MOTHERTERESAWOMEN'SUNIVERSITY
KODAIKANAL - 624101

DEPARTMENT OF PHYSICS

B.Sc.PHYSICS

Curriculum Framework, Syllabus and Regulations

(Based on TANSCHE Syllabus underChoice Based Credit Systems – CBCS)

(For the candidates to be admitted from the Academic Year2023-24)

B.Sc.,PHYSICS

Preamble

Physics is one ofthe basic and fundamentalsciences. The curriculumfor the graduate programme in Physics is revised as per the UGC guidelines on the Learning Outcome-based course framework.The learner-centriccoursesletthestudent progressivelydevelopa deeper understanding of various aspects of physics.

The new curriculum offers courses in the core areas of mechanics, acoustics, opticsand spectroscopy, electricity and magnetism, atomic and nuclear physics, solid state, electronics and other fields. The courses will train students with sound theoretical and experimental knowledge that suits the needs of academics and industry.In addition to the theoretical course work, the students also learn physics laboratory methods for different branches of physics, specialized measurement techniques, analysis of observational data, including error estimation, etc. The students will have a deeper understanding of the laws of nature through subjects like classical mechanics, quantum mechanics, statistical physics, etc. The problem-solving ability of students will be enhanced. The students can apply principles in physics to real-life problems. Courses like integrated electronics and microprocessors willenhance logicalskills as wellas employabilityskills. Numerical methods and mathematical physics provide analyticalthinking and provide a better platform for higher-level physics for research.

Theirstructuredcourseswithwell-defined objectives and learningoutcomesguide prospective students in choosing elective courses to broaden their skills not only in the field of physics but also in interdisciplinary areas.The elective modules of the framework offer students the choice to gain knowledge and expertise in specialized domains of physics like astrophysics, medical physics, etc.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATEEDUCATION	
Programme	**B.Sc.,Physics**
Programme Code	
Duration	**3years[UG]**
Programme Outcomes: (Theseare mere guidelines. Facultycan CreatePOs based on their Curriculumor Adoptfrom UGCorthe Universityfor their Programme)	**PO1:Disciplinaryknowledge:** Capableofdemonstratingcomprehensiveknowledgeandunderstanding Ofoneormoredisciplinesthatformapartofanundergraduate programme ofstudy **PO2:Communication Skills:** Abilitytoexpressthoughtsandideaseffectivelyinwritingandorally Communicatewithothersusingappropriatemedia;confidentlyshare one'sviewsandexpressherself/himself;demonstratetheabilitytolisten carefully;readandwriteanalyticallyandpresentcomplexinformationin A clearandconcise mannertodifferentgroups. **PO3:Criticalthinking:** Capabilitytoapplytheanalyticthoughttoabodyofknowledge;analyse Andevaluatetheproofs,arguments,claims,beliefsonthebasisof Empiricalevidences;identifyrelevantassumptionsorimplications; Formulatecoherentarguments;criticallyevaluatepractices,policiesand Theoriesbyfollowingscientificapproach. **PO4:Problemsolving:**

	Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather thanreplicate curriculumcontent knowledge;and applyone'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 andsynthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6:Research-relatedskills**: 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 conclusionsfrom data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7:Cooperation/Teamwork:** Abilityto work effectivelyand respectfully with diverse teams; facilitate cooperative or coordinated effort onthe 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: Scientificreasoning**: 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:Reflectivethinking**: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. **PO10Information/digitalliteracy:** 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. **PO11Self-directed learning**: Ability to work independently, identify appropriate resources requiredfor a project, and manage a project through to completion. **PO12Multiculturalcompetence:** Possess knowledge of the values and beliefs of multiple cultures and a globalperspective; and capabilityto effectivelyengage ina multicultural society and interact respectfully with diverse groups. **PO 13:Moralandethicalawareness/reasoning**: Ability to embrace 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 demonstrating the 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 intellectualpropertyrights;appreciatingenvironmentalandsustainability issues;andadoptingobjective,unbiasedandtruthfulactionsinall

	Aspectsofwork. **PO14: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. **PO15: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 personaldevelopment,meetingeconomic,socialandculturalobjectives, 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 basedontheir curriculumor adopt from UGC or Universityfor their Programme)**	**PSO1:Placement:** To prepare the students who will demonstrate respectful engagementwith 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**:**Researchand Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4**:**ContributiontoBusiness World:** Toproduceemployable,ethicalandinnovativeprofessionalstosustainin the dynamic business world. **PSO5**:**ContributiontotheSociety:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit

WRITTENEXAMINATIONQUESTIONPAPERPATTERN

TheoryPaper(Bloom'sTaxonomy based)

(CommonforUG,PG,Certificate,DiplomaandP.G.Diploma Programmes)

IntendedLearningSkills	**Maximum75Marks** **PassingMinimum:50%** **Duration: Three Hours**
Memory Recall/Example/ CounterExample/Knowledge Aboutthe Concepts/Understanding	**Part–A(10x2=20Marks)** AnswerALLquestions **EachQuestion carries2marks**

	TwoquestionsfromeachUnit
	Question1toQuestion10
Descriptions/Application (problems)	**Part–B(5x5=25Marks)Answer ALL questions Eachquestioncarries5Marks**
	Either-orType BothpartsofeachquestionfromthesameUnit
	Question 11(a)or11(b) to **Question 15(a)or15(b)**
Analysis/Synthesis/Evaluation	**Part-C (3x10=30Marks) Answerany THREE questions Eachquestioncarries10Marks**
	ThereshallbeFIVEquestionscoveringallthe Fiveunits
	Question 16to Question20

SYLLABUSFRAMEWORKFORUGPROGRAMMES (As per TANSCHE –From 2023 – 2024)
B.Sc.PHYSICS

SEMESTER –I

Part	CourseCode	CourseTitle	Credit	No.of Hours	CIA	ESE	Total Marks
Part-1	U23TAL101/ U23MAL101/ U23FRL101/ U23HIL101	Language – 1: Tamil / Malayalam/French/Hindi	3	6	25	75	100
Part-2	U23ENL101	Language2- English	3	6	25	75	100
Part-3	U23PHT101	Core Theory – 1: PropertiesofMatterand Acoustics	5	5	25	75	100
	U23PHP102	CorePractical - 1	5	5	25	75	100
	U23PHAE11	SubjectBasedElective-I(Allied-1): Mathematics	3	4	25	75	100
Part-4	U23PHS11A /U23PHS11B	SkillEnhancementCourse1 (AdvancedMathematical Physics/EnergyPhysics)	2	2	25	75	100
	U23PHF101	FoundationCourse: IntroductoryPhysics	2	2	25	75	100
	TOTAL		23	30			

SEMESTER –II

Part	CourseCode	CourseTitle	Credit	No.of Hours	CIA	ESE	Total Marks
Part-1	U23TAL202/ U23MAL202/ U23FRL202/ U23HIL202	Language – 1: Tamil / Malayalam/French/Hindi	3	6	25	75	100
Part-2	U23ENL202	Language2- English	3	6	25	75	100
Part-3	U23PHT203	Core Theory – 2: Heat,Thermodynamics and StatisticalPhysics	5	5	25	75	100
	U23PHP204	Core Practical - 2	5	5	25	75	100
	U23PHE22A	SubjectBasedElective – 2 (Allied-2): Mathematics	3	4	25	75	100
Part-4	U23PHS22A	SkillEnhancementCourse–2 : Soft Skills	2	2	25	75	100
	U23PHS23A	SkillEnhancementCourse–3 (ElectronicsinEverydaylife) – Additional Credits - 2	-	-	25	75	100
	U23PHNM21	Naan Mudhalvan Course - 1	2	2			
	TOTAL		23	30			

SEMESTER – III

Part	Course Code	Course Title	Credit	No.of Hours	CIA	ESE	Total Marks
Part - 1	U23TAL303/ U23MAL301/	Language – 1: Tamil / Malayalam/French/Hindi	3	6	25	75	100

	U23FRL303/ U23HIL303						
Part - 2	U23ENL303	Language 2 - English	3	6	25	75	100
Part - 3	U23PHT305	Core Theory – 3: General Mechanics and Classical Mechanics	5	5	25	75	100
	U23PHP306	Core Practical – 3	5	5	25	75	100
	U23PHE33A	Subject Based Elective-III (Allied-II): Chemistry	3	4	25	75	100
Part - 4	U23PHS34A	Skill Enhancement Course IV (Non Major Elective- Physics for everyday life)	1	2	25	75	100
	U23PHNM32	Naan Mudhalvan Course - 2	2	2	25	75	100
TOTAL			22	30			

SEMESTER – IV

Part	Course Code	Course Title	Credit	No.of Hours	CIA	ESE	Total Marks
Part - 1	U23TAL404 / U23MAL404/ U23FRL404/ U23HIL404	Language – 1: Tamil / Malayalam/French/Hindi	3	6	25	75	100
Part - 2	U23ENL404	Language 2 - English	3	6	25	75	100
Part - 3	U23PHT407	Core Theory – 4: Optics and Spectroscopy	5	5	25	75	100
	U23PHP408	Core Practical - 4	5	5	25	75	100
	U23PHE44A	Subject Based Elective - 4 (Allied-II): Chemistry Practical	3	3	25	75	100
Part - 4	U23PHS45A	Skill Enhancement Course – V (Non Major Elective-Astro Physics)	2	2	25	75	100
	U23PHNM43	Naan Mudhalvan Course - 3	2	2	25	75	100
	U23EVS401	EVS	2	2	25	75	100
TOTAL			25	31			

SEMESTER – V

Part	Course Code	Course Title	Credit	No.of Hours	CIA	ESE	Total Marks
Part – 3	U23PHT509	Core Theory – 5: Atomic Physics and Lasers	4	5	25	75	100
	U23PHT510	Core Theory – 6: Relativity and Quantum Mechanics	4	5	25	75	100
	U23PHP511	Core Practical - 5	4	5	25	75	100
	U23PHT512	Core Theory -7: Digital Electronics and Microprocessor 8085	4	5	25	75	100
	U23PHE55A/ U23PHE55B	Subject Based Elective 5 – A. Communication Physics/ B. Energy Physics	3	3	25	75	100
	U23PHE56A/ U23PHE56B	Subject Based Elective 6 – A. Mathematical Physics/ B. Numerical methods and C programming	3	3	25	75	100
Part – 4	U23VAE501	Skill Enhancement Course – VI: (Value Education)	2	2	25	75	100
	U23PHI501	Internship	2	-	25	75	100
	U23PHNM54	Naan Mudhalvan Course - 4	2	2	25	75	100
TOTAL			28	30			

SEMESTER – VI

Part	Course Code	Course Title	Credit	No.of Hours	CIA	ESE	Total Marks
Part – 3	U23PHT613	Core Theory –8: Nuclear and Particle Physics	4	6	25	75	100
	U23PHT614	Core Theory – 9: Solid State Physics	4	6	25	75	100
	U23PHPR61	Project	4	6	25	75	100
	U23PHE67A/ U23PHE67B	Subject Based Elective 7: A. Nano Science and Nano Technology/ B. Medical Instrumentation	3	5	25	75	100
	U23PHE68A / U23PHE68B	Subject Based Elective 8: A. Material Science/ B. Digital Photography	3	5	25	75	100
	U23EAS601	Extension Activity	1	-	25	75	100
Part -4	U23PHNM65	Naan Mudhalvan Course - 5	2	2	25	75	100
		TOTAL	21	30			

DISCIPLINE SPECIFIC ELECTIVES

1. **COMMUNICATION SYSTEMS**
2. **ENERGY PHYSICS**
3. **MATHEMATICAL PHYSICS**
4. **ADVANCED MATHEMATICAL PHYSICS**
5. **NUMERICAL METHODS AND C PROGRAMMING**
6. **MATERIALS SCIENCE**
7. **LASERS AND FIBER OPTICS**
8. **DIGITAL PHOTOGRAPHY**
9. **NANO SCIENCE**
10. **MEDICAL INSTRUMENTATION**

NON-MAJOR ELECTIVES

1. **PHYSICS FOR EVERYDAY LIFE**
2. **ASTROPHYSICS**
3. **MEDICAL PHYSICS**
4. **HOME ELECTRICAL INSTALLATION**
5. **PHYSICS OF MUSIC**

COURSE	**FIRSTSEMESTER–CORETHEORY1**	
COURSETITLE	**PROPERTIESOFMATTERANDACOUSTICS**	
CREDITS	5	CourseCode:U23PHT101
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 ofthe substance. Students who undergo this course aresuccessfullyboundtogetabetterinsightandunderstandingof Thesubject.	

