MAR IVANIOS COLLEGE
(AUTONOMOUS)

THIRUVANANTHAPURAM

DEPARTMENT OF PHYSICS

Syllabus for FDP
Bachelor of Science in Physics

Academic Year (2018)

Preamble

The primary mission of the First Degree Programme in Physics is to provide an outstanding education for students. Our curriculum serves undergraduate students who seek, by the study of Physics, to acquire critical thinking skills and to develop the understanding and problem-solving abilities which are increasingly needed in our technological society. The undergraduate courses of study provide solid foundation in physics and they introduce a broad spectrum of modern trends in physics and experimental, computational and mathematical skills of students which are essential to further advancement. The syllabus is framed in such a way that it bridges the gap between the Plus Two and Post Graduate levels of physics by providing a more complete and logical framework in almost all areas of basic physics.

FDP PROGRAMME

Programme outcomes.

The programme aims at

PO1: imparting education and training to the best quality at the undergraduate level and nurture graduates, of the calibre sought by industries and public service, as well as academicians, teachers and researchers of global standards.

PO2: attracting outstanding students from all backgrounds.

PO3: providing an intellectually stimulating environment in which the students have the opportunity to develop their knowledge and skills to the best of their potential.

PO4: maintaining the highest academic standards in undergraduate teaching.

PO5: imparting skills essential to gather information from resources and use them.

PO6: equipping students in methodology related to basic and applied sciences..

FDP PROGRAMME IN PHYSICS : B.Sc (PHYSICS)

Programme specific outcomes.

Objectives

By the end of the second semester, the students will have,

PSO1: attained a common level in basic mechanics and properties of matter and laid a secure foundation in mathematics for their future courses.

PSO2: developed their experimental and data analysis skills through a wide range of experiments in the practical laboratories.

By the end of the fourth semester, the students will have

PSO3: been introduced to powerful tools for tackling a wide range of topics in Thermodynamics, Statistical Mechanics and Electrodynamics.

PSO4: become familiar with additional relevant mathematical techniques.

PSO5: further developed their experimental skills through a series of experiments which also illustrate major themes of the lecture courses.

By the end of the sixth semester, the students will have

PSO6: covered a range of topics in almost all areas of physics including quantum physics, solid state physics, computational physics, electronics and research methodology.

PSO7: had experience of independent work such as projects, seminars etc.

PSO8: have developed their understanding of core physics.

I. GENERAL STRUCTURE FOR THE FIRST DEGREE PROGRAMME IN PHYSICS

(ESE-End Semester Exam), CE (Continuous Evaluation) L-Lecture, P-Practical

FDP B.Sc. PHYSICS (Core)			Instructional h/week	Credit	ESE/ ESA duration (h)	CE/ CA %	ESE/ ESA %
Semester	**Paper Code**	**Title of paper**					
1.	AUPY141	Basic Mechanics & Properties of Matter	2	2	3	20	80
2.	AUPY221	Classical Mechanics **(Foundation Course 2)**	2	2	3	20	80
3.	AUPY341	Thermodynamics & Statistical Physics	3	3	3	20	80
4.	AUPY441	Electrodynamics	3	3	3	20	80
		Practicals					
	AUPY44PI	Mechanics, Properties of Matter, Error Measurements, Heat and Acoustics	3	3	3	20	80
5.	AUPY541	Methodology in Physics & Relativistic Mechanics	4	4	3	20	80
	AUPY542	Quantum Mechanics	4	4	3	20	80

	AUPY543	Electronics	4	4	3	20	80
	AUPY544	Atomic & Molecular Physics	4	4	3	20	80
		Open Course					
	AUPY581.a	Applied Physics	3	2	3	20	80
	AUPY581.b	Astronomy & Astrophysics	3	2	3	20	80
	AUPY581.c	Biophysics	3	2	3	20	80
	AUPY581.d	Energy Physics	3	2	3	20	80
	AUPY581.e	Environmental Physics	3	2	3	20	80
6.	AUPY641	Solid State Physics	4	4	3	20	80
	AUPY642	Nuclear & Particle Physics	4	4	33	20	80
	AUPY643	Classical & Modern Optics	4	4	3	20	80
	AUPY644	Computer Science	4	4	3	20	80
		Elective Course					
	AUPY691.a	Computer Hardware & Networking	3	2	3	20	80
	AUPY691.b	Electronic Instrumentation	3	2	3	20	80
	AUPY691.c	Nanoscience & Technology	3	2	3	20	80
	AUPY691.d	Photonics	3	2	3	20	80
	AUPY691.e	Space Science	3	2	3	20	80
		Practicals					
	AUPY64PII	Optics, Electricity and Magnetism	3	2	3	20	80
	AUPY64PIII	Digital Electronics and Computer Science	3	3	3	20	80
	AUPY645	Project & Study Tour Report		4	3	-	100

FDP B.Sc. CHEMISTRY (Complementary)			**Instructional h/week**	**Credit**	**ESE duration (h)**	**CE %**	**ESE %**
Semester	**Paper Code**	**Title of paper**					
1.	AUPY131.2b	Rotational Dynamics & Properties of Matter	2	2	3	20	80
2.	AUPY231.2b	Thermal Physics	2	2	3	20	80
3.	AUPY331.2b	Optics, Magnetism & Electricity	3	3	3	20	80
4.	AUPY431.2b	Atomic physics, Quantum mechanics & Electronics	3	3	3	20	80
		Practicals					
	AUPY43.2bPI	Complimentary Practical Physics	2	4	3	20	80

FDP B.Sc. MATHEMATICS (Complementary)			**Instructional h/week**	**Credit**	**ESE duration (h)**	**CE (%)**	**ESE (%)**
Semester	**Paper Code**	**Title of paper**					
1.	AUPY131.2c	Mechanics & Properties of Matter	2	2	3	20	80
2.	AUPY231.2c	Heat and Thermodynamics	2	2	3	20	80

3.	AUPY331.2c	Optics, Magnetism & Electricity	3	3	3	20	80
4.	AUPY431.2c	Modern Physics & Electronics	3	3	3	20	80
		Practicals					
	AUPY43.2cPI	Complimentary Practical Physics	2	4	3	20	80

	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**	**Semester 5**	**Semester 6**
Total Credits (120)	16	17	18	25	18	26

II. QUESTION PAPER PATTERN

For all semesters

Question Type	**Total number of Questions**	**Number of Question to be answered**	**Marks for each Questions**	**Total Marks**
Very short answer type(One word to Maximum of 2 sentences)	10	10	1	10
Short answer(Not to exceed one paragraph)	12	8	2	16
Short essay(Not to exceed 120 words)	9	6	4	24
Long essay	4	2	15	30
Total	**35**	**26**		**80**

III. OPEN/ELECTIVE COURSES

During the programme the students have to undergo one open course and one elective course. Students attached to the Physics department can opt for one Elective course from the Physics department and one Open Course from any other departments. Students have to do the open course during the fifth semester and the elective course during the sixth semester. Department of Physics offers the following open courses during the fifth semester for students of other departments.

