture of 8085 – registers, flags, ALU, address and data bus, demultiplexing address/data bus – control and status signals – control bus – Pin out diagram – Functions of different pins – Interrupts and its types.

UNIT V: Programming Techniques **Hours: 12**

Instruction set of 8085 – data transfer, arithmetic, logic, branching and machine control group of instructions – addressing modes – register indirect, direct, immediate, and implied addressing modes. Assembly language & machine language – programming techniques: addition, subtraction, multiplication, division, ascending, descending order, largest and smallest (single byte)

COURSE OUTCOMES:

On completion of the course students

1. Gain knowledge of the idea behind of number systems and inter-conversions.
2. To know the working and importance of arithmetic circuits.
3. Obtain ideas about elements of Sequential circuits and organisation of memory.
4. Explain the architecture and pin out of 8085 MPU
5. Understand addressing modes and the way of writing assembly level programs in 8085 MPU.

TEXT BOOKS:

1. M. Morris Mano, "Digital Design "3rd Edition, PHI, New Delhi.
2. Ronald J. Tocci. "Digital Systems-Principles and Applications" 6/e. PHI. New Delhi. 1999.(UNITS I to III)
3. S. Salivahana & S. Arivazhagan-Digital circuits and design
4. Microprocessor Architecture, Programming and Applications with the 8085 – Penram International Publishing, Mumbai.- Ramesh S. Gaonakar

REFERENCE BOOKS:

1. Herbert Taub and Donald Schilling. "Digital Integrated Electronics" . McGraw Hill. 1985.
2. S.K. Bose. "Digital Systems". 2/e. New Age International.1992.
3. D. K. Anvekar and B. S. Sonade. "Electronic Data Converters: Fundamentals &Applications". TMH.1994.

4. Malvino and Leach. “Digital Principles and Applications”. TMG HillEdition
5. Microprocessors and Interfacing – Douglas V.Hall
6. Microprocessor and Digital Systems – Douglas V.Hall

WEBLINKS:

1. https://youtu.be/-paFaxtTCkI
2. https://youtu.be/s1DSZEaCX_g

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: VI **PART: III** **ELECTIVE: VII**	**23UPHYE64** **PHYSICS PRACTICAL - VI**	**Credit:3** **Hours :5**

COURSE OBJECTIVES	1. To demonstrate various optical phenomena principles, working, apply with various materials and interpret the results. 2. To Construct circuits to learn about the concept of electricity, current, resistance in the path of current, different parameters that affect a circuit. Set up experiments, observe, analyse and assimilate the concept. 3. To perform basic experiments on characteristics of electronic devices and then get into the applications such as amplifiers, oscillators, counters, multivibrators. 4. Perform fundamental experiments on microprocessor 8085 and learn to write programs by themselves.

Minimum of Ten Experiments from the list:

1. Dispersive power of plane diffraction grating.
2. Spectrometer – (i- i′) curve.
3. Carey Foster's bridge - Temperature coefficient of resistance of the coil.
4. Potentiometer – E.M.F of a thermocouple.
5. Determination of M and B_H – using Deflection and vibration magnetometer- Tan B position
6. Clipping and Clamping circuits using Diodes
7. Transistor Emitter follower.
8. Colpitt's oscillator – using transistor.
9. Astable multivibrator - using transistor.
10. Operational amplifier - non-inverting amplifier and Summing amplifier
11. Operational amplifier- Differential amplifier (Subtracting amplifier)
12. Operational amplifier - D/A converter by binary resistor method.
13. NOR as universal building block.
14. Half adder / Half subtractor using basic logic gate ICs
15. Microprocessor 8085 – multiplication (8 bit only)
16. Microprocessor 8085 – division (8 bit only)
17. Microprocessor 8085 – Square (8 bit only)
18. Microprocessor 8085 – ascending/ descending order (8 bit only)