UNITS	COURSEDETAILS
UNIT-I	**ELASTICITY:** Hooke's law – stress-strain diagram – elastic constants–Poisson'sratio –relationbetweenelasticconstantsand Poisson's ratio – work done in stretching and twisting a wire – twistingcoupleonacylinder –rigiditymodulus bystatictorsion– Torsionalpendulum(withandwithoutmasses)
UNIT-II	**BENDING OF BEAMS:**cantilever– expression for Bending moment – expression for depression at the loaded end of the cantilever–oscillationsofacantilever –expressionfortimeperiod – experiment to find Young's modulus – non-uniform bending– experiment to determine Young's modulus by Koenig's method – Uniformbending–expressionforelevation–experimentto determine Young's modulus using microscope
UNIT-III	**FLUID DYNAMICS:** *Surface tension*: definition – molecular forces– excess pressure over curved surface – application to spherical and cylindrical drops and bubbles – determination of surfacetensionbyJaegar'smethod–variationofsurfacetensionwith temperature *Viscosity*:definition–streamlineandturbulent flow–rateofflowof liquid in a capillary tube – Poiseuille's formula –corrections – terminal velocity and Stoke's formula– variation of viscosity with Temperature

UNIT-IV	**WAVES AND OSCILLATIONS:** Simple Harmonic Motion (SHM) – differential equation of SHM – graphical representation of SHM–compositionoftwoSHMinastraight lineand at right angles – Lissajous'sfigures-free,damped, forcedvibrations–resonanceand Sharpness of resonance. Lawsoftransverse vibrationinstrings–sonometer–determination OfAC frequencyusingsonometer–determinationoffrequencyusing Melde'sstringapparatus
UNIT-V	**ACOUSTICSOFBUILDINGSAND ULTRASONICS:** Intensityofsound –decibel– loudnessofsound –reverberation– Sabine's reverberation formula – acoustic intensity – factors affecting the acoustics of buildings. *Ultrasonic waves*: production of ultrasonic waves – Piezoelectric crystalmethod–magnetostrictioneffect –applicationofultrasonic waves

UNIT-VI	**PROFESSIONALCOMPONENTS:**expertlectures–seminars—webinars – industry inputs – social accountability – patriotism
TEXTBOOKS	1. D.S.Mathur,2010,ElementsofPropertiesofMatter, S.Chandand Co. 2. BrijLalandN.Subrahmanyam,2003,PropertiesofMatter, S.Chandand Co 3. D.R.KhannaandR.S.Bedi,1969,TextbookofSound, AtmaRamand sons 4. BrijLalandN.Subrahmanyam,1995,AText BookofSound, Second revised edition,Vikas Publishing House. 5. R.Murugesan,2012,PropertiesofMatter, S.ChandandCo.
REFERENCE BOOKS	1. C.J.Smith,1960,GeneralPropertiesofMatter,Orient Longman Publishers 2. H.R.Gulati, 1977, FundamentalofGeneralPropertiesofMatter, Fifth edition,R. Chand and Co. 3. A.PFrench,1973,VibrationandWaves,MITIntroductory Physics, Arnold-Heinmann India.
WEB RESOURCES	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-SuaSu1sandt=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/

METHODOFEVALUATION:

ContinuousInternalAssessment	EndSemesterExamination	Total	Grade
25	75	100	

COURSEOUTCOMES:

Attheendofthecourse,the studentwillbeableto:
:

COURSEOUTCOMES	**CO1**	Relateelasticbehaviorintermsofthree moduli ofelasticity and workingoftorsionpendulum.
	CO2	Ableto appreciateconceptofbendingofbeamsandanalyze Theexpression,quantifyand understandnatureofmaterials.
	CO3	Explainthesurfacetensionandviscosityoffluidandsupport Theinterestingphenomenaassociatedwithliquidsurface, soap films provide an analogue solution to many engineering

		problems.
	CO4	Analyzesimpleharmonicmotionsmathematicallyandapply them. Understand the concept of resonance and use it to Evaluatethefrequencyofvibration.Setupexperimentto evaluate frequency of ac mains
	CO5	Understandtheconceptofacoustics,importanceof constructing buildings with good acoustics. Able to apply their knowledge of ultrasonics in real life, especiallyinmedicalfieldandassimilatedifferentmethodsof production of ultrasonic waves

MAPPINGWITHPROGRAMOUTCOMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**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

COURSE	**FIRSTSEMESTER –COREPRACTICAL1**	
COURSETITLE	**PRACTICAL1**	
CREDITS	5	CourseCode:U23PHP102
COURSE OBJECTIVES	Applyvarious physics concepts to understand Properties ofMatter, setupexperimentationtoverifytheories,quantifyand analyse,able to do error analysis and correlate results	

PropertiesofMatter

MinimumofEightExperimentsfromthelist:

1. DeterminationofrigiditymoduluswithoutmassusingTorsionalpendulum.
2. DeterminationofrigiditymoduluswithmassesusingTorsionalpendulum.
3. Determinationofmomentofinertiaofanirregularbody.
4. Verificationofparallelaxestheoremonmomentof inertia.
5. Verificationofperpendicularaxestheoremonmoment of inertia.
6. DeterminationofmomentofinertiaandgusingBifilarpendulum.
7. DeterminationofYoung'smodulusby stretchingofwirewithknown masses.
8. VerificationofHook'slawbystretchingofwiremethod.
9. DeterminationofYoung'smodulusbyuniformbending–loaddepressiongraph.
10. DeterminationofYoung'smodulusbynon-uniformbending–scaleand telescope.
11. DeterminationofYoung's modulusbycantilever–loaddepressiongraph.

12. Determination of Young's modulus by cantilever–oscillation method
13. Determination of Young's modulus by Koenig's method–(or unknown load)
14. Determination of rigidity modulus by statictorsion.
15. Determination of Y,n and K by Searle's double bar method.
16. Determination of surface tension and interfacial surface tension by drop weight method.
17. Determination of co-efficient of viscosity by Stokes' method–terminal velocity.
18. Determination of criticalpres sure for streamline flow.
19. Determination of Poisson's ratio of rubber tube.
20. Determination of viscosity by Poiseullie's flow method.
21. Determination radius of capillarytube by mercury pellet method.
22. Determination of using compound pendulum.

METHODOFEVALUATION:

ContinuousInternalAssessment	EndSemesterExamination	Total	Grade
25	**75**	**100**	

METHODOFEVALUATION:

ContinuousInternalAssessment	EndSemesterExamination	Total	Grade
25	**75**	**100**	

CourseCode: U23PHS11A

ADVANCEDMATHEMATICALPHYSICS	
LearningObjective: Thefundamentalsof matricesandvectorcalculuslearntin earlier coursewillenablestudentstolearnadvancedtopicsandtheorems.Thespecialfunctions Andapplicationsofpartialdifferentialequationswillbe ofuseinresearchata laterstage.	
UNITS	**COURSEDETAILS**
UNIT-I	**MATRICES: i**ntroduction – specialtypes of matrices – transpose – conjugate– conjugate transpose– symmetric andanti symmetric – HermitianandskewHermitian–orthogonalandunitary–properties – characteristic equation – roots and characteristic vectors – diagonalization–Cayley–Hamiltontheorem–simpleproblems

UNIT-II	**VECTORCALCULUS:**∇operator –divergence–secondderivative 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(withoutproblem) –Gauss'sdivergencetheoremandproof– Stroke'stheoremandproof–simple problems.
UNIT-III	**SPECIAL FUNCTIONS:** definition –Beta function – Gamma function–evaluationofBetafunction–other formsofBetafunction – evaluationofGammafunction–other formsofGammafunction – RelationbetweenBetaandGammafunctions–simple problems.
UNIT-IV	**FROBENIUSMETHODANDSPECIALFUNCTIONS:**singular Pointsofsecondorderlinear differentialequationsand importance – singularities of Bessels and Laguerreequations, Frobenius method and applications to differential equations: Legendre and Hermitedifferentialequations–LegendreandHermitepolynomials– Rodriguesformula–generatingfunction– 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–conductinganddielectricsphereinanexternaluniform Electricfield–waveequationanditssolutionforvibrationalmodes of a stretched string
TEXTBOOKS	1. MathematicalPhysics,B.D.Gupta-VikasPublishingHouse,4th Edition (2006) 2. MathematicalPhysics,SatyaPrakash(SultanChand)
REFERENCE BOOKS	1. Mathematical MethodsorPhysicists,G.B.Arfken,H.J.Weber,F.E.Harris(2013,7th Edn., Elsevier) 2. MathematicalPhysics–H.K.Dass,Dr.RamaVerma(S.Chand Publishing) 3. AdvancedEngineeringMathematics,ErwinKreyszig(Wiley India) 4. MathematicalPhysicsandSpecialRelativity, M.Das, P.K.Jena andB.K. Dash(SrikrishnaPrakashan)

ELECTIVECOURSES(EC)

U23PHS11B –ENERGYPHYSICS	
LearningObjective: Togettheunderstandingoftheconventionalandnon-Conventionalenergysources,theirconservationandstorage systems.	
UNITS	**COURSEDETAILS**
UNIT-I	**INTRODUCTION TO ENERGY SOURCES:**energy consumption as a measure of prosperity – world energy future – energy sourcesand their availability – conventional energy sources – non-conventionalandrenewableenergysources–comparison–merits Anddemerits.
UNIT-II	**SOLARENERGY:**solarenergyIntroduction–solarconstant –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 – typesofgreenhouses– solarcells.
UNIT-III	**WIND ENERGY:**introduction–natureofthe wind – basic principle ofwindenergyconversion–windenergydataandenergyestimation – basic componentsofWind EnergyConversionSystems(WECS) – AdvantagesanddisadvantagesofWECS–applications–tidalenergy
UNIT-IV	**BIOMASS ENERGY:** introduction – classification – biomass conversion technologies –photosynthesis – fermentation - biogas generation–classificationofbiogasplants–anaerobicdigestionfor biogas– woodgasification–advantagesanddisadvantages.
UNIT-V	**ENERGYSTORAGE:**importanceofenergystorage-batteries-lead acid battery-nickel-cadmium battery– fuelcells – types of fuel cells – advantages and disadvantages of fuel cells – applications of fuel cells- hydrogenstorage.
TEXTBOOKS	1. G.D.Rai,Non-ConventionalSourcesofEnergy,Khanna Publishers, 2009, 4th Edn. 2. SPSukhstme,JKNayak,SolarEnergy,PrinciplesofThermal Collection and Storage, McGraw Hill, 2008, 3rd Edn. 3. DPKothari,KPSingal,RakeshRajan,PHILearningPvtLtd, 2011,2nd Edn.
REFERENCE BOOKS	1. JohnTwidellandTonyWeir,RenewableEnergyResources, Taylor and Francis, 2005, 2nd Edn. 2. S.A.AbbasiandNasemaAbbasi,RenewableEnergysourcesand their environmental impact, PHI Learning Pvt. Ltd, 2008. 3. M.P.Agarwal,SolarEnergy,S.ChandandCo.Ltd.,New Delhi,1982 4. H.C.Jain,Non-ConventionalSourcesofEnergy, Sterling Publishers,1986.