(a). Open Courses

Open Course
Applied Physics
Astronomy & Astrophysics
Biophysics
Energy Physics
Environmental Physics

Department of Physics offers the following Elective courses during the sixth semester for students of Physics department.

(b). Elective Courses

Elective Course
Computer Hardware & Networking
Electronic Instrumentation
Nanoscience & Technology
Photonics
Space Science

IV. EVALUATION AND GRADING

The Evaluation of each Course shall consist of two parts

1) Continuous Evaluation (CE) or Continuous Assessment (CA)

2) End Semester Evaluation (ESE) or End Semester Assessment (ESA)

The CE/CA and ESE/ESA ratio shall be 1:4 for all Courses with or without practical. **There shall be a maximum of 80 marks for ESE/ESA and maximum of 20 marks for CE/CA for all Courses (Theory and Practical).** A student shall be permitted to appear for the End Semester Examinations for any semester (practical/theory) if the student secures **not less than 75%** aggregate attendance for all the courses taken together during the semester. Grades are given on a 7-point scale based on the total percentage of mark (CE+ESE) as given below.

Criteria for Grading

Percentage of marks	CCPA	Letter Grade
90 and above	9 and above	A+ Outstanding
80 to < 90	8 to<9	A Excellent
70 to <80	7to<8	B Very Good

60 to < 70	6to<7	C Good
50 to < 60	5to<6	D Satisfactory
40 to < 50	4to<5	E Adequate
Below 40	<4	F Failure

The following are the distribution of CA/CE marks for the theory courses of UG programmes:

Theory Courses	Mark distribution [Maximum marks]
Test [1 number]	10
Assignment/ Seminar- any 1	5
Attendance	5

The following are the distribution of CA/CE marks for the practical courses of UG programmes.

Practical papers	Mark distribution [Maximum marks]
Test	10
Record	5
Performance/Punctuality/Skill	5

V. TESTS: (MAX. MARKS 10)

For each Course there shall be one internal test during a semester. This will be a model examination for three hours and will be based on the question paper pattern for the End Semester Examination. It is mandatory that all students must appear for this test. There will be no provision for retest on the basis of absence in the test. The scheme and question paper pattern for the test paper as well as for the End Semester Examination will be prepared by the Board of Studies.

VI. ATTENDANCE (MAX. MARKS 5):

A Student must secure a minimum of 75% aggregate attendance for all the courses of a semester taken together to become eligible to register for each End Semester Examination. The attendance percentage will be calculated from the day of commencement of the semester to the last working day of that semester. Attendance eligibility will be checked both at the time of registration for the End Semester Examination as well as at the time of issue of the hall tickets. Those students who fail to secure the minimum aggregate attendance will have to repeat the semester with the next batch by seeking re-admission. The award of attendance for CE/CA shall be given course-wise. A student who fails to get 75% attendance can apply for condonation from the College, if duly recommended by the Faculty Advisor and Head of the Department, for a maximum of 10 days in a semester for valid reasons, twice during the entire programme. Condonation thus granted shall not be considered for the award of CE marks. A student who seeks condonation on genuine medical grounds should produce a medical certificate clearly stating the inability of the student to attend classes with the recommendation of the Faculty Advisor and Head of the Department on condition that the matter pertaining to leave of absence has been given in writing by the parent/guardian to the concerned Head of the Department within 3 working days from the commencement of leave. The decision of the Principal shall be final in such matters. Reappearance of course(s) will be distinctly indicated in the final mark/grade sheet.Marks shall be allotted for course-wise attendance, for individual courses in which a student has registered, as follows:

ATTENDANCE %	MARKS
Less than 75%	0 mark
75%	1 mark
76 to 80%	2 marks
81 to 85%	3 marks
86 to 90%	4 marks
Above 90%	5 marks

VII. ASSIGNMENTS OR SEMINARS: (MAX. MARKS 5)

Each student shall be required to do one assignment or seminar for each Course. The seminars shall be organized by the teacher/teachers in charge of CA and the same shall be assessed by a group of teachers including the teacher/ teachers in charge of that Course. Assignments/Seminars shall be evaluated on the basis of their quality. The teacher shall

define the expected quality of an assignment in terms of structure, content, presentation etc. and inform the same to the students. Due weight shall be given for punctuality in submission. The Seminar will be evaluated in terms of structure, content, presentation, interaction etc and carried out/conducted in supervision with the concerned department.

VIII. PROJECT/DISSERTATION WORK:

For each First Degree Programme there shall be a Project/Dissertation Work. The Project/Dissertation work can be done either individually or by a group not exceeding five students. However, Viva-Voce based on the Project/Dissertation work shall be conducted individually.

The topic of the project work shall either be allotted by the supervising teacher or be selected by the students in consultation with the supervising teacher during Semester 4. The experimental or theoretical work related to the project shall be carried out during Semester 5 with the help of the supervising teacher, and the dissertation work shall be completed before the end of Semester 5. However the Project Dissertation shall be submitted to the Department in duplicate only before the completion of the sixth semester. There shall be no continuous assessment for Dissertation / Project work. A Board of two Examiners appointed by the Controller of Examination shall evaluate the report of the Project/Dissertation work. The detailed guidelines regarding the conduct and evaluation of the Project/Dissertation will be framed by the Boards of Studies.

VIII.1. Guidelines for preparation and submission of dissertation/project in FDP in Physics

For FDP Physics, the project carries 4 credits. The aim of the Project work is to bring out the talents of students and to introduce them to research methodology. The work may be chosen from any branch of Physics, which may be Experimental, theoretical or computational. Emphasis should be given for originality of approach.

The project shall be done individually or as a group of maximum 5 students. The projects are to be identified during the 4^{th} semester with the help of the supervising teacher. The report of the project (of about 30-40 pages) in duplicate shall be submitted to the department by the end of the 6^{th} semester well before the commencement of the examination. The reports are to be produced before the external examiners appointed by the institution as per guidelines for valuation.

VIII.2. A. Evaluation of project

The evaluation of the project shall be done by two external examiners according to the scheme given below. Each candidate shall be evaluated separately. There shall be a maximum of 12 candidates per session with two sessions per day.

The evaluation of dissertation shall be according to the scheme given below.

Component	Marks
Originality of approach	9
Relevance of the topic	9
Involvement of the candidate	12
Presentation of report	45

There should be a viva- voice based on the Project/ Dissertation and study tour/field trip conducted individually. The various components to be considered in the viva-voce are given below.

Components	Marks
Understanding the objective of the project work/study tour report.	5
Background knowledge of Project &subject	5
Knowledge on the Content	15

The grade for the Project is consolidated by combining the Grades of Dissertation submission and the Project based viva-voce, taking in to account the weights assigned to them as shown below.