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

SEMESTER: VI **PART: III**	**23UPHYE65-1** **ADVANCED MATHEMATICAL PHYSICS**	**Credit:3** **Hours :4**

ELECTIVE: **VIsII**		

Learning Objective: The fundamentals of matrices and vector calculus learnt in earlier course will enable students to learn advanced topics and theorems. The special functions and applications of partial differential equations will be of use in research at a later stage.	
UNITS	**COURSE DETAILS**
UNIT-I	**MATRICES: i**ntroduction – special types of matrices – transpose – conjugate– conjugate transpose– symmetric andanti symmetric – Hermitian and skew Hermitian – orthogonal and unitary – properties – characteristic equation – roots and characteristic vectors – diagonalization– Cayley–Hamilton theorem –simple problems
UNIT-II	**VECTOR CALCULUS:**∇operator – divergence – second derivative of vector functions or fields –Laplacianoperator – curl of a vector – line integral – line Integral of a vector field around an infinitesimal rectangle – curl of conservative field – surface integral – volume integral (without problem) – Gauss's divergence theorem and proof – Stroke's theorem and proof –simple problems.
UNIT-III	**SPECIAL FUNCTIONS:** definition –Beta function – Gamma function – evaluation of Beta function – other forms of Beta function – evaluation of Gamma function – other forms of Gamma function – relation between Beta and Gamma functions – simple problems.
UNIT-IV	**FROBENIUS METHOD AND SPECIAL FUNCTIONS:**singularpoints of second order linear differential equations and importance –singularities of Bessels and Laguerre equations, Frobenius method and applications to differential equations: Legendre and Hermite differential equations – Legendre and Hermite polynomials – Rodrigues formula –generating function – orthogonality
UNIT-V	**PARTIAL DIFFERENTIAL EQUATIONS:**solutions to partial differential equations using separation of variables - Laplace's equation in problems of rectangular – cylindrical and spherical symmetry – conducting and dielectric sphere in an external uniform electric field – wave equation and its solution for vibrational modes of a stretched string
TEXT BOOKS	1. Mathematical Physics, B.D. Gupta-Vikas Publishing House, 4 th Edition (2006) 2. Mathematical Physics, Satya Prakash (Sultan Chand)
REFERENCE BOOKS	1. Mathematical Methods for Physicists, G.B.Arfken, H.J.Weber, F.E.Harris (2013, 7th Edn., Elsevier) 2. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Publishing) 3. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India) 4. Mathematical Physics and Special Relativity, M. Das, P.K. Jena and B.K. Dash (Sri Krishna Prakashan)

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: VI PART: III ELECTIVE: VIII	23UPHYE65-2 MATERIALS SCIENCE	Credit:3 Hours :4

Learning Objective: To learn imperfections in crystals, deformation of materials and testing of materials. To get knowledge on behavior of a material, under the action of light and their applications. To know the applications of crystal defects.	
UNITS	**COURSE DETAILS**
UNIT-I	**CRYSTAL IMPERFECTIONS:** introduction – point defects: vacancies **(***problems***)**, interstitials, impurities, electronic defects –line defects: edge dislocation **(***problems***)**, screw dislocation – surface defects: extrinsic defects – intrinsic defects: grain boundaries, tilt and twist boundaries, twin boundaries, stacking faults – volume defects – effect of imperfections.
UNIT-II	**MATERIAL DEFORMATION: i**ntroduction – elastic behavior of materials – atomic model of elastic behavior –modulus as a parameter in design – rubber like elasticity – inelastic behavior of materials – relaxation process – viscoelastic behavior of materials.
UNIT-III	**PERMANENT DEFORMATION AND STRENGTHENING METHODS OF MATERIALS:** introduction –plastic deformation: tensile stress-strain curve – plastic deformation by slip – creep: mechanism of creep – creep resistant materials – strengthening methods: strain hardening, grain refinement – solid solution strengthening – precipitation strengthening.
UNIT-IV	**OPTICAL MATERIALS:** introduction – optical absorption in metals, semiconductors and insulators – NLO materials and their applications – display devices and display materials: fluorescence and phosphorescence – light emitting diodes –liquid crystal displays.
UNIT-V	**MECHANICAL TESTING:** destructive testing: tensile test, compression test, hardness test – nondestructive testing (NDT): radiographic methods, ultrasonic methods – thermal methods of NDT: thermography – equipment used for NDT: metallurgical microscope
TEXT BOOKS	1. Material science and Engineering, Raghavan V,Prentice Hall of India, Sixth Edition, 2015 2. Materials science, V. Rajendran, McGraw Hill publications 2011
REFERENCE BOOKS	1. William D. Callister, Jr., Material Science and Engineering – An Introduction, 8th Edition, John Wiley and Sons, Inc., 2007 2. W. Bolton, "Engineering materials technology", 3rd Edition, Butterworth and Heinemann, 2001. 3. Donald R. Askel and, Pradeep P. Phule, "The Science and Engineering of Materials", 5th Edition, Thomson Learning, First Indian Reprint, 2007. 8. William F. Smith, "Structure and Properties of Engineering Alloys", Mc.Graw-Hill Inc., U.S.A, 2nd edition, 1993.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

SEMESTER: VI PART: III ELECTIVE: VIII	23UPHYE65-3 NANOSCIENCE AND NANOTECHNOLOGY	Credit:3 Hours :4

Course Objective: This course aims to provide an overall understanding of Nanoscience and Nanotechnology and introduces different types of nanomaterials, their properties, fabrication methods, characterization techniques and a range of applications.