METHODOFEVALUATION:

ContinuousInternalAssessment	EndSemesterExamination	Total	Grade
25	**75**	**100**	

COURSE	**FIRSTSEMESTER–FOUNDATIONCOURSE**
COURSETITLE	**U23PHFC1-INTRODUCTORYPHYSICS**
CREDITS	5
COURSE OBJECTIVES	Tohelpstudentsget anoverviewofPhysicsbefore learningtheir corecourses.To serveasabridgebetweentheschoolcurriculum Andthe degreeprogramme.

UNITS	COURSE DETAILS
UNIT-I	vectors,scalars–examplesforscalarsandvectorsfromphysical quantities–addition,subtractionofvectors–resolutionandresultant of vectors – units and dimensions– standard physics constants
UNIT-II	Differenttypesofforces–gravitational,electrostatic,magnetic, electromagnetic, nuclear –mechanicalforces like, centripetal, centrifugal, friction,tension,cohesive,adhesive forces
UNIT-III	different formsofenergy–conservationlawsofmomentum, energy –typesofcollisions–angular momentum–alternateenergysources– real life examples
UNIT-IV	types of motion– linear, projectile, circular, angular, simple harmonic motions–satellite motion–bankingofa curvedroads– stream line and turbulent motions – wave motion –comparison of lightandsoundwaves–free,forced,dampedoscillations
UNIT-V	surface tension – shape of liquid drop –angle ofcontact –viscosity – lubricants – capillary flow – diffusion – real life examples– propertiesandtypesofmaterialsindailyuse-conductors,insulators –thermalandelectric
UNIT-VI	**PROFESSIONALCOMPONENTS:**expertlectures–seminars—webinars – industry inputs – social accountability – patriotism
TEXTBOOKS	1. D.S.Mathur,2010,ElementsofPropertiesofMatter, S.Chandand Co 2. BrijLalandN. Subrahmanyam, 2003,PropertiesofMatter, S.ChandandCo.
REFERENCE BOOKS	1. H.R.Gulati,1977,FundamentalofGeneralProperties ofMatter, Fifthedition, S.ChandandCo.
WEB RESOURCES	1. http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.htmlhttps://science.nasa.gov/ems/ 2. https://eesc.columbia.edu/courses/ees/climate/lectures/radiation_hays/

METHODOFEVALUATION:

ContinuousInternalAssessment	EndSemesterExamination	Total	Grade
25	**75**	**100**	

COURSEOUTCOMES:

Attheendofthecourse,the studentwillbeableto:

COURSEOUTCOMES	**CO1**	Applyconceptofvectorstounderstand conceptsofPhysics Andsolveproblems
	CO2	AppreciatedifferentforcespresentinNaturewhile learning Aboutphenomenarelatedtothesedifferentforces.
	CO3	Quantifyenergyindifferentprocessandrelatemomentum, velocity and energy
	CO4	Differentiatedifferenttypesofmotionstheywould encounter in various courses and understand their basis
	CO5	Relatevariouspropertiesofmatterwiththeir behavior and connect them with different physical parameters involved.

MAPPINGWITHPROGRAMOUTCOMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-points scaleofSTRONG(**3**),MEDIUM(**2**)andLOW(**1**).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	3

SECONDSEMESTER

COURSE	**SECOND SEMESTER–CORE-3THEORY**
COURSETITLE	**U23PHT203-HEAT,THERMODYNAMICSand STATISTICALPHYSICS**
CREDITS	5
COURSE OBJECTIVES	The course focuses to understand a basic in conversion of temperature in Celsius, Kelvin and Fahrenheit scales. Practical exhibition and explanation oftransmission ofheat in good and bad conductor.Relatethe lawsofthermodynamics,entropyineveryday life and explore the knowledge of statistical mechanics and its Relation

UNITS	COURSEDETAILS
UNIT-I	**CALORIMETRY:** specific heat capacity– specific heat capacity of gases $C_P$and C_V– Meyer's relation – Joly's method for determination of C_V– Regnault's methodfor determination of C_P**LOWTEMPERATUREPHYSICS:** Joule-Kelvin effect – porous plug experiment – Joule-Thomson effect – Boyletemperature – temperatureofinversion– liquefactionofgas byLinde'sProcess – A diabaticdemagneStisation.
UNIT-II	**THERMODYNAMICS-I:** zeroth law and first law of thermodynamics – P-V diagram– heat engine –efficiencyofheat engine–Carnot'sengine,construction,workingandefficiencyof Petrolengine anddieselengines –comparisonofengines.
UNIT-III	**THERMODYNAMICS-II:** second law of thermodynamics – entropy of an ideal gas – entropy change in reversible and irreversibleprocesses–T-Sdiagram–thermodynamicalscaleof temperature – Maxwell's thermodynamical relations –Clasius-Clapeyron'sequation (first latent heat equation) – third law of thermodynamics–unattainabilityofabsolutezero–heat death.
UNIT-IV	**HEATTRANSFER:**modesofheattransfer:conduction, convection and radiation. *Conduction*: thermal conductivity – determination of thermal conductivity of a good conductor by Forbe's method – determinationofthermalconductivityofabad conductorbyLee's disc method. *Radiation*:blackbodyradiation(Ferry'smethod)–distributionof energy in black bodyradiation – Wien's law and Rayleigh Jean's law –Planck's law of radiation – Stefan's law – deduction of Newton'slawofcoolingfromStefan'slaw.

UNIT-V	**STATISTICALMECHANICS:**definitionofphase-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 – expressionfor distributionfunction –comparisonofthree statistics.
UNIT-VI	**PROFESSIONALCOMPONENTS:**expert lectures–seminars—webinars–industryinputs– socialaccountability– patriotism
TEXTBOOKS	1. BrijlalandN.Subramaniam,2000,HeatandThermodynamics, S.Chandand Co. 2. NarayanamoorthyandKrishnaRao,1969,Heat,TriveniPublishers, Chennai. 3. V.R.KhannaandR.S.Bedi,19981st Edition,TextbookofSound, Kedharnaath Publish and Co, Meerut 4. Brijlal and N. Subramanyam, 2001, Waves and Oscillations,VikasPublishingHouse,NewDelhi. 5. Ghosh,1996,TextBookofSound,S.ChandandCo. 6. R.MurugeshanandKiruthigaSivaprasath,ThermalPhysics, S.Chandand Co.
REFERENCE BOOKS	1. J.B.RajamandC.L.Arora,1976,HeatandThermodynamics,8th edition, S.Chandand Co. Ltd. 2. D.S.Mathur,HeatandThermodynamics,SultanChandand Sons. 3. Gupta,Kumar,Sharma,2013,StatisticalMechanics,26th Edition, S. Chand and Co. 4. Resnick,HallidayandWalker,2010,FundamentalsofPhysics, 6th Edition. 5. Sears, Zemansky, Hugh D. Young,Roger A. Freedman, 2021 UniversityPhysicswithModernPhysics15thEdition,Pearson.
WEB RESOURCES	1. https://youtu.be/M_5KYncYNyc 2. https://www.youtube.com/watch?v=4M72kQulGKkandvl=en 3. Lecture1:ThermodynamicsPart 1|VideoLectures|StatisticalMechanicsI: StatisticalMechanicsofParticles| Physics| MITOpenCourseWare 4. http://www.freebookcentre.net/Physics/Physics-Books-Online.html

METHODOFEVALUATION:

ContinuousInternalAssessment	EndSemesterExamination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
Attheendofthecourse,the studentwillbeableto:

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 identifiestherelationshipbetweenheatcapacity,specificheat capacity.ThestudyofLowtemperaturePhysicssetsthebasis for the students to understand cryogenics, superconductivity, SuperfluidityandCondensed Matter Physics
	CO2	DerivetheefficiencyofCarnot'sengine.Discussthe Implicationsofthe lawsofThermodynamicsindieseland petrol engines
	CO3	Abletoanalyzeperformanceofthermodynamicsystemsviz efficiencybyproblems.Getsaninsightintothermodynamic properties like enthalpy, entropy
	CO4	Studytheprocessofthermal conductivityand applyit to good and bad conductors. Quantify different parameters related to heat,relatethemwithvariousphysicalparametersandanalyse them
	CO5	Interpret classical statistics concepts such as phase space, ensemble, Maxwell-Boltzmann distribution law. Develop the statisticalinterpretationofBose-EinsteinandFermi-Dirac. Applytoquantumparticlessuchas photonandelectron

MAPPINGWITHPROGRAMOUTCOMES:
Mapcourseoutcomes**(CO)**foreachcoursewith program outcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**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

COURSE	**SECONDSEMESTER– CORE-4-PRACTICAL2**
COURSETITLE	**U23PHP204- PRACTICAL2**
CREDITS	5

COURSE OBJECTIVES	Applytheirknowledgegainedabouttheconceptofheat andsound waves,resonance, calculate frequency of ac mains set up experimentationtoverifytheories,quantifyand analyse,abletodo Erroranalysisandcorrelate results
HEAT, OSCILLATIONS,WAVESandSOUND	
MinimumofEightExperimentsfromthelist:	

1. Determination of specific heat by cooling–graphical method.
2. Determination of thermal conductivity of good conductor by Searle's method.
3. Determination of thermal conductivity of bad conductor by Lee's disc method.
4. Determination of thermal conductivity of bad conductor by Charlaton's method.
5. Determination of specific heat capacity of solid.
6. Determination of specific heat of liquid by Joule's electrical heating method (applying radiation correction by Barton's correction/graphical method),
7. Determination of Latentheat of a vaporization of a liquid.
8. Determination of Stefan's constant for Black body radiation.
9. Verification of Stefan's-Boltzmans law.
10. Determination of thermal conductivity of rubber tube.
11. Helmholtzresonator.
12. Velocity of sound through a wire using Sonometer.
13. Determination of velocity of sound using Kunds tube.
14. Determinationoffrequencyofan electrically maintained tuning for k
15. To verify the laws of transverse vibration usings onometer.
16. To verify the laws of transverse vibration using Melde's apparatus.
17. To compare the mass perunitlength of two strings using Melde's apparatus.
18. Frequency of AC by usings onometer.