	Weight
Dissertation	3
Viva-voce	1

There shall be no continuous evaluation for the project.

IX. STUDY TOUR

Students shall also be encouraged to conduct a field work/field tour/study tour to any of the regional or national scientific laboratory at which any type of scientific research in the areas of physical, chemical or mathematical sciences is carrying out. They can also visit any of the university teaching and research departments. The field trip

shall be conducted after the 5th semester examinations and before the commencement of the 6th semester without affecting the examination schedule. The schedule can be worked out in consultation with the authorities of the visiting institute. Students are required to interact with scientists / physicists / professors / researchers / academicians in the institute, where they are visiting and make a comprehensive report on their visit. The interaction can be individually or as a group mode, but the students shall submit their individual reports. The report shall contain the following points.

1. Name of the institute visited:
2. Areas of research work carrying out in the institute:
3. Name of scientists/physicist/professors/researchers/academicians to whom they interacted:
4. Description of any major work carrying out in the institute (not less than 600 words or 2 pages):
5. Few photographs:
6. Correlation between your knowledge with this research activity:

The tour reports must be submitted along with the dissertation of the project work. Few questions can also be asked from the tour report at the time of project viva voce.

X. EVALUATION OF PRACTICAL EXAMINATION

The practical examinations for the core subject shall be conducted by the institution at the end of Semesters 4 and 6 with a common time table and questions set by the College. Similarly the practical examination for the complementary course shall be conducted by the college at the end of the 4th semester. The examiners shall be selected from a panel of experts prepared by the Controller of Examination. **There shall be two external examiners and one internal examiner who is *not* in charge of the practical classes of respective batches.** The mark sheet duly certified by the Head of the Department should be sent to the Controller of Examination of the college before the commencement of the end semester examinations. The scheme and question paper pattern for the end semester practical examinations will be prepared by the Chairman of the Board constituted for conducting practical examinations.

AUPY141:BASIC MECHANICS & PROPERTIES OF MATTER

Total Teaching Hours for Semester: 36	**No of Lecture Hours/Week:2**
Max Marks:80	**Credits:2**
Course Outcomes.	

The course includes chapters on Dynamics of rigid bodies, Conservation of energy, Oscillations, Waves, Acoustics, Elasticity and Properties of fluids. The students may be able to learn

CO1. the theory and experimental procedures of flywheel, compound bar pendulum, bent beams and torsion pendulum and static torsion to determine moment of inertia, acceleration due to gravity, Young's modulus of the materials and rigidity modulus of the materials, respectively

CO2. the theory and experimental procedures to determine the surface tension and viscosities of liquids

CO3. the properties and specifications of girders

CO4. the acoustics of buildings

MECHANICS	**Total Teaching Hours:26**
Unit-1 Dynamics of Rigid Bodies	**Teaching Hours:7**
Equations of motion for rotating rigid bodies-angular momentum and M.I-Theorems on M.I- calculation of M.I of bodies of regular shapes- uniform rod, ring, disc, annular ring, solid cylinder, hollow cylinder and solid sphere-KE of rotating and rolling bodies-torque-Determination of M.I of a fly wheel (theory, experiment and applications).	
Unit-2 Conservation of energy	**Teaching Hours:3**
Conservation laws-Work –power- Kinetic Energy – Work Energy theorem- Conservative Forces -potential energy – Conservation of energy for a particle– energy function- Non Conservative forces- Friction- types of friction.	
Unit-3 Oscillations	**Teaching Hours:7**
Simple harmonic motion – Energy of harmonic oscillators-simple pendulum-mass on a spring-oscillation of two particles connected by a spring- compound bar pendulum - interchange ability of suspension and oscillation-four points collinear with C.G about which the time period is the same-conditions for maximum and minimum periods - Determination of g using symmetric bar pendulum.	
Unit-4 Waves	**Teaching Hours:5**

Mechanical and electromagnetic wave motion- General equation of a wave motion-expression for a plane progressive harmonic wave- energy density for a plane progressive wave- transverse waves in stretched string (expression)- longitudinal waves in rods- longitudinal waves in gas.

Unit 5- Acoustics	**Teaching Hours:4**

Reverberation-Sabines reverberation formula-Determination of absorption coefficient-acoustic Intensity-Factors affecting acoustics of buildings.

PROPERTIES OF MATTER	**Total Teaching Hours:10**
Unit 6- Elasticity	**Teaching Hours:6**

Relations connecting the three elastic modulii- poisson's ratio- bending of beams-bending moment-cantilever-centrally loaded beams and uniformly bent beams-I section girders-torsion of a cylinder-expression for torsional couple -work done in twisting a wire-torsion pendulum-static torsion-theory and experiment.

Unit 7–Properties of Fluids	**Teaching Hours :4h**

Expression for excess of pressure on a curved liquid surface -determination of surface tension by Jaeger's method, Poisseulle's formula, Stoke's formula-theory and experiment.

Book for study and reference.

1. **Hans H.S and Puri S.P, Mechanics, TMH: Second edition.**
2. **J.C Upadhyaya Mechanics – (Ramaprasad)**
3. **D.S.Mathur, Properties of matter**
4. **Halliday and Resnick, Fundamentals of Physics**
5. Brijlal and Subramaniam, Oscillations and waves
6. P.V.Naik Principles of Physics-, PHI.
7. P.Vivekanandan, Mechanics and Properties of matter

Topics for assignments /discussion in the tutorial session (sample)

1. Physics-The fundamental science-historical development of mechanics-some implications of the principle of mechanics-The scope of mechanics.
2. Life of eminent physicists- Newton, Einstein, C.V.Raman, Edison.
3. Study of Young's modulus for different types of wood.
4. Study of variation of surface tension for different detergents.
5. Study of viscosity of different types of ink and to arrive at knowledge of its fluidity.
6. Wide applications of Bernoulli's equation.
7. Variation of surface tension with temperature by Jaeger's method

AUPY221-CLASSICAL MECHANICS (Foundation Course-2)

Total Teaching Hours for Semester:36	**No of Lecture Hours/Week:2**
Max Marks:80	**Credits:2**
Course Outcomes	

The course includes chapters on Particle dynamics, Conservation laws and properties of space and time, Motion in central force field, Collisions and Lagrangian dynamics. The students may be able to learn

CO1. the conservation of linear momentum, angular momentum and energy, on the basis of linear uniformities and rotational invariance of space and homogeneity of flow of time,

CO2. the theory of motion in central force field extending up to the explanation of Kepler's laws of planetary motion ,

CO3. the Lagrangian and Newtonian approaches using the examples of simple pendulum, Atwood's machine and compound pendulum

CO4. the generalized coordinates .