UNIT-I NANOSCIENCE AND NANOTECHNOLOGY: Nanoscale– nature and nanostructures – nanostructures: 0D, 1D,2D– surface to volume ratio– size effect – excitons – quantum confinement– metal-based nanoparticles (metal and metal oxide) – nanocomposites (non-polymer based) – carbon nanostructures – fullerene –SWCNT and MWCNT

UNIT-II PROPERTIES OF NANOMATERIALS: Introduction –mechanical behaviour – elastic properties – hardness and strength – ductility and toughness –superplastic behaviour – optical properties – surface plasmon resonance – electrical properties – dielectric materials and properties – magnetic properties – super Para magnetism – electrochemical properties – properties of CNTs.

UNIT-III FABRICATION METHODS AND VACUUM TECHNIQUES: Top-down and bottom-up approaches – electrochemical method – chemical & physical vapour depositions (CVD & PVD) – plasma arc discharge – sputtering – thermal evaporation – pulsed laser deposition – ball milling – lithography: photolithography – e-beam lithography – sol-gel methods – synthesis of CNT.

UNIT-IV CHARACTERIZATION TECHNIQUES: Scanning probe microscopy – scanning tunnelling microscopy – atomic force microscopy – scanning electron microscopy – transmission electron microscopy –powder XRD method: determination of structure and grain size analysis – UV-visible and photoluminescence spectroscopy.

UNIT-V APPLICATIONS OF NANOMATERIALS: Medicine: drug delivery – photodynamic therapy – molecular motors –energy: fuel cells –rechargeable batteries – supercapacitors– photovoltaics. sensors: nano sensors based on optical and physical properties – electrochemical sensors – nano biosensors. nanoelectronics: CNTFET – display screens – GMR read/write heads – nanorobots –applications of CNTs.

TEXT BOOKS:

1. K. K. Chattopadhyay and A. N. Banerjee, (2012), Introduction to Nanoscience and Nanotechnology, PHI Learning Pvt. Ltd.,
2. M.A. Shah, Tokeer Ahmad (2010), Principles of Nanoscience and Nanotechnology, Narosa Publishing House Pvt Ltd.
3. Mick Wilson, et al (2005) Nanotechnology, Overseas Press.
4.

REFERENCE BOOKS:

1. Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA
2. J. H. Fendler (2007) Nano particles and nano structured films; Preparation, Characterization and Applications, John Wiley & Sons
3. B. S. Murty, et al (2012) Textbook of Nanoscience and Nanotechnology, Universities Press.

SEMESTER: VI PART: IV PREFESSIONAL COMPETENCY SKILL:	23UPHYF66 PROBLEM SOLVING SKILLS IN PHYSICS, APTITUDE AND REASONING (PROFESSIONAL COMPETENCY SKILL)	Credit:2 Hours :3

Course objective:

Main objective of this course is to make the student to solve problems in core physics.
(Minimum of 15 problems based on various principles of Physics are required in each unit).

1. **To apply broad physical principles** to specific situations and solve problems using appropriate equations and methods.
2. **To develop a problem-solving strategy** that involves examining the situation, identifying the knowns and unknowns, choosing a suitable equation, solving for the desired quantity, and checking the validity and significance of the solution.
3. **To use multiple representations** such as diagrams, graphs, tables, equations, and words to analyze and communicate physical phenomena and solutions.
4. **To estimate and evaluate** the reasonableness and accuracy of their solutions using dimensional analysis, order-of-magnitude estimates, significant figures, and experimental uncertainties.
5. **To demonstrate improved cognitive skills** such as critical thinking, logical reasoning, creativity, and metacognition in solving physics problems.

UNIT I: PROBLEMS IN MECHANICS AND PROPERTIES OF MATTER:

Newton laws of motion for various systems (1 and 2 dimension) - Conservation laws and collisions - Rotational mechanics - central force - Harmonic oscillator – Elasticity - Viscosity - surface tension.

UNIT II: PROBLEMS IN THERMAL PHYSICS:

Kinetic theory - MB distribution - Laws of thermodynamics – Ideal Gas law - Various Thermodynamic process - Entropy calculation for various process - Heat engine - TS and PV diagram - Free energies various relations.