METHODOFEVALUATION:

ContinuousInternalAssessment	EndSemesterExamination	Total	Grade
25	**75**	**100**	

U23PHS23-ELECTRONICSINEVERDAYLIFE

2Hours/2Credits

Objective: Tomakenonphysicsstudentsunderstandbasicelectronicconceptsanditsapplications in dailylife.

UNITI FNDAMENTALS

Electrical and Electronic symbols – Resistors -Capacitors – Resistance wale – Capacitorwale–Electricalquantities–Electricalformulas–Magnetism–Meters– FusewireTransistors –
Integratedchips.

UNITIIELECTRICALAPPLIANCES

Switchboard – Main box – Metalcircular breakers (MCB) – AC – DC currents– Twophase – Three phase electrical connections – generators – uninterrupted power supply (UPS) –stabilizer– voltageregulators – Electrical devices–Iron box– Fan

UNITIIIELECTRONICHOMEAPPLIANCES

Radio–Audiotaperveaulem,speaker–televisions–VCR–CDPlayer–DVD– calculators–Computers–Blockdiagramofacomputer–Inputdevice–Memory device–control unit–Arithmeticandlogicunit–outputdevice–microprocessor– RAM –ROM –scanner– printer– Digital camera–LCD Projectors – Displaydevices

UNITIVCOMMUNICATIONELECTRONICS

Principlesofopticalfibercables(OFC) –Telephone–MobilePhones– wireless phone –Antenna–Internet –Intranet

UNITVSAFETYMECHANISM

Handling electrical appliances – power saving methods – hazards prevention methods –protectionofHi-Fi electronic devices.

BooksforStudyandreference:

1. S.S.Kamble–ElectronicsandMathematicsDataBook–AlliedPublishersLtd–1997

2. WilliamDavidCooper,ElectronicandInstrumentationandMeasurementTechnique(2nd Edition),1978.

COURSE	**THIRD SEMESTER – CORE**U23PHT305
COURSETITLE	**GENERAL MECHANICS AND CLASSICAL MECHANICS**
CREDITS	**4**
COURSE OBJECTIVES	This course allows the students: To have a basic understanding of the laws and principles of mechanics; To apply the concepts of forces existing in the system; To understand the forces of physics in everyday life; To visualize conservation laws; To apply Lagrangian equation to solve complex problems.

UNITS	**COURSEDETAILS**
UNIT-I	**LAWS OF MOTION:** Newton's Laws– forces – equations of motion – frictional force – motion of aparticlein a uniformgravitational 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.
UNIT-II	**CONSERVATION LAWS OF LINEAR AND ANGULAR MOMENTUM: c**onservation of linear and angular momentum – Internal forces andmomentum 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 scatteringby heavy nucleus.
UNIT-III	**CONSERVATION LAWS OF ENERGY:** Introduction – significance of conservation laws – law of conservation of energyconcepts of work- power – energy – conservative forces – potential energy and conservation of energy ingravitational and electric field – examples –non-conservative forces – general law of conservation of energy.
UNIT-IV	**RIGID BODY DYNAMICS: T**ranslational 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 rollingalong a plane surface – body rolling down an inclined plane – gyroscopic precision – gyrostatic applications.
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.

TEXT BOOKS	1. J.C.Upadhyaya, 2019, Classical Mechanics, Himalaya Publishing house, Mumbai. 2. P.DuraiPandian, LaxmiDuraiPandian, MuthamizhJayapragasam,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.
REFERENCE BOOKS	1. Goldstein Herbert, 1980, Classical Mechanics. U.S.A: Addison and Wesely. 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

METHOD OF EVALUATION:

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

COURSE OUTCOMES:

Attheendofthecourse,the studentwillbeableto:

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:

Mapcourseoutcomes**(CO)**foreachcoursewith program outcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**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

COURSE	**THIRD SEMESTER – CORE**
COURSETITLE	**CORE PRACTICALS**U23PHP306
CREDITS	4
COURSE OBJECTIVES	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

ELECTRICITY (any eight experiments)

1. Calibration of low range and high range voltmeter using potentiometer
2. Calibration of ammeter using potentiometer.
3. Measurement of low resistances using potentiometer.
4. Determination of field along the axis of a current carrying circular coil.
5. Determination of earth's magnetic field using field along axis of current carrying coil.
6. Determination of specific resistance of the material of the wire usingPO box.
7. Determination of resistance and specific resistance using Carey Foster's bridge.
8. Determination of internal resistance of a cell using potentiometer.
9. Determination of specific conductance of an electrolyte.
10. Determination of EMF of thermo couple using potentiometer
11. Determination of capacitance using De-sauty's bridge and B.G./Spot galvanometer/head phone.
12. Determination of figure of merit of BG or spot galvanometer.
13. Comparison of EMF of two cells using BG.
14. Comparison of capacitance using BG.

METHOD OF EVALUATION:

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

NON MAJOR ELECTIVES (NME)

U23PHS34PHYSICS FOR EVERYDAY LIFE	
Learning Objective: To know where all physics principles have been put to use in daily life and appreciate the concepts with a better understanding also to know about Indian scientists who have made significant contributions to Physics	
UNITS	**COURSE DETAILS**
UNIT-I	**MECHANICAL OBJECTS: s**pring scales – bouncing balls –roller coasters – bicycles –rockets and space travel.
UNIT-II	**OPTICAL INSTRUMENTS AND LASER:**vision corrective lenses – polaroid glasses – UV protective glass – polaroid camera – colour photography – holography and laser.
UNIT-III	**PHYSICS OF HOME APPLIANCES:** bulb – fan – hair drier – television – air conditioners – microwave ovens – vacuum cleaners
UNIT-IV	**SOLAR ENERGY:** Solar constant – General applications of solar energy – Solar water heaters – Solar Photo – voltaic cells – General applications of solar cells.
UNIT-V	**INDIAN PHYSICIST AND THEIR CONTRIBUTIONS:** C.V.Raman, HomiJehangirBhabha, Vikram Sarabhai, Subrahmanyan Chandrasekhar, Venkatraman Ramakrishnan, Dr. APJ Abdul Kalam and their contribution to science and technology.
TEXT BOOKS	1. The Physics in our Daily Lives, Umme Ammara, Gugucool Publishing, Hyderabad, 2019. 2. For the love of physics, Walter Lawin, Free Press, New York, 2011.

METHOD OF EVALUATION:

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

COURSE	**FOURTH SEMESTER - CORE**
COURSETITLE	**OPTICS AND SPECTROSCOPY**U23PHT407
CREDITS	**4**
COURSE OBJECTIVES	To provide an in-depth understanding of the basics of various phenomena in geometrical and wave optics; To explain the behavior of light in different mediums; 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 design of optical systems and methods to minims aberrations; To solve problems in optics by selecting the appropriate equations and performing numerical or analytical calculations.

UNITS	**COURSEDETAILS**
UNIT-I	**LENS AND PRISMS:** Fermat's principle of least time – postulates of geometrical optics – thick and thin lenses – focal length, critical thickness, power and cardinal points of a thick lens – narrow angled prisms. *Lens*: lens makers formula (no derivation) – aberrations: spherical aberration,chromaticaberrations, 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 – circularlyand 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	**SPECTROSCOPY:** Infra-red spectroscopy near infra-red and far infra-red – properties –origin of IR spectra – IR spectrophotometer – applications interpretation of IR spectra – CH, CO, CN bending and stretching vibrational modes only – scattering of light – Raman effect –classical theory –quantum theory –mutual exclusion principle – Raman spectrometer- characteristics of Raman lines –applications – ultraviolet and visible spectroscopy –properties – spectrophotometer.
TEXT BOOKS	1. Subramaniam. N&Brijlal, 2014,Optics, 25th edition,S.Chand &Co. 2. S.L.Gupta,V.Kumar& R.C.Sharma,1997,Elements of Spectroscopy, 13th Edition, Pragati Prakashan, Meerut. 3. G.Aruldhass,2000,MolecularStructure and Spectroscopy,II edition.PHIPvt Ltd, New Delhi. 4. P.R.Sasikumar, 2012, Photonics, PHIPvt Ltd, New Delhi. 5. K.Rajagopal, 2008, Engineering Physics, PHIPvt Ltd, New Delhi. 6. V.Rajendran, 2012, Engineering Physics, Tata McGraw Hill.
REFERENCE BOOKS	1. Agarwal B.S, 2011,Optics, KedernathRamnath Publishers, Meerut. 2. Sathyaprakash, 1990,Optics,VIIedition, RatanPrakashanMandhir, New Delhi. 3. C.N.Banewell, 2006, Introduction to Molecular Spectroscopy,IVedition,TMH Publishing Co,New Delhi. 7. 4. AjoyGhatak, 2009,Optics, 4thedition, PHIPvt Ltd, New Delhi. 5. Singh &Agarwal,2002,Optics and Atomic Physics, 9thedition, PragatiPrakashan Meerut. 6. D.Halliday,R.Resnick and J. Walker, 2001, Fundamentals of Physics,6th edition, Willey, New York. 7. JenkinsA.Francis & White, 2011, Fundamentals of Optics, 4th edition, McGraw Hill Inc., NewDelhi.
WEBLINKS	1. https://science.nasa.gov/ems/ 2. https://www.youtube.com/watch?v=tL3rNc1G0qQ&list=RDCMUCzwo7UlGkb-8Pr6svxWo-LA&start_radio=1&t=2472 1. https://science.nasa.gov/ems/ 3. https://www.youtube.com/watch?v=tL3rNc1G0qQ&list=RDCMUCzwo7UlGkb-8Pr6svxWo-LA&start_radio=1&t=2472 4. https://imagine.gsfc.nasa.gov/educators/gammarayburstsl/imagine/index.html 1. http://www.thephysicsmill.com/2014/03/23/sky-blue-lord-rayleigh-sir-raman-scattering/ 5. http://www.thephysicsmill.com/2014/03/23/sky-blue-lord-rayleigh-sir-raman-scattering/

METHOD OF EVALUATION:

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

COURSE OUTCOMES:
Attheendofthecourse,the studentwillbeableto:

COURSEOUTCOMES	**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 optical instruments
	CO4	Interpret basic formulation of polarization and gain knowledge about polarimeter, appraise its usage in industries
	CO5	Relate the principles of optics to various fields of IR, Raman and UV spectroscopy and understand their instrumentation and application in industries

MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**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

COURSE	**FOURTH SEMESTER – CORE**
COURSETITLE	**CORE PRACTICALS**U23PHP408
CREDITS	4

COURSE OBJECTIVES	Demonstrate various optical phenomena principles, working, apply with various materials and interpret the results.

LIGHT(any eight experiments)

1. Determination of refractive index of prism using spectrometer.
2. Determination of refractive index of liquid using hollow prism and spectrometer
3. Determination of dispersive power of a prism.
4. Determination of radius of curvature of lens by forming Newton's rings.
5. Determination of thickness of a wire using air wedge.
6. Determination of Cauchy's Constants.
7. Determination of resolving power of grating
8. Determination of resolving power of telescope
9. Comparison of intensities using Lummer Brodhum Photometer.
10. Determination of range of motion using Searlesgoniometer.
11. Verification of Newton's formula for a lens separated by a distance.
12. Determination of refractive index of a given liquid by forming liquid lens
13. Determination of refractive index using Laser.
14. Determination of wavelengths, particle size using Laser/Monochromatic source.
15. Determination of resolving power of Diffraction grating using Laser
16. Determine the thickness wire using Laser.