Unit-1 Particle Dynamics	**Teaching Hours:5**

Newton's laws of motion – mechanics of a particle – equation of motion of a particle – Motion of a charged particle in electromagnetic field – mechanics of a system of particles. *Book 2; Chapter 3*

Unit-2 Conservation laws and properties of space and time	**Teaching Hours:6**

Linear uniformities of space and conservation of linear momentum – rotational invariance of space and law of conservation of angular momentum – homogeneity of flow of time and conservation of energy. *Book 1; Ch. 5*

Unit-3 Motion in central force field	**Teaching Hours:10**
Equivalent one body problem – motion in central force field – general features of motion – motion in an inverse square law force field – equation of the orbit – Kepler's laws of planetary motion and their deduction *Book 2; Chapter 5 & Book 3; Ch. 4*	
Unit-4 Collisions (6 h):	**Teaching Hours:6**
Conservation laws – laboratory and centre of mass systems – kinetic energies in the lab and CM systems – Cross-section of elastic scattering. *Book 1; Chapter 7*	
Unit-5 Lagrangian Dynamics	**Teaching Hours:9**
Constraints – generalized coordinates – principle of virtual work – D' Alembert's principle, Lagrange's equation from D' Alembert's principle, – applications of Lagrange's equation in simple pendulum, Atwood's machine and compound pendulum (comparison of Lagrangian approach with Newtonian approach). *Book 3; Chapter 2*	
Book for study and reference.	
1. H.S.Hans and S.P.Puri, Mechanics – (Tata-McGraw Hill). **2. R.G.Thakwale and P.S.Puranik, Introduction to classical mechanics – (Tata-McGraw Hill).** **3. J C Upadhyaya, Classical Mechanics – (Himalaya Publishing House)** 4. Goldstein, Classical Mechanics –. 5. Vimal Kumar Jain, Classical Mechanics- (Ane Books Pvt Ltd) 6. Schaum's outlines, Modern Physics. 7. Walter Greiner, Classical Mechanics - Systems of Particles & Hamiltonian Dynamics. 8. Arther Bieser, Concepts of Modern physics- (Tata-McGraw Hill). 9. N.C Rana and P.S.Joag, Classical Mechanics.	

AUPY341-THERMODYNAMICS AND STATISTICAL PHYSICS	
Total Teaching Hours for Semester:54	**No of Lecture Hours/Week:3**
Max Marks:80	**Credits:3**
Course Outcomes	

Discusses Transference of heat, Thermodynamics, Entropy and Statistical Physics

The students may be able to learn

CO1 about the basics of conduction and radiation

CO2 the laws of thermodynamics.

CO3 detailed analysis of thermodynamic processes

CO4 on heat engines.

CO5 explanations on the concepts based on entropy.

CO6 the basics of Statistical Physics

CO7 the discussions based on Statistical distributions

Unit-1 Conduction	**Teaching Hours:5**
Thermal conductivity - determination by Lee's Disc method for bad conductor, radial and cylindrical flow of heat, thermal conductivity of rubber, Wiedmann-Franz law *chapter 8 Ref 3*	
Unit-2 Radiation	**Teaching Hours:5**
Energy distribution in black body spectrum -Wien's displacement law-Rayleigh-Jeans law-Planck's hypothesis-Stefan's law, determination of Stefan's constant and solar constant, determination of solar temperature *chapter 8 Ref 3*	
Unit-3 Thermodynamics	**Teaching Hours:14**
Zeroth Law & First law of Thermodynamics, differential form -Thermodynamic processes-Expression for work done in isothermal and adiabatic processes. Application of first law to specific heat and latent heat. Reversible and irreversible processes. Second law of thermodynamics- Clausius and Kelvin statements - Carnot engine - Principle refrigerator, working and efficiency Otto engine and Diesel engine – working and efficiency. *Ref 2, 3*	
Unit-4 Entropy	**Teaching Hours:12**
Definition of entropy, change of entropy in reversible and irreversible cycle, Clausius inequality and second law of thermodynamics, entropy and available energy,. T-S diagram, Entropy, probability and disorder. Nernst theorem and third law of thermodynamics. Phase transition, first order phase trans ition Clausius-Clepeyron Equation ,higher order phase transition (qualitative study) Liquid Helium, Gibb's and Helmhol's Functions, Maxwell's Equations *chapter 6, Ref 3 & Ref 1*	

Unit-5 Statistical Physics	**Teaching Hours:18**
Statistical probability, Macro& Microstates, Phase space, Statistical ensemble, Postulate of equal probability, Maxwell Boltzmann distribution, Velocity distribution. Indistinguishability of identical particles, Bose Einstein and Fermi Dirac distribution functions, comparison of three statistics, Application of BE & FD statistics, Bose-Einstein condensation Thermionic emission.	
Book for study and reference.	
1. S.K. Roy Thermal and Statistical Mechanics- (New Age International) **2. D. S. Mathur Heat and Thermodynamics – (S. Chand &Co)** **3. Brijlal & Subrahmanyam Heat and Thermodynamics- (S. Chand &Co)** **4. Arthur Beiser Concepts of Modern Physics – (TMH)** 5. Kamal Singh & S. P. Singh Elements of Statistical Mechanics- (S. Chand & Co) 6. C. J. Babu Thermal Physics, Statistical Physics and Solid state Physics –(Calicut University Press) 7. Sinha, Statistical Mechanics – (TMH) 8. Zemansky Heat and Thermodynamics-, McGraw-Hill	

AUPY441 – ELECTRODYNAMICS	
Total Teaching Hours for Semester:54	**No of Lecture Hours/Week:3**
Max Marks:80	**Credits:3**
Course Outcomes	
Chapters: Electrostatics, Magnetostatics, Electromagnetic induction, Electromagnetic waves, Transient current, Alternating current and Circuit theory The students may be able to learn **CO1** the basic knowledge about the laws in electrostatics **CO2** the discussions on the electric field, potential and charge distribution **CO3** the explanations of the concepts of polarization and electric field in matter	

CO4 the discussion on the laws in magnetostatics.

CO5 the explanations of vector potential and magnetic intensity.

CO6 the basics of electromagnetic induction and Maxwell's equations

CO7 the different aspects of electromagnetic waves

CO8 the discussions on the growth and decay of electric current.