UNIT III: PROBLEMS IN ELECTRICITY & MAGNETISM:

Electrostatics - calculation of Electrostatic quantities for various configurations – Conductors - Calculation of Magnetic quantities for various configuration - Electromagnetic induction - Errors and propagation of errors - Plotting the graphs for various elementary and composite functions.

Unit -IV NUMERICAL ABILITY:

Calendar - Average - Percentage - Profit and Loss - Simple Interest - Compound Interest - Time and Work - Pipes and Cisterns - Time and Distance - Problems on Trains - Boats and Streams - Ratios and Proportions.

Unit V: REASONING:

Test of Reasoning - Verbal Reasoning: Series Completion - Analogy - Data Sufficiency - Assertion and Reasoning - Logical Deduction - Non-Verbal Reasoning: Series and Classification.

Course Outcome:

By the end of this course, students should be able to:

1. **apply broad physical principles** to specific situations and solve problems using appropriate equations and methods.
2. **develop a problem-solving strategy** that involves examining the situation, identifying the knowns and unknowns, choosing a suitable equation, solving for the desired quantity, and checking the validity and significance of the solution.
3. **use multiple representations** such as diagrams, graphs, tables, equations, and words to analyze and communicate physical phenomena and solutions.
4. **estimate and evaluate** the reasonableness and accuracy of their solutions using dimensional analysis, order-of-magnitude estimates, significant figures, and experimental uncertainties.
5. **demonstrate improved cognitive skills** such as critical thinking, logical reasoning, creativity, and metacognition in solving physics problems.

TEXTBOOKS:

1. Mechanics (in SI units) by Charles Kittel, Walter D knight etc. (Berkeley Physics course-volume 1), Tata McGraw Hill publication, second edition.
2. Properties of matter by D. S. Mathur, S. Chand Publications, 11th Edition.
3. Thermal physics by S. C. Garg, R M Bansal & C K Ghosh. (Tata McGraw Hill Publications), 1st edition.
4. Electricity & magnetism (in SI units) by E. M. Purcell, Tata McGraw hill Publication, 2nd Edition.
5. Play with graphs by Amith Agarwal, Arihant Publications.
6. Aggarwal, R.S. 2001. Quantitative Aptitude. S. Chand. New Delhi.
7. Aggarwal, R.S. 2010. A Modern Approach to Verbal and Non Verbal Reasoning. S. Chand, New Delhi.

REFERENCE BOOKS:

1. Fundamentals of Physics by Halliday & Resnick, Wiley Publications, 8th Edition.
2. Advanced level physics by Nelkon and Parker, CBS publishers, 7th edition.
3. Solving Problems in Physics by H.C. Verma.
4. The Art of Problem Solving in Physics Volume 1 by K. Gopala Krishna and S. Srinivasan.
5. Physics: Principles with Applications by Douglas C. Giancoli.
6. TPACK Implementation in Physics Textbook: Practice Problem-Solving Skill in Newton's Law of Motion for Senior High School Students by Rizky Nurul Fajriyah and Siti Fatimah.
7. Sahitya Bhawan Test of Reasoning & Numerical Ability book in English for competitive exams | General Mental Ability / Quantitative Aptitude for Government Job preparation by Dr. S.S. Chaudhary; Dr. N.K. Porwal.

WEBLINKS:

1. https://files.eric.ed.gov/fulltext/EJ1217444.pdf
2. https://phys.libretexts.org/Bookshelves/University_Physics/Book%3A_University_Physics_%28OpenStax%29/Book%3A_University_Physics_I_-_Mechanics_Sound_Oscillations_and_Waves_%28OpenStax%29/01%3A_Units_and_Measurement/1.08%3A_Solving_Problems_in_Physics
3. https://www.practiceaptitudetests.com/verbal-reasoning-tests/
4. https://www.toppr.com/guides/reasoning-ability/verbal-reasoning/verbal-reasoning-practice-questions/
5. https://testbook.com/reasoning/verbal-reasoning
6. https://www.bankexamsindia.com/numerical-ability-exam-syllabus-topics-to-prepare/
7. https://testbook.com/cuet/general-test-numerical-ability-practice-questions
8. https://www.vskills.in/practice/numerical-ability-mock-test

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG (**S**), MEDIUM (**M**) and LOW (**L**).

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

SEMESTER: VI **PART: V** **EXTENSION ACTIVITY**	**23UPHYX67** **EXTENSION ACTIVITY**	**Credit:1** **Hours :-**

(Refer to the Regulations)