METHOD OF EVALUATION:

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

ASTROPHYSICS
Learning Objective: This course intends tointroduce 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 celestialbodies along with the instrumentation and techniques used in astronomical research	
UNITS	**COURSE DETAILS**
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:** (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 Any three activities to be done compulsorily.
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,

METHOD OF EVALUATION:

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

COURSE	**FIFTH SEMESTER - CORE**
COURSE TITLE	**ATOMIC PHYSICS AND LASERS**U23PHT509
CREDITS	**4**

COURSE OBJECTIVES	To study about electric charges, their properties through experiments; To gain knowledge on photoelectric effect; To solve problems based on Einstein's photoelectric equation; To make students understand the development of atom models, quantum numbers, coupling schemes and analysis of magnetic moments of an electrons; To gain knowledge on excitation and ionization potentials, splitting of spectral lines in magnetic and electric fields; To understand the principle, production and applications of lasers.

UNITS	**COURSE DETAILS**
UNIT-I	**THE ELECTRON AND POSITIVE RAYS:** e/m of electronby Dunnington's method –charge of electron by Millikan's oil drop method – properties of positive rays –e/m of positive rays by Thomson's parabola method (*problems calculation of e/m ratio of positive rays*)–mass spectrographs and uses– Bainbridge and Dempster's mass spectrographs
UNIT-II	**PHOTOELECTRIC EFFECT:** Photoelectric emission – Leonard's experiment – Richardson and Compton experiment – laws of photoelectric emission – Einstein's photoelectric equation (*problems using Einstein's photoelectric equation*) –experimental verification by Millikan's method –photoelectric cell– photo emissive cell –photovoltaic cell – photo conducting cell – applications of photoelectric cells –photomultiplier.
UNIT-III	**ATOMIC STRUCTURE:** Sommerfield's relativistic atom model –vector atom model –various quantum numbers – L-S and J-J coupling – Pauli's exclusion principle –magnetic dipole moment of an electron due to orbital and spin motion – Bohr magnetron - Stern and Gerlach experiment – Lande 'g' factor.
UNIT-IV	**SPLITTING OF SPECTRAL LINES:** excitation, ionisation and critical potentials – Davis and Goucher's method – optical spectra – spectral notation and selection rules – fine structure of sodium D-line – Zeeman effect – experimental arrangement and classical and quantum theory of normal Zeeman effect – Larmor's theorem – anomalous Zeeman effect –explanation of splitting of D_1 and D_2lines of sodium – Paschen Back effect - Stark effect (Qualitative only).
UNIT-V	**LASERS: g**eneral principles of lasers – properties of lasers action – spontaneous and stimulated emission – population inversion – optical pumping – He-Ne laser (principle and working) – semiconductor laser –laser applications–holography.
TEXT BOOKS	1. R. Murugesan, Modern Physics, S. Chand & Co**. (**All units**)** (Units I&II-Problems) 2. Brijlal & N. Subrahmanyam, Atomic & Nuclear Physics, S. Chand & Co. (All units) 3. J. B. Rajam, Modern Physics, S. Chand & Co. 4. Sehgal&Chopra, Modern Physics, Sultan Chand, New Delhi 5. Avadhahnulu, An Introduction to Lasers - Theory and Applications, M.N., S.Chand& Co., New Delhi, 2001.

REFERENCE BOOKS	1. Perspective of Modern Physics, Arthur Beiser, McGraw Hill. 2. Modern Physics, S. Ramamoorthy, National Publishing & Co. 3. Laser and Non-Linear Optics by B.B.Laud, Wiley Easter Ltd.,NewYork,1985.
WEBLINKS	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:

Attheendofthecourse,the studentwillbeableto:

COURSEOUTCOMES	**CO1**	**List** the properties of electrons and positive rays, **define**specific charge of positive rays, **know** different mass spectrographs.
	CO2	**Outline**photoelectric effect and the terms related to it, **State**laws of photoelectric emission, Explain experiments and applications of photo electric effect, Solve problems based on photoelectric equation.
	CO3	**Explain different atom models,** Describe**different quantum numbers and different coupling schemes.**
	CO4	**Differentiate between** excitation and ionization potentials, **Explain** Davis and Goucher's experiment,**Apply**selection rule,**Analyse**Paschen-Back effect,**Compare** Zeeman and Stark effect.
	CO5	**Understand the condition for production of laser, Appreciate various** properties and applications of lasers.

MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**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

COURSE	**FIFTH SEMESTER – CORE X**
COURSETITLE	**RELATIVITY AND QUANTUM MECHANICS** U23PHT510
CREDITS	4
COURSE OBJECTIVES	To understand the theory of relativity, its postulates and the consequences.To learn the importance of transformation equations and also to differentiate between special and general theory of relativity.To interpret the wave theory of matter with various theoretical and experimental evidences.To derive and use Schrodinger's wave equation and also learn about various operators. To solve Schrodinger's wave equation for simple problems and analyses to understand the solutions.

UNITS	**COURSE DETAILS**
UNIT-I	**SPECIAL THEORY OF RELATIVITY:** Michelson-Morley experiment–frames of reference – Galilean Relativity – postulates of special theory of relativity – Lorentz transformation – consequences – time dilation–concept of simultaneity – Doppler effect – length contraction–variation of mass with velocity – Einstein's mass-energy relation– relativistic momentum – energy relation
UNIT-II	**TRANSFORMATION RELATIONS: T**ransformation of velocity, mass, energy and momentum – four vector – invariance under transformation – Lorentz transformation and velocity addition equations in terms of hyperbolic functions. **GENERAL THEORY OF RELATIVITY:** Inertial and Gravitational mass – Principle of equivalence – Experimental evidences for General theory of Relativity

UNIT-III	**PHOTONS AND MATTER WAVES:**Difficulties of classical physics and origin of quantum theory –black body radiation – Planck's law – Einstein's photoelectric equation –Compton effect – pair production – De Broglie waves – phase velocity and group velocity– Davisson and Germer's experiment –uncertainty principle – consequences –illustration of Gamma ray microscope.
UNIT-IV	**OPERATORS AND SCHRÖDINGER EQUATION:**postulates of quantum mechanics – Wave function and its interpretation – Schrödinger's equation – linear operators – Eigenvalue – Hermitian operator – properties of Hermitian operator– observable – operators for position, linear Momentum, angular momentum components –commutator algebra –commutator between these operators –expectation values of position and momentum – Ehrenfest theorem.
UNIT-V	**SOLVING SCHRÖDINGER EQUATION FOR SIMPLE PROBLEMS:** One-dimensional problems: (i) particle in a box, (ii) barrier penetration problem – quantum mechanical tunneling, (iii) linear harmonic oscillator. higher dimensional problems: (i) Rigid rotator (qualitative),(ii) Hydrogen atom (qualitative).
TEXT BOOKS	1. *Special Theory of Relativity,S. P. Puri,* Pearson Education, India, 2013. 2. Concepts of Modern Physics, A.Beiser, 6th Ed., McGraw-Hill, 2003. 3. Modern Physics, R. Murugeshan, KiruthigaSivaprasath,S. Chand & Co.,17th Revised Edition, 2014. 4. Quantum Mechanics, S.P.Singh, M.K.Bagde, S.Chand& Co., New Delhi, 2000. 5. Quantum Mechanics in Physics and Chemistry with Applications to Biology,RabiMajumdar, PHI, 2011. 6. Modern Physics, R. Murugesan, S.Chand& Co., New Delhi. **(**Quantum Mechanics,Gupta, Kumar and Sharma. Jai PrakashNath&Co Meerut 7. Quantum mechanics – Satyaprakash and Swati Saluja. KedarNath Ram Nath& Co.
REFERENCE BOOKS	1. Fundamentals of Modern Physics, Peter J. Nolan, 1stEdition, 2014, by Physics 2. Quantum Mechanics,V.Murugan, Pearson Education, India, 2014. 3. Quantum Mechanics, Alastair I. M. Rae and Jim Napolitano, 6th Edition, CRC Press:Taylor& Francis, 2010. 4. Quantum Physics:A Fundamental Approach to Modern Physics, John S. Townsend, University Science Books, Sausalito, California, 2010. 5. Quantum Mechanics: Theory and Applications, AjoyGhatak and S. Lokanathan, Springer ScienceBusiness Media, Dordrecht, Netherlands, 2004. 6. Physics of the Atom,Editor(s): M. R. Wehr, J. A. Richards, T. W. Adair, 4th Edition, Narosa, 2013. 7. Quantum Mechanics, V.Devanathan, Narosa Pub. House,

	Chennai, 2005. 8. Quantum Mechanics, V.K. Thangappan, New Age International, New Delhi. 9. A Text Book of Quantum Mechanics, Mathews &Venkatesan, Tata McGraw Hill, New Delhi. 10. Quantum Mechanics, Ghatak&Loganathan, Macmillan Publications. 11. Introduction to Quantum Mechanics, Pauling & Wilson, McGraw Hill Co., NewYork. 12. Quantum Mechanics, Gupta, Kumar and Sharma. Jai PrakashNath&Co Meerut
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

METHOD OF EVALUATION:

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

COURSE OUTCOMES:
Attheendofthecourse,the studentwillbeableto:

COURSEOUTCOMES	**CO1**	Understand various postulates of special theory of relativity.
	CO2	**Appreciate the importance of transformation equations and also the general theory of relativity..**
	CO3	Realise the wave nature of matter and understand its importance
	CO4	Derive Schrodinger equation and also realize the use of operators.
	CO5	Apply Schrödinger equation to simple problems.

MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**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	M	S	M	M	M
CO3	M	M	S	M	S	S	M	S	S	S
CO4	M	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	M	M	S	M	M	S

COURSE	**FIFTH SEMESTER - CORE**
COURSETITLE	**CORE PRACTICALS**U23PHP511
CREDITS	4
COURSE OBJECTIVES	Demonstrate various optical phenomena principles, working, apply with various materials and interpret the results.

1. Diffraction grating Normal incidence.
2. Diffraction grating minimum deviation.
3. Diffraction at a wire.
4. Specific rotation of sugar solution.
5. Bi-prism – Determination of □.
6. Thickness of a thin film of Bi-prism
7. Brewster's law – polarization
8. Double refraction (□e and □o)
9. Y – by Corlus method.
10. Dispersive power of plane diffraction grating.
11. Diffraction a straight edge.
12. Kundt's tube – Velocity of sound, Adiabatic Young's modulus of the material of the rod.
13. Forbe's method – Thermal conductivity of a metal rod.
14. Spectrometer– Grating - Normal incidence - Wave length of Mercury spectral lines.
15. Spectrometer – Grating - Minimum deviation - Wave length of Mercury spectral lines.
16. Spectrometer – (i-d) curve.
17. Spectrometer – (i-i′) curve.
18. Spectrometer – Narrow angled prism.
19. Rydberg's constant
20. e/m Thomson method
21. h by photocell

22. Spectral response of photo conductor (LDR).
23. Potentiometer –Resistance and Specific resistance of the coil.
24. Potentiometer – E.M.F of a thermocouple.
25. Carey Foster's bridge - Temperature coefficient of resistance of the coil.
26. Deflection Magnetometer – Determination of Magnetic moment of a bar magnet and $B_H$using circular coil carrying current.
27. Vibration magnetometer - Determination of B_H using circular coil carrying current– Tan B position.
28. B.G – Figure of Merit – Charge Sensitivity

METHOD OF EVALUATION:

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

COURSE	**FIFTH SEMESTER – DISCIPLINE SPECIFIC ELECTIVE**
COURSETITLE	**DIGITAL ELECTRONICS AND MICROPROCESSOR 8085**
CREDITS	4U23PHT512
COURSE OBJECTIVES	To learn all types of number systems, 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.