CO9 the explanation of charging and discharging in a capacitor

CO10 the discussions on various ac circuits and bridges

CO11 the analysis of Thevenin's and Norton's theorems, maximum power transfer theorems

Unit-1 Electrostatic Field	**Teaching Hours:10**
Electric field*: Introduction*, Coulomb's Law*, Electric field*, continuous charge distribution* Divergence and curl of electrostatic fields; Field lines, flux and Gauss' law, the divergence of E, applications of gauss's law, the Curl of E Electric potential: Introduction to potential, Comments on potential, Poisson's and Laplace's equations, Potential of a localized charge distribution, electrostatic boundary. Work and energy in Electrostatics: The work done to move a charge, the energy of a point charge distribution, The energy of a continuous charge distribution.	
Unit-2 Electrostatic fields in matter	**Teaching Hours:8**
Polarization: Dielectrics, induced dipoles, Polarization, The field of a polarized object: Bound charges, Physical interpretation of bound charges, and the field inside a dielectric Electric displacement: Gauss's law in the presence of dielectrics, Boundary conditions	
Unit-3 Magnetostatics	**Teaching Hours:14**
Introduction*, The Biot-Savart law*, Ampere's force law*, Magnetic torque,Magnetic flux and gauss's law for magnetic fields, Magnetic vector potential, Magnetic intensity and Ampere's circuital law, Magnetic materials.	
Unit-4 Electromagnetic Induction	**Teaching Hours:6**
Electromotive force: Ohm's law, Electromagnetic induction: Faraday's law, the induced electric field Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations in matter, Boundary conditions.	
Unit-5 Electromagnetic waves	**Teaching Hours:6**

Waves in one dimension: The wave equation Electromagnetic waves in vacuum: The wave equation for E and B, Monochromatic plane waves, Energy and momentum in electromagnetic waves

Unit 6-Transient currents	**Teaching Hours:6**

Growth and decay of current in LR and CR circuits-Measurement of high resistance by leakage- Charging and discharging of a capacitor through LCR circuit.

Unit 7-Alternating current	**Teaching Hours:6**

AC through series LCR (acceptor circuit) and parallel LCR circuit (rejecter circuit)- Q- factor, Power in AC-power factor - AC bridges Maxwell's L/C bridge and Owens's bridge.

Unit 8-Circuit Theory	**Teaching Hours:4**

Ideal voltage and current sources- Thevenin's and Norton's theorems, Maximum power transfer theorem, h parameters applied to two port networks

* Revision topics

Book for study and reference.

1. **David J Griffith, Electrodynamics - (PHI 3rd edition)**
2. **Murugesan, Electricity and Magnetism- (S.Chand & Co.)**
3. **K. K.Tiwari, Electricity and Magnetism- (S.Chand & Co.)**
4. Bhag Guru and Huseyin Hizirogulu, Electromagnetic theory fundamentals- (Cambridge University Press 2nd edition)
5. E.M. Purcell, Electricity and Magnetism –, Berkley Physics course, Vol.2 (MGH)
6. J.H. Fewkes & John Yarwood, Electricity and Magnetism(University tutorial press
7. D.C.Tayal Electricity and Magnetism (Himalaya Publishing Co)
8. Muneer H. Nayfeh & Norton K. Bressel, Electricity and Magnetism_ - (John Wiley & Sons)
9. Walter Greiner, Classical Electrodynamics- (Springer International Edition)
10. Jordan & Balmain, Electromagnetic waves and radiating systems- (PHI)
11. B.B.Laud, Electromagnetics, (Wiley Eastern Ltd.2nd edition)
12. Reitz &Milford, Introduction to electrodynamics- (Addison Wesley)

Topics for discussion in Tutorial session/Assignments (sample)

1. Electrostatic energy is stored in a field' Comment.
2. Discuss the electrostatic properties of conductors.

3. What is meant by electrostatic shielding? Discuss?
4. Discuss the peculiarities of electric displacement D and electric field E. How they are incorporated in Maxwell's Equations?
5. Discuss the properties of linear dielectrics. What differentiates a dielectric to be linear or not?
6. Discuss on the applications of Ampere's circuital law.
7. Compare electrostatics and magnetostatics.
8. Why magnetic forces cannot do work?
9. Discuss about cyclotron motion & cycloid motion.
10. Discuss whether there existed any stand-off between ohm's law and Newton's second law
11. A battery has an *emf*. Can this *emf*. is a 'force' ? How will you interpret electromotive force?
12. Discuss the role of motional *emf* in power generation
13. Discuss the orthogonality of E, B and propagation vector k
14. A wave function can have a sinusoidal representation. Solve the wave equation for this function and discuss the various terms related to a wave such as amplitude, frequency, phase, wave number, frequency etc.
15. Complex representation of wave function has good advantage. Why? Discuss the linearity of wave function. (use complex notation)
16. Discuss AC through LC, LR and CR circuits
17. Show that sharpness of resonance is equal to Q- factor
18. What is a choke coil? Discuss the advantage of using a choke coil instead of a resistor

AUPY541: METHODOLOGY IN PHYSICS & RELATIVISTIC MECHANICS	
Total Teaching Hours for Semester:72	**No of Lecture Hours/Week:4**
Max Marks:80	**Credits:4**
Course Outcomes	

This course is a gateway to a research career in scientific institutions. Students who complete this course may be able to

CO1: learn the objectives and motivation in research

CO2: acquire a deep knowledge about the experimentation, observation, data collection

CO3: do the interpretation and analysis of research data
CO4: attain a deep knowledge about different types of analysis.
CO5: do the error analysis
CO6: draft a thesis or dissertation.

CO7: write research papers for publication

CO8: know the basics of entry into advanced research in specialized fields in reputed institutions

CO9: attain knowledge about the frames of reference and Galilean transformation

CO10: understand the basic idea about the special theory of relativity

Unit-1 Introduction	**Teaching Hours:10**

Objectives and motivation in research, research approaches, significance of research, different methods of research, characteristic features of scientific method, different steps of scientific research, literature survey, purposes of literature survey, criteria of good research, features for selecting a problem, scientific researches in India.

Unit-2 Experimentation & Analysis	**Teaching Hours:12**

Design of an experiment; experimentation; observation; data collection; interpretation and deduction, repeatability and replication; Documentation of experiments, Types of experiments. Types of analysis, Statistical testing of hypothesis, null hypothesis, and Significance test; Statistics based acceptance or rejection of a hypothesis. Deduction of scientific correlation, patterns and trends.

Unit-3 Error Analysis	**Teaching Hours:10**

Basic ideas of error measurement, uncertainties of measurement, importance of estimating errors, dominant errors, random errors, systematic errors, rejection of spurious measurements Estimating and reporting errors, errors with reading scales, number of significant digits, absolute and relative errors, standard deviation, error bars and graphical representation.

Unit-4 Familiarization in Thesis/dissertation writing and Publication of results in a Journal	**Teaching Hours:8**

Thesis/dissertation writing:- Preliminary section (title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface, acknowledgement), main text (abstract, introduction, experimental section, results and discussion), conclusion, references, scope of future study. Paper writing:- general format for a science journal (title of the work- author/authors name- address of the author- abstract- key words- introduction- theory/experimental section- analysis/discussion of results- summary/conclusion- references- list of tables- list of figures). *(Book 1, 2 and 6)*

Unit-5 Hamiltonian dynamics	**Teaching Hours:7**

Generalized momentum and cyclic coordinates -Hamiltonian function H – conservation of energy – Hamilton's equations –examples of Hamiltonian dynamics – one dimensional harmonic oscillator-two dimensional harmonic oscillator using Cartesian coordinates (comparison of Newtonian, Lagrangian and Hamiltonian approach

Unit 6- Frames of reference and Galilean transformation	**Teaching Hours:5**

Inertial frames of reference-Galilean transformation-non-inertial frames -reference frame with translational acceleration-uniformly rotating frame- fictitious forces-centrifugal forces and coriolis forces.