UNITS	COURSE DETAILS
UNIT-I	Decimal, binary, octal, hexadecimal numbers systems and their conversions – codes: BCD, gray and excess-3 codes –code conversions –complements (1's, 2's, 9's and 10's) –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, EAROM. IC – logic families: RTL, DTL, TTL logic, CMOS NAND & NOR Gates, CMOS Inverter, Programmable Logic Devices – Programmable Logic Array (PLA), Programmable Array Logic (PAL).
UNIT-IV	8085 Microprocessor: introduction to microprocessor – INTEL 8085 architecture – register organization –pin configuration of 8085, interrupts and its priority – Program Status Word (PSW) –instruction set of 8085 –addressing modes of 8085 –assembly language programming using 8085 –programmes for addition (8-Bit & 16-Bit), subtraction (8-Bit & 16-Bit), multiplication (8- Bit), division (8- Bit) – largest and smallest number in an array – BCD to ASCII and ASCII to BCD.
UNIT-V	I/O Interfaces: serial communication interface (8251-USART) – programmable peripheral interface (8255-PPI) –programmable interval timers (8253) – keyboard and display (8279), DMA controller (8237).
TEXT BOOKS	1. M.Morris Mano, "Digital Design "3rd Edition, PHI, NewDelhi. 2. Ronald J. Tocci. "Digital Systems-Principles and Applications" 6/e. PHI. New Delhi. 1999.(UNITS I to IV) 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 5. Microcomputer Systems the 8086/8088 family – YU-Cheng Liu and GlenSA
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

METHOD OF EVALUATION:

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

COMMUNICATION PHYSICSU23PHE55A	
Learning Objective: To get a thorough knoowledge on transmission and reception of radio waves, the different types of communication like fibre optic, radar, satellite, cellular	
UNITS	**COURSE DETAILS**
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 super heterodyne radio receiver, advantages – FM receiver – difference between FM and AM receivers.
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 fiberoptic communication
UNIT-III	**RADAR COMMUNICATION: i**ntroduction - basic radar system –radar range – antenna scanning –pulsed radar system – search radar –tracking radar – moving target indicator Doppler effect-MTI principle – CW Doppler radar
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
UNIT-V	**MOBILE COMMUNICATION:** introduction – concept of cell – basic cellular mobile radio system – cellphone – facsimile – important features of fax machine – application of facsimile – VSAT (very small aperture terminals) modem IPTV (internet protocol television) -Wi-Fi-4G (basic ideas)
TEXT BOOKS	1. V.K.Metha, Principles of Electronics, S. Chand & CoLtd., 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.

METHOD OF EVALUATION:

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

ENERGY PHYSICSU23PHE55B	
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 & 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 Twidell& Tony Weir, Renewable Energy Resources, Taylor & Francis, 2005, 2ndEdn. 2. S.A. Abbasi and NasemaAbbasi, Renewable Energy sources and their environmental impact, PHI Learning Pvt. Ltd, 2008. 3. M. P. Agarwal, Solar Energy, S. Chand & Co. Ltd., New Delhi,1982 4. H. C. Jain, Non-Conventional Sources of Energy, Sterling Publishers,1986.

METHOD OF EVALUATION:

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

MATHEMATICAL PHYSICS U23PHE56A	
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 & 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. **FOURIER TRANSFORMS**: Fourier Integral theorem(Statement only)–Fourier, Fourier sine and Fourier cosine transforms,– Fourier transform ofsingle pulse – trigonometric,exponential and Gaussianfunctions – inverse Fourier transform – convolution theorem.
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 & 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. Kusse & Erik A. Westwig, 2nd Ed, WILEY-VCH Verlag, 2006. 4. Vector space & Matrices – J. C. Jain, Narosa Publishing House Pvt. Ltd.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade

25	**75**	**100**	

NUMERICAL METHODS AND C PROGRAMMING U23PHE56B	
Learning Objective: To understand the methods in numerical differentiation and integration and to develop the problem solving skills of the student. To introduce and explain the basic structure, rules of compiling and execution of C programming.	
UNITS	**COURSE DETAILS**
UNIT-I	**NUMERICAL SOLUTIONS:** determination of zeros of polynomials – roots of linear and nonlinear algebraic and transcendental equations – bisection and Newton-Raphson methods – convergence and divergence of solutions
UNIT-II	**NUMERICAL DIFFERENTIATION, INTEGRATION AND CURVE FITTING:** Newton's forward and backward interpolation – Lagrange's interpolation – Newton-Raphson method to find square root and cube roots – principle of least squares – fitting a straight line and exponential curve – trapezoidal rule – Simpson's 1/3 and 1/8 rule
UNIT-III	**ALGORITHM, FLOW CHART AND PROGRAM:** development of algorithm – flow chart for solving simple problems– average of set of numbers – greatest, smallest – conversion of Fahrenheit to Celsius and Celsius to Kelvin, miles to kilometer – sorting set of numbers in ascending and descending order – square matrix, addition, subtraction and multiplication of order (2x2) using arrays.
UNIT-IV	**INTRODUCTION TO C:** importance of C – basic structure of C programming – constants, variables and data types – character set, key words and identifiers – declaration of variables and data types – operators – expressions: arithmetic, relational, logical, assignment – increment and decrement – conditional – comma operators
UNIT-V	**CONTROL STRUCTURE:** decision making with if, if-else, nested if – switch –go to – break – continue –while, do while, for statements – arrays, one dimensional and two dimensional – declaring arrays – storing arrays in memory –initializing arrays – simple programs
TEXT BOOKS	1. Numerical methods,Singaravelu,Meenakshipublication,4th Edn., 1999. 2. Numerical methodsP.Kandasamy, K.Thilagavathy, K. Gunavathi, S.Chand, 2016 3. Programming in C, Balagurusamy, TMG, ND, 2012 4. Numerical Analysis,,M.K.Venkatraman, NPH, 2013 **5.** Numerical Analysis, B.D.Gupta, Konark Publishers, New Delhi, 2013
REFERENCE BOOKS	1. Schaum's outline series, Theory and Problems of programming in C, C.Byron& S. Gottfried, Tata McGraw Hill 2003 2. Numerical methods and C Programming, Veerarajan, 2015.

METHOD OF EVALUATION:

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

COURSE	**SIXTH SEMESTER – CORE**
COURSETITLE	**NUCLEAR AND PARTICLE PHYSICS**U23PHT613
CREDITS	4
COURSE OBJECTIVES	To understand constituents, properties and models of nucleus.To give reason for radioactivity and study their properties.To learn about the principles of various particle detectors and accelerators. To acquire knowledge on different types of nuclear reactions and their applications. To know the reason for cosmic rays and their effect on the surface of earth and also understand the classification of elementary particles.

UNITS	**COURSE DETAILS**
UNIT-I	**PROPERTIES OF NUCLEUS:** constituents of nucleus – isotopes, isobars, isotones – nuclear size, mass, density, charge, spin, angular momentum, magnetic dipole moment, electric quadrupole moment (qualitative) – binding energy – mass defect – packing fraction – nuclear stability – binding energy per nucleon graph – properties of nuclear force – meson theory of nuclear forces – Yukawa potential. **NUCLEAR MODELS:** liquid drop model –Weizacker's semi-empirical mass formula – shell model – magic numbers.
UNIT-II	**RADIO ACTIVITY:** radio activity – laws of radioactivity – radioactive disintegration, decay constant, half-life, mean-life (only final formulae) **–** unitsof radioactivity**–**successive disintegration – transient and secular equilibrium– properties of alpha, beta and gamma rays – Geiger-Nuttall law –α-ray spectra –Gamow's theory of α-decay (qualitative) –β-ray spectrum – neutrino theory of β-decay – nuclear isomerism – K-shell capture – internal conversion – non-conservation of parity in weak interactions.
UNIT-III	**PARTICLE DETECTORS AND ACCELERATORS** **DETECTORS:** gas detectors –ionization chamber – G-M counter – scintillation counter – photo multiplier tube (PMT) – semiconductor detectors – neutron detector. **ACCELERATORS:** l**inear accelerators – cyclotron – synchrotron – betatron– electron synchrotron – proton synchrotron (Beaverton)**
UNIT-IV	**NUCLEAR REACTIONS:** types of nuclear reactions – conservation laws in nuclear reaction – Q-value– threshold energy – nuclear fission – energy released in fission – chain reaction – critical mass – nuclear reactor – nuclearfusion – sources of stellar energy – proton-proton cycle – Carbon-Nitrogen cycle – thermonuclear reactions – controlled thermonuclear reactions.
UNIT-V	**ELEMENTARY PARTICLES AND** **COSMIC RAYS:** Discovery of cosmic rays – primary and secondary cosmic rays – cascade theory of cosmic ray showers – altitude and latitude effects –discovery of positron – pair production – annihilation of matter – Van-Allen radiation belts – big-bang theory – future of the Universe (elementary ideas only).

	ELEMENTARY PARTICLES:P articles and antiparticles – classification of elementary particles – types of fundamental interactions – quantum numbers of elementary particles , conservation laws and symmetry – quarks and types – quark model (elementary ideas only).
TEXT BOOKS	2. R Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S. Chand & Co. (2013) 3. Brijlal& N. Subramaniyan, Atomic and Nuclear Physics S.Chand& Co 4. J.B. Rajam, Modern Physics, S Chand &Co.Publishing Co. 5. D.C. Tayal, Nuclear Physics, Himalayan Publishing House 6. Atomic and Nuclear Physics, Brijlal& N. Subramaniyan, S.Chand& Co
REFERENCE BOOKS	1. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub. 2. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008) 3. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998). 4. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004). 5. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press 6. Introduction to Elementary Particles, D. Griffith, John Wiley & Son 7. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi 8. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000). 9. Theoretical Nuclear Physics, J.M. Blatt &V.F.Weisskopf (Dover Pub.Inc., 1991) 10. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (AcademicPress, Elsevier, 2007). 11. 13. Nuclear Physics, S. N. Ghoshal, S Chand & Co. Edition 2003 15. Elements of Nuclear Physics, M. L.Pandya& R. P. S.Yadav, KedarNath& Ram Nath
WEBLINKS	1. http://hyperphysics.phy-astr.gsu.edu/hbase/nuccon.html 2. https://www.kent.edu/physics/nuclear-physics-links 3. https://www2.lbl.gov/abc/links.html

METHOD OF EVALUATION:

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

COURSE OUTCOMES:
Attheendofthecourse,the studentwillbeableto:

COURSEOUTCOMES	**CO1**	Describe various models that explain about the nuclear structures
	CO2	Give reason for various kinds of radioactivity and also know laws governing them
	CO3	Know the principles and applications of various particle detectors and accelerators.
	CO4	Discuss the concepts used in nuclear reaction.
	CO5	Classify various elementary particles and study the effect of cosmic rays.

MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**L**).

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

COURSE	**SIXTH SEMESTER – CORE**
COURSETITLE	**SOLID STATE PHYSICS**U23PHT614
CREDITS	4
COURSE OBJECTIVES	To understand constituents, properties and models of nucleus. To give reason for radioactivity and study their properties.To learn about the principles of various particle detectors and accelerators. To acquire knowledge on different types of nuclear reactions and their applications.To know the reason for cosmic rays and their effect on the surface of earth and also understand the classification of elementary particles.

UNITS	COURSE DETAILS

UNIT-I	**BONDING 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 – Brillouin zones – X-rays – Bragg's law(simple problems) – experimental methods: Laue method, powder method and rotating crystal method
UNIT-II	**ELEMENTARY LATTICE DYNAMICS:** Lattice vibrations and phonons: linear monoatomicand diatomic chains. acoustical and optical phonons –qualitative description of the phonon spectrum in solids – Dulong and Petit's Law – Einstein and Debye theories ofspecific heat of solids – T^3 law (qualitative only)–properties of metals – classical free electron theory of metals(Drude-Lorentz) – Ohm's law – electrical and thermal conductivities – Weidemann-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'stheory of diamagnetism – Langevin'stheory 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 – classical theory of electric polarisability –normal and anomalous dispersion – Cauchy and Sellmeir relations – Langevin-Debye equation – complex dielectric constant -optical phenomena. Application – plasma oscillations – plasma frequency –plasmons,
UNIT-V	**FERROELECTRIC & SUPERCONDUCTING PROPERTIES OF MATERIALS: F**erroelectric 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)

TEXT BOOKS	1. Introduction to Solid State Physics,Kittel, Willey Eastern Ltd (2003). 2. Solid state Physics, Rita John,1st edition, TataMcGraw 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/

METHOD OF EVALUATION:

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

COURSE OUTCOMES:

Attheendofthecourse,the studentwillbeableto:

COURSEOUTCOMES	**CO1**	Classify the bonding &crystal structure also learn about the crystal structure analysis using X ray diffraction.
	CO2	Understand the lattice dynamics and thus learn the electrical and thermal properties of materials.
	CO3	Give reason for classifying magnetic material on the basis of

		their behaviour.
	CO4	Comprehend the dielectric behavior of materials.
	CO5	Appreciate the ferroelectric and super conducting properties of materials.

MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**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

NANOSCIENCE AND NANO TECHNOLOGYU23PHE67A	
Learning 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.	
UNITS	**COURSE DETAILS**
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 behavior –elastic properties – hardness and strength – ductility and toughness –superplastic behavior – optical properties – surface plasmon resonance – electrical properties – dielectric materials and properties – magnetic properties – super paramagnetism – electrochemical properties – properties of CNTs.
UNIT-III	**FABRICATION METHODS AND VACUUM TECHNIQUES:T**op-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 tunneling 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: nanosensors based on optical and physical properties – electrochemical sensors – nanobiosensors. 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.
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.

METHOD OF EVALUATION:

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

MEDICAL INSTRUMENTATIONU23PHE67B	
Learning Objective: This course aims to provide background of the Physics principles inmedical instrumentation technologies through theoretical & practical learning.	
UNITS	**COURSE DETAILS**
UNIT-I	**BIOMETRICS:**Introduction to man-instrument system and its components –problems encountered in measuring living systems – transducers– force, motion, pressure transducers. **AUDIOMETRY:**Mechanism of hearing – air and bone conduction – threshold of hearing –audiometer – masking in audiometry – pure tone and speech audiometer – evoked response audiometry – hearing aids
UNIT-II	**BIOELECTRIC POTENTIALS AND ELECTRODES:**Biomedical signals – sources of bioelectric potentials – resting, action and propagation of bioelectric potentials –bio-potential electrodes – skin surface, needle electrodes. **BIOMEDICAL RECORDERS: E**lectro-conduction system of heart – electro cardiogram (ECG) – Einthoven's triangle — electro encephalogram (EEG) –brain waves – EEG instrumentation – recording of evoked potentials – electro myogram (EMG)–pulse oximeter.
UNIT-III	**DIAGNOSTIC RADIOLOGY:** Radiography – primary radiological image – contrast agents, filters– beam restrictor, grid –image quality **COMPUTED TOMOGRAPHY:**linear tomography – computed tomography – helical and multi slice –image quality– radiation dose. **RADIOISOTOPES AND NUCLEAR MEDICINE: R**adioisotopes – radiopharmaceuticals – technetium generator – gamma camera – positron emission tomography – disposal of radioactive waste.
UNIT-IV	**ULTRASOUND IMAGING:** Ultrasound transducer – ultrasound imaging– Doppler ultrasound – ultrasound image quality & bio-effects.

	MAGNETIC RESONANCE IMAGING: Proton & external magnetic field – precession – radiofrequency and resonance – MRI signal – relaxation time – MRI instrumentation – imaging sequences – biosafety
UNIT-V	**PROJECT ASSIGNMENT:**Clinical practice of *one* of the following:electro cardiogram, electro encephalogram, electro myogram, electro oculogram, computed tomography, positron emission tomography, ultrasound
TEXT BOOKS	1. Leslie Cromwell, Fred Weibell, Erich Pfieffer(2002) Biomedical Instrumentation & Measurements Prentice Hall of India, New Delhi. 2. R. S. Khandpur (2003)Handbook of Biomedical Instrumentation 2nd Edn. Tata McGraw Hill, New Delhi. 3. KuppusamyThayalan (2017), Basic Radiological Physics 2nd Edn. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
REFERENCE BOOKS	1. John Webster (2004) Bioinstrumentation John Wiley and Sons, Singapore. 2. John Enderle, Susan Blanchard, Joseph Bronzino (2005) Introduction to Biomedical Engineering, 2nd ed. Elsevier, San Deigo 3. William Hendee, Geoffrey Ibbott, Eric Hendee (2005) Radiation therapy Physics 3rd ed. Wiley-Liss, New Jersey

METHOD OF EVALUATION:

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

MATERIALS SCIENCEU23PHE681	
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 – equilibrium concentration of point imperfections **(***problems***)**– application of point defects –line defects: edge dislocation**(***problems***),** screw dislocation – surface defects: extrinsic defects – intrinsic defects: grain boundaries, tilt &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 – spring-Dash pot models of 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 publications2011
REFERENCE BOOKS	1. William D. Callister, Jr., Material Science & Engineering – An Introduction, 8th Edition, John Wiley & Sons, Inc., 2007 2. W. Bolton, "Engineering materials technology", 3rd Edition, Butterworth & Heinemann, 2001. 3. Donald R. Askeland, Pradeep P. Phule, "The Science and Engineering of Materials", 5th Edition, Thomson Learning, First Indian Reprint, 2007. 4. William F. Smith, "Structure and Properties of Engineering Alloys", Mc-Graw-Hill Inc., U.S.A, 2nd edition, 1993.

METHOD OF EVALUATION:

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

DIGITAL PHOTOGRAPHYU23PHE682	
Learning Objective: To understand the principles of photography and image formation and the science and arts behind it. To understand the essential components ofconventional and digital cameras and also the different image processing techniques.	
UNITS	**COURSE DETAILS**
UNIT-I	**PHOTOGRAPHY AND BASIC PRINCIPLE OF IMAGE FORMATION:** principle –chemical route and digital route –light, wavelengths, colours – shadows – light intensity and distance – making light form images –pin-hole images – practical limitations to pin-hole images – lens instead of pin-hole – focal length and image size – imaging of closer subjects.
UNIT-II	**LENSES – CONTROLLING THE IMAGES:** photographic lens – focal length and angle of view **(***problems***)** – focusing movement – aperture and f-numbers **(***problems***)** – depth of field– depth of focus – image stabilization – lenses for digital cameras – lens and camera care
UNIT-III	**CAMERA USING FILMS AND ITS TYPES:** camera and its essential components– shutter – aperture – light measurement – film housing – camera types: view camera– view finder camera – Reflex camera– single lens reflex (SLR) camera

UNIT-IV	**DIGITAL CAMERAS PRINCIPLE AND TYPES:** principle of digital image capturing –comparison of digital and analog picture information – megapixel – grain, noise and pixel density – optical and digital zooming – image stabilizer – bit depth – white balance – colour modes – file formats (TIFF, RAW & JPEG) – storage cards and types – digital cameras: camera phones – compact camera – hybrid camera – digital SLR.
UNIT-V	**THE DIGITAL IMAGE – POSTPRODUCTION:** hardware: computer and its peripherals – software: saving digital file – basic editing: navigating the image – undo/redo/history – crop – rotate – brightness and contrast – colour balance – hue/saturation – dodge/burn – cloning and retouching – removing an element in an image – advanced editing: histogram/levels – curves – selection tools: magic wand – printing digital images: inkjet printer – laser printer – dye sub printer – lambda/light jet printers.
TEXT BOOKS	1. Michel J.Langford , Anna Fox & Richard Sawdon Smith, Basic photography, 9th Edition, , 2010-NL, Focal press, London **2.** Henry Carroll, Read this if you want to take great photographs of people, Laurence King Publishing
REFERENCE BOOKS	1. Mark Galer, Digital Photography in Available Light essential skills, 2006, Focal press, London **2.** Paul Harcourt Davies, The Photographer's practical handbook, 2005, UK PRESS

METHOD OF EVALUATION:

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

COURSE	**ALLIED PAPER**
COURSETITLE	**ALLIED PHYSICS – I**
CREDITS	3
COURSE OBJECTIVES	To impart basicprinciplesof Physics that which would be helpful for students who have taken programmes other than Physics.