Unit 7- Special theory of relativity	**Teaching Hours:20**

Origin and significance of special theory of relativity – search for universal frame of reference – Michelson-Morley experiment – postulates of special theory of relativity– consequences – Lorentz transformation equations – kinematical consequences of Lorentz Transformation – length contraction – time dilation – twin paradox - transformation of velocity – causality and maximum signal velocity – relativistic optical shifts – space like and time like intervals – variation of mass with velocity – mass energy equivalence – transformation of relativistic momentum and energy – tachyons –four vector and their transformation – experimental evidence for special theory of relativity.

Book for study and reference.

1. **C.R.Kothari; Research methodology-methods and techniques, New age International publishers**
2. **Bass, Joel, E and et.al. Methods for Teaching Science as Inquiry, Allyn & Bacon,**

2009

3. **Hewitt, Paul G, Suzanne Lyons, John A. Suchocki & Jennifer Yeh, Conceptual Integrated Science, Addison-Wesley, 2007**
4. Newton RG. The Truth of Science: New Delhi, 2nd edition
5. John R. Taylor. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, Univ. Science Books
6. Yarwood and Wittle; Experimental Physics for Students, Chapman & Hall Publishers.
7. Chopra S.C and Cande R.D, Introduction to computers for Engineers, TMH
8. Sanjay Saxena, A first course in computers, Vikas Publishing House Pvt Ptd.
9. http://www.upscale.utoronto.ca/PVB/Harrison/ErrorAnalysis/
10. **H.S.Hans and S.P.Puri Mechanics (Tata-McGraw Hill).**
11. **J C Upadhyaya Classical Mechanics (Himalaya Publishing House)**
12. **R.G.Thakwale and P.S.Puranik, Introduction to classical mechanics – (Tata- McGraw Hill).**

Topics for assignments (sample)

1. Make a sample data and prepare a model of thesis (report) for an exercise (content can be blank paragraphs or with dashed lines).
2. Collect data based on a topic. Eg.“ Use of mobile phones and electronic gadgets among the students in your college” and write a thesis model (strictly following the format of thesis writing).
3. Make a sample data and prepare a model paper for publication as an exercise (content can be blank paragraphs or with dashed lines).
4. Prepare a model article based on a topic, say “Use of internet among the students in your college” for publication (strictly following the format of journal publication).

AUPY542- QUANTUM MECHANICS

Total Teaching Hours for Semester:72	**No of Lecture Hours/Week:4**
Max Marks:80	**Credits:4**

Course Outcomes	
Students who complete this course may be able to **CO1:** understand the emergence of quantum mechanics **CO2:** get idea of wave function and its statistical interpretation **CO3:** state and apply the postulates of quantum mechanics to predict the outcome of measurement on model systems **CO4:** apply principles of quantum mechanics to calculate observables on known wave functions **CO5:** solve stationary states like infinite square well, harmonic oscillator and free particle **CO6:** understand the mathematical foundations of quantum Mechanics **CO7:** solve the Schrodinger equation for simple configurations.	
Unit-1 The Emergence of Quantum Mechanics	**Teaching Hours:14**
Black body radiation- photoelectric effect- The Compton effect-wave properties of matter and electron diffraction-The Bohr atom -The Rutherford planetary model-The Bohr postulates-The correspondence principle. *Book 1; Chapter 1.*	
Unit-2 The Wave Function	**Teaching Hours:8**
The Schrödinger equation-The statistical interpretation-probability-normalization-momentum-The uncertainty principle- postulates of quantum mechanics**.** *Book 2; Chapter 1 & Book 3*	
Unit-3 The Time -Independent Schrödinger Equation	**Teaching Hours:30**
Stationary states-infinite square well- The harmonic oscillator-free particle-The Delta-Function potential-The finite square well**.** *Book 2; Chapter 2 & Book 3*	
Unit-4 Formalism	**Teaching Hours:20**
Linear algebra-Function spaces-The generalized statistical interpretation-The generalized uncertainty principle. *Book 2; Chapter 3 & Book 3.*	
Book for study and reference.	
1. Stephen Gasiorowicz, Quantum Physics (3/e) - John Wiley and Sons (2003).	

2. **D.J.Griffiths Introduction to Quantum Mechanics –, PHI (1995).**
3. **G. Aruldhas Quantum Mechanics –, PHI.**
4. W. Greiner Quantum Mechanics: An Introduction (4/e), , Springer (2001)
5. Y. Peleg, R.Pnini, E.Zaarur Schaum's Outline of Theory and Problems of Quantum Mechanics, , Schaum's outline series, MGH (ISBN 0070540187)
6. P.M.Mathews and S.Venkatesan, A Text book of Quantum Mechanics, TMH.
7. Ghatak and Lokanathan, A text book of Quantum Mechanics.
8. R. Shankar Principles of Quantum Mechanics (2/e), ISBN0-306-44790-8, Plenum Press.

AUPY543-ELECTRONICS

Total Teaching Hours for Semester:72	**No of Lecture Hours/Week:4**
Max Marks:80	**Credits:4**
Course Outcomes	

Chapters: Diode Circuits, Transistor, Large signal (power) amplifiers Feedback & Oscillator circuits, Modulation, Field Effect Transistor,Operational amplifiers.

Students who complete this course may be able to

CO1 get basic ideas about the theory of semiconductors

CO2 understand the basics of p-n junction diode and different types of diodes

CO3 understand the transistor circuits, biasing and amplifiers

CO4 understand the basics of different types of power amplifiers

CO5 get ideas of feedback and different types of oscillators

CO6 get knowledge on the principles of modulation and communication

CO7 analyse JFET, MOSFET, UJT and SCR

CO8 attain the basic ideas of differential and operational amplifiers.

Unit-1 Diode Circuits	**Teaching Hours:14**

Extrinsic semiconductor – n-type and p-type semiconductors - PN junction –PN junction under forward and reverse biased conditions – r m s value and peak inverse voltage – diode characteristics - ac and dc resistances - half wave and full wave rectifiers (average dc value of current, ripple factor and efficiency) - different types of

filters (shunt capacitor, LC and CLC) - breakdown mechanism in diodes - Zener diode-voltage regulator- LED (theory and application)-solar cell-photodiode-Tunnel diode-theory, characteristics and working. *[Ref. 1: Chapter. 2, Ref. 2: Chapter 17, Ref. 3: Chapter 9]*	
Unit-2 Transistor	**Teaching Hours:18**
Theory of BJT operation - CB, CE and CC characteristics - alpha and beta and gamma - relation between transistor currents - biasing circuits (CE configuration) - stability factors - selection of operating point - ac and dc load lines -Q point- collector feedback; base resistor and potential divider methods - small signal BJT amplifiers - input and output resistances - graphical analysis of the small signal CE amplifier (frequency response, band width and gain in dB) - small signal CC amplifier (emitter follower) - h parameter - h parameter model equivalent circuit - effect of Q point on AC operation. *[Ref. 1: Chapter 4, Ref. 2: Chapter18]*	
Unit-3 Large signal (power) amplifiers	**Teaching Hours:6**
Amplifier classes and efficiency - class A operation - transformer coupled class A amplifier - class B amplifier - push pull amplifier - basic ideas of class AB and class C operation - multi stage amplifiers - frequency responses - distortion in amplifiers. *[Ref. 2: Chapter. 22]*	
Unit-4 Feedback & Oscillator circuits	**Teaching Hours:8**
Feedback principles – negative feedback – emitter follower – advantages of negative feedback - positive feedback - principle of sinusoidal feedback oscillation - Barkhausen criterion for oscillations - RC phase shift, Wien bridge, Hartley, Colpitt's, and Crystal oscillators (derivations not required). *[Ref. 1: Chapter. 6, Ref. 2: Chapter. 25]*	
Unit-5 Modulation	**Teaching Hours:6**
Fundamentals of modulation - AM, FM and PM -Analysis of AM- frequency spectrum of AM - power in AM - modulated class C amplifier - linear demodulation of AM signal - frequency spectrum for FM - super heterodyne AM receivers. *[Ref. 1: Chapter.14]*.	
Unit 6 Field Effect Transistor	**Teaching Hours:8**
JFET- Basic construction - Theory of operation - Static characteristics - Drain characteristics- Advantages - MOSFET – Depletion enhancement MOSFET – Construction – Static characteristics. Uni-junction Transistor - Construction- operation Silicon	

Controlled rectifier - Construction- biasing - operation-applications. *[Ref. 2: Chapters. 15 & 16, Ref. 3, Ref. 4: Chapter. 4]*

Unit 7 Operational amplifiers IC741)	**Teaching Hours:12**

Introduction – Schematic symbol and pin configuration - circuit configuration and block diagram representation – ideal OP amp.- equivalent circuit – CMRR – dual input, balanced output differential amplifier - voltage gain, input and output resistances – differential mode and common mode – virtual ground principle – parameters of OP amp. - inverting amplifier - non inverting amplifier - differential amplifier - summing and subtractor amplifiers. *[Ref. 1: Chapter. 7, Ref. 4: Chapter. 16]*.

Book for study and reference.

1. **Santiram Kal Basic electronics.**
2. **B. L. Theraja Basic electronics.**
3. **V. K. Mehta Principles of electronics.**
4. **Anwar A. Khan, Kanchan K. Dey A first course in Electronics.**
5. **Theodore F.Bogart,Jr Electronic Devices and Circuits-. – Universal book stall**
6. **Robert Boylestad & Louis Nashelski Electronic devices and Circuit theory- Vth edition PHI**
7. **John D Ryder Electronic fundamentals & applications-Prentice Hall IndiaPvt.Ltd.**
8. **Dennis Roddy, John Coolen, Electronic Communications, Fourth edition.**

Topics for assignments/discussion in the tutorial session (sample)

1. Electronic projects using flip flops
2. Electronic projects using logic gates
3. Electronic projects using IC 741 OP amp.
4. Electronic projects using timer 555
5. Electronic projects using IC 311
6. Constant voltage power supplies
7. Constant current sources
8. Oscillators of different frequencies
9. Low range frequency generators
10. High range frequency generators

11. Voltage regulated dc power supplies with variable output
12. Voltage regulated dual power supplies with variable output
13. Instrument for the measurement of capacitance
14. Instrument for the measurement of dielectric constant of a liquid/ solid
15. Effect of temperature on electronic components

AUPY544- ATOMIC AND MOLECULAR PHYSICS

Total Teaching Hours for Semester:72	**No of Lecture Hours/Week:4**
Max Marks:80	**Credits:4**
Course Outcomes	

Students who complete this course may be able to

CO1: understand the importance of models in describing the properties of atom.

CO2: get an idea about the atomic spectra.

CO3: get a thorough fundamental knowledge about the different spectroscopic techniques.

Unit-1 Vector Atom Model	**Teaching Hours:10**

Bohr's theory, correspondence principle. Somerfield's atom model and explanation of fine structure of H line in Balmer series of hydrogen atom. Limitation of sommerfield atom model. Vector atom model- Various quantum numbers associated with vector atom model-, L.S andj.j couplings –application of spatial quantization- Pauli's exclusion principle -periodic classification of elements –some examples of electronic configuration with modern symbolic representations- magnetic dipole moment of electron due to orbital and spin motion - Stern and Gerlach experiment-Spin-Orbit coupling. *(Ref: 2, art. 6.1 to 6.21, pages 98-112).*

Unit-2 Atomic Spectra	**Teaching Hours:14**

Optical spectra-Spectral terms and notations - selection rules - intensity rule and interval rule - fine structure of sodium D lines – hyperfine structure-alkali spectra - Zeeman Effect - Larmor's theorem – quantum mechanical explanation of normal Zeeman Effect. Anomalous Zeeman Effect –Paschen-Back effect-Stark effect. *(Ref: 2, art.6.22 to 6.28)*