UNITS	COURSE DETAILS
UNIT-I	**WAVES, OSCILLATIONS AND ULTRASONICS:** simple harmonic motion (SHM) – composition of two SHMs at right angles (periods in the ratio 1:1) – Lissajous figures – uses – laws of transverse vibrations of strings – determination of AC frequency using sonometer (steel and brass wires) – ultrasound – production – piezoelectric method – application of ultrasonics.
UNIT-II	**PROPERTIES OF MATTER:** *Elasticity*: elastic constants – bending of beam – theory of non- uniform bending – determination of Young's modulus by non-uniform bending – energy stored in a stretched wire – torsion of a wire – determination of rigidity modulus by torsional pendulum *Viscosity*: streamline and turbulent motion – critical velocity –

	coefficient of viscosity – Poiseuille's formula – comparison of viscosities – burette method,
UNIT-III	**HEAT AND THERMODYNAMICS:** Joule-Kelvin effect – Joule-Thomson porous plug experiment – theory – temperature of inversion – liquefaction of Oxygen– Linde's process of liquefaction of air– liquid Oxygen for medical purpose– importance of cryocoolers – thermodynamic system – thermodynamic equilibrium – laws of thermodynamics.
UNIT-IV	**ELECTRICITY AND MAGNETISM:** potentiometer – principle – measurement of thermo emf using potentiometer –magnetic field due to a current carrying conductor – Biot-Savart's law – field along the axis of the coil carrying current.
UNIT-V	**DIGITAL ELECTRONICS AND DIGITAL INDIA:** logic gates, OR, AND, NOT, NAND, NOR , EXOR logic gates – universal building blocks – Boolean algebra – De Morgan's theorem – verification – overview of Government initiatives: software technological parks under MeitY, NIELIT- semiconductor laboratories under Dept. of Space – an introduction to Digital India
UNIT-VI	**PROFESSIONAL COMPONENTS:**Expert lectures –seminars — webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. R.Murugesan (2001), AlliedPhysics,S. Chand&Co,NewDelhi. 2. BrijlalandN.Subramanyam (1994), WavesandOscillations,VikasPublishing House,NewDelhi. 3. BrijlalandN.Subramaniam (1994), PropertiesofMatter,S.Chand&Co.,NewDelhi. 4. J.B.Rajam and C.L.Arora (1976). Heat and Thermodynamics (8^{th} edition), S.Chand&Co.,New Delhi. 5. R.Murugesan(2005), OpticsandSpectroscopy,S.Chand&Co,NewDelhi. 6. A.Subramaniyam, AppliedElectronics2^{nd}Edn.,NationalPublishingCo.,Chennai.
REFERENCE BOOKS	1. ResnickHallidayandWalker(2018).FundamentalsofPhysics(11^{th}edition),JohnWilleyand Sons, Asia Pvt.Ltd., Singapore. 2. V.R.KhannaandR.S.Bedi (1998), TextbookofSound1^{st}Edn. KedharnaathPublish&Co, Meerut. 3. N.S.KhareandS.S.Srivastava (1983), ElectricityandMagnetism10^{th}Edn.,AtmaRam&Sons, New Delhi. 4. D.R.KhannaandH.R. Gulati(1979). Optics,S. Chand &Co.Ltd.,New Delhi. **5.** V.K.Metha(2004).Principlesofelectronics6^{th} Edn. S.Chandandcompany.
WEBLINKS	1. https://youtu.be/M_5KYncYNyc 2. https://youtu.be/ljJLJgIvaHY 3. https://youtu.be/7mGqd9HQ_AU 4. https://youtu.be/h5jOAw57OXM 5. https://learningtechnologyofficial.com/category/fluid-

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

METHOD OF EVALUATION:

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

COURSE OUTCOMES:

Attheendofthecourse,the studentwillbeableto:

COURSE OUTCOMES	**CO1**	Explain types of motion andextend their knowledge in the study of variousdynamicmotionsanalyzeand demonstrate mathematically. Relate theory with practical applications in medical field.
	CO2	Explaintheirknowledgeofunderstandingaboutmaterialsandtheir behaviorsandapplyittovarioussituationsinlaboratoryandreal life. Connect droplet theory with Corona transmission.
	CO3	Comprehend basic concept of thermodynamics concept of entropyand associated theorems able to interpret the process of flowtemperaturephysicsinthebackgroundofgrowthof this technology.
	CO4	Articulate the knowledge about electric current resistance,capacitance in terms of potential electric field and electric correlatetheconnectionbetweenelectricfieldandmagneticfieldandanalyzethemmathematicallyverifycircuitsandapplytheconceptstoconstructcircuitsandstudythem.
	CO5	Interpret the real life solutions using AND, OR, NOT basiclogicgatesandintendtheirideastouniversalbuildingblocks. InferoperationsusingBooleanalgebraandacquireelementaryideasofICcircuits.Acquire information about various Govt. programs/ institutions in this field.

MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-

pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**L**).

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

COURSE	**EVEN SEMESTER - CORE**
COURSETITLE	**ALLIED PRACTICALS – I**
CREDITS	3/2
COURSE OBJECTIVES	Apply various physics concepts to understand Properties of Matter and waves, set up experimentation to verify theories, quantify and analyse, able to do error analysis and correlate results

ANY Seven only

1. Young's modulus by non-uniform bending using pin and microscope
2. Young's modulus by non-uniform bending using optic lever,scale and telescope
3. Rigidity modulus by static torsion method.
4. Rigidity modulus by torsional oscillations without mass
6. Surface tension and interfacial Surface tension – drop weight method
7. Comparison of viscosities of two liquids – burette method
8. Specific heat capacity of a liquid – half time correction
9. Verification of laws of transverse vibrations using sonometer
10. Calibration of low range voltmeter using potentiometer
11. Determination of thermo emf using potentiometer
12. Verification of truth tables of basic logic gates using ICs
13. Verification of De Morgan's theorems using logic gate ICs.
14. Use of NAND as universal building block.

Note : Use of digital balance permitted

METHOD OF EVALUATION:

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

COURSE	**ALLIED PAPER**
COURSETITLE	**ALLIED PHYSICS –II**
CREDITS	3

COURSE OBJECTIVES	To understand the basic concepts of optics, modern Physics, concepts of relativity and quantumphysics, semiconductorphysics, and electronics.

UNITS	**COURSE DETAILS**
UNIT-I	**OPTICS: i**nterference – interference in thin films –colors of thin films – air wedge – determination of diameter of a thin wire by air wedge – diffraction – diffraction of light vs sound – normal incidence – experimental determination of wavelength using diffraction grating (no theory) – polarization – polarization by double reflection – Brewster's law – optical activity – application in sugar industries
UNIT-II	**ATOMIC PHYSICS:** atom models – Bohr atom model – mass number – atomic number – nucleons – vector atom model – various quantum numbers – Pauli's exclusion- photo electric effect – Einstein's photoelectric equation – applications of photoelectric effect: solar cells, solar panels, optoelectric devices
UNIT-III	**NUCLEAR PHYSICS:** nuclear models – liquid drop model – magic numbers – shell model – nuclear energy – mass defect – binding energy – radioactivity – uses – half life – mean life - radio isotopes and uses –controlled and uncontrolled chain reaction – nuclear fission – energy released in fission – chain reaction – critical reaction – critical size- atom bomb – nuclear reactor – breeder reactor – nuclear fusion – thermonuclear reactions – differences between fission and fusion.
UNIT-IV	**INTRODUCTION TO RELATIVITY AND GRAVITATIONAL WAVES**:frame of reference – postulates of special theory of relativity – Galilean transformation equations – Lorentz transformation equations – derivation – length contraction – time dilation – twin paradox – mass-energy equivalence.
UNIT-V	**SEMICONDUCTOR PHYSICS:** p-n junction diode – forward and reverse biasing – characteristic of diode – zener diode – characteristic of zener diode – voltage regulator – full wave bridge rectifier – construction and working – advantages (no mathematical treatment) – USB cell phone charger –introduction to e-vehicles and EV charging stations
UNIT-VI	**PROFESSIONAL COMPONENTS:**Expert lectures –seminars — webinars – industry inputs – social accountability – patriotism

TEXT BOOKS	1. R.Murugesan (2005), AlliedPhysics,S.Chand&Co,NewDelhi. 2. K.ThangarajandD.Jayaraman(2004), AlliedPhysics,PopularBookDepot,Chennai. 3. BrijlalandN.Subramanyam(2002), TextbookofOptics,S.Chand&Co,NewDelhi. 4. R.Murugesan (2005), ModernPhysics,S.Chand&Co,NewDelhi. 5. A.SubramaniyamAppliedElectronics, 2nd Edn.,NationalPublishingCo.,Chennai.
REFERENCE BOOKS	1. ResnickHallidayandWalker (2018), FundamentalsofPhysics, 11th Edn.,JohnWilleyandSons, Asia Pvt.Ltd.,Singapore. 2. D.R.KhannaandH.R. Gulati (1979).Optics, S.Chand&Co.Ltd.,New Delhi. 3. A.Beiser (1997), ConceptsofModernPhysics,TataMcGrawHillPublication,NewDelhi. 4. Thomas L. Floyd (2017), Digital Fundamentals, 11th Edn., Universal Book Stall, NewDelhi. 5. V.K.Metha(2004), Principlesofelectronics, 6th Edn. ,S.ChandandCompany, New Delhi.
WEBLINKS	1. https://www.berkshire.com/learning-center/delta-p-facemask/https://www.youtube.com/watch?v=QrhxU47gtj4https://www.youtube.com/watch?time_continue=318&v=D38BjgUdL5U&feature=emb_logo 2. https://www.youtube.com/watch?v=JrRrp5F-Qu4 3. https://www.validyne.com/blog/leak-test-using-pressure-transducers/ 4. https://www.atoptics.co.uk/atoptics/blsky.htm - 5. https://www.metoffice.gov.uk/weather/learn-about/weather/optical-effects

METHOD OF EVALUATION:

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

COURSE OUTCOMES:

Attheendofthecourse,the studentwillbeableto:

COURSEOUTCOMES	**CO1**	Explaintheconceptsof interferencediffractionusingprinciplesof superpositionofwaves and rephrase the concept of polarization based on wave patterns
	CO2	Outline the basic foundation of different atom models and variousexperiments establishing quantum concepts. Relate the importance ofinterpretingimprovingtheoreticalmodelsbasedonobservation. Appreciateinterdisciplinarynatureofscience and in solar energy related applications.
	CO3	Summarizethepropertiesofnuclei, nuclearforcesstructureofatomicnucleusandnuclear models. Solveproblems on delayratehalf-lifeand mean-life.Interpret nuclear processes likefission and fusion. Understand the importance of nuclear energy, safety measures carried and get our Govt.agencies like DAE guiding the country in the nuclear field.
	CO4	Todescribethebasicconceptsofrelativitylikeequivalenceprincipl e, inertialframes and Lorentz transformation. Extend their knowledge on concepts ofrelativityandviceversa. Relate this with current research in this field and get an overview of research projects of National and International importance, like LIGO, ICTS, and opportunities available.
	CO5	Summarize the working of semiconductor devices like junction diode, Zenerdiode, transistors and practical devices we daily use like USB chargers and EV charging stations.

MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**L**).

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

COURSE	**EVEN SEMESTER – CORE**
COURSETITLE	**ALLIED PRACTICALS – II**
CREDITS	3/2
COURSE OBJECTIVES	Apply various Physics concepts to understand concepts of Light, electricity and magnetism and waves, set up experimentation to verify theories, quantify and analyze, able to do error analysis and correlate results

Any Eight

1. Radius of curvature of lens by forming Newton's rings
2. Thickness of a wire using air wedge
3. Wavelength of mercury lines using spectrometer and grating
4. Refractive index of material of the lens by minimum deviation
5. Refractive index of liquid using liquid prism
6. Determination of AC frequency using sonometer
7. Specific resistance of a wire using PO box
8. Thermal conductivity of poor conductor using Lee's disc
9. Determination of figure of merit table galvanometer
10. Determination of Earth's magnetic field using field along the axis of a coil
11. Characterisation of Zener diode
12. Construction of Zener/IC regulated power supply
13. Construction of AND, OR, NOT gates using diodes and transistor or discrete components.
14. NOR gate as a universal building block
15. NAND gate as a universal building block
16. AND,OR and NOT gate using IC's
17. Characterisation of Junctiondiode

METHOD OF EVALUATION:

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