Unit-3 X-ray Spectra	**Teaching Hours:8**
Introduction-production of X-ray-properties of X-rays-continuous and characteristics X- ray spectrum-Origin of X-rays-Moseley's law-absorption of X-rays-hydrogen like character of X-ray spectrum-X-ray absorption spectrum.*(Ref: 3, art.6.1 to 6.7, pages 147-158 & Ref: 2, art 26.6, pages 386-387).*	
Unit-4 Molecular spectra	**Teaching Hours:28**
Molecular orbital-hydrogen molecule ion-hydrogen molecule-hybridization electromagnetic spectra-molecular energies-classification of molecules-rotational spectra of diatomic molecules-rotational energy levels-selection rules-rotational spectrum-isotope effect- bond length and atomic mass. Diatomic vibrational spectra-vibrational energy levels-selection rule-vibrational transitions-Rotation-Vibration transitions-I.R spectrometer-electronic spectra sequences and progressions-Frank-Condon principle -Raman scattering-quantum\ theory of Raman scattering-classical description of Raman scattering-vibrational Raman spectra-diatomic molecules-polyatomic molecules-rotational Raman spectra- Raman spectrometer. *(Ref: 1 appendix C& art. 9.1 to 9.12.5, pages 166-188,417-419)*	
Unit-5 Resonance Spectroscopy	**Teaching Hours:12**
NMR principle-Resonance condition-NMR spectrometer-chemical shift-indirect spin-spin interaction applications of NMR spectroscopy.ESR principle- Resonance condition -ESR spectrometer-hyperfine interaction-applications of ESR spectroscopy. Moss Bauer spectroscopy principle -isomer shift. *(Ref: 1 art. 9.13.1 to 9.15.2, pages 189-200).*	
Book for study and reference.	
1. G.Aruldas and P.Rajagopal Modern Physics, PHI, New Delhi, 2005. **2. R.Murugesan Modern Physics, S.Chand& Co., Reprint, 2008.** **3. N.Subramaniam&Brijlal, Atomic and Nuclear Physics- S.Chand& Co.** **4. J.B.Rajam Atomic Physics, S.Chand&Co.** **5. A.Beiser Concepts of Modern Physics by,Tata McGraw-Hill,New Delhi,6th Edn** **5. Banwell Fundamentals of Molecular Spectroscopy - (TMH)** **6. Walker & StrawSpectroscopy-, Chapman & Hill.** 7. **G.Aruldas Molecular Spectroscopy PHI.**	
Topics for assignments/discussion in the tutorial session (sample)	

1. History of atom model
2. Rutherford experiment leading to atom model
3. Bohr model of atom and correspondence principle.
4. Molecular bond and electron sharing.
5. Width of spectral lines.
6. Spectroscopic techniques.
7. X-ray diffraction for identification of samples

AUPY581-OPEN COURSES

(54 HOURS-2CREDITS)

AUPY581.b. ASTRONOMY AND ASTROPHYSICS

(54 HOURS-2CREDITS)

Total Teaching Hours for Semester:54	**No of Lecture Hours/Week:3**
Max Marks:80	**Credits:2**
Course Outcomes	

Students who complete this course may be able to

CO1: understand the basic ideas of the science of Astronomy

CO2: understand the historical developments in Astronomy and Astrophysics.

CO3: get an idea on the origin of the Universe and celestial bodies in the sky.

CO4: get a thorough knowledge on the Solar system, about seasons and development of calendar.

Unit-1 Introduction	**Teaching Hours:4**

Astronomy and Astrophysics, Importance of Astronomy, Methods of Astronomy and Astrophysics**,** The Scientific Methods, Scope of Astronomy.*(Book 2, Chapter 1, P 1 – 6)*

Unit-2 Astronomy	**Teaching Hours:15**

Birth of the Universe, Ancient astronomy, Medieval Astronomy, Renaissance Astronomy, Modern Astronomy.*(Book 1, Chapter 4, 5, P 65-70, 78-101)*

Unit-3	**Teaching Hours:15**
The Objects in the Sky The Microwave background radiation, The Sun, The Stars, Neutron Stars and Black holes, Supernovae, Galaxies*.) (Book 1, Chapter 6, P 102 -127)*	
Unit-4 The Solar System	**Teaching Hours:15**
Sun and Planets, Formation of the Planets, Comets, Planets and Satellites, Asteroids, Meteorites*(Book 1, Chapter 7, P 128-154)*	
Unit-5 Earth in Space	**Teaching Hours:5**
Motion of the Earth, The Calendar, The Seasons.*(Book 1, Chapter 8 , P 155 -162)*	
Book for study and reference.	
1. Cesare Emiliani Planet Earth, , (Cambridge University Press, 1995) **2. K. D. Abhayankar Astrophysics - (University Press,2001)** 3. William Lowrie, Fundamentals of Geophysics (Cambridge University Press,1997) 4. R. Murugeshan, Kiruthika Sivaprasath, Modern Physics- (2007), S.Chand &Company Ltd. 5. Baidyanadh Basu Introduction to Astrophysics. 6. C. J. Babu Modern Trends in Physics Vol I , 7. K. Harra& Keith O.Mason, Space Science –Louise (Imperial College Press,London, 2004) 8. G.K.Sasidharan, The Great Universe, S.Chand& Co New Delhi 2008	

AUPY641- SOLID STATE PHYSICS	
Total Teaching Hours for Semester:72	**No of Lecture Hours/Week:4**
Max Marks:80	**Credits:4**
Course Outcomes	
Students should gain basic knowledge of solid state physics. This indicates that the student will: **CO1 :** be able to account for interatomic forces , crystal systems and symmetries **CO2 :** be able to account for how crystalline materials are studied using X-ray and neutron	

diffraction, including the techniques of instrumentation.

CO3 : be able to study the concept of Conduction in metals and free electron model.

CO4 : be able to study on the electrical and thermal conduction in metals.

CO5 : know Bloch's theorem and what energy bands are.

CO6 : be able to account for what the Fermi surface is and how it can be measured

CO7 : know basic models of magnetism in materials

CO8 : to study on the magnetic, dielectric and Optical properties of materials

CO9 : to understand the phenomenological theory and properties of superconductors.

Unit-1 Crystal Structures and interatomic forces	**Teaching Hours:18**
Introduction-crystalline state-basic definitions-Fourteen Bravais lattices and seven crystal systems-elements of symmetry-nomenclature of crystal directions and crystal planes-Miller indices-examples of simple crystal structures-amorphous solids and liquids-interatomic forces-types of bonding. *(Book 1: Chapter 1)*	
Unit-2 X-ray, Neutron and Electron diffraction	**Teaching Hours:12**
Introduction-generation and absorption of X-rays-Bragg's law- reciprocal lattice and X-ray diffraction-diffraction condition and Bragg's law-experimental techniques-neutron diffraction-electron diffraction. *(Book 1: Chapter 3)*	
Unit-3 Conduction in metals – Free electron model	**Teaching Hours:12**
Introduction-conduction electrons-free electron gas-electrical conductivity-electrical resistivity versus temperature-heat capacity of conduction electrons -Fermi surface-electrical conductivity-effects of the Fermi surface-thermal conductivity in metals-Hall effect and magneto resistance (Book 2, ch.10 & Book 3, ch.9)-A.C conductivity and optical properties-failure of free electron model. *(Book 1: Chapter 5).*	
Unit-4 Band Theory	**Teaching Hours:5**
Bloch theorem-The Kronig -Penney model-construction of Brillouin zones- conductors, semiconductors and insulators. *(Book 2: Chapter 11, art.11.1, 11.2, 11.3, 11.11).*	
Unit-5 Magnetic Properties of materials	**Teaching Hours:8**
Introduction-review and basic formulae-magnetic susceptibility-classification of materials-Langevin diamagnetism-Para magnetism-magnetism in metals- ferromagnetism in insulators-antiferromagnetism and ferromagnetism-ferromagnetism in metals-ferromagnetic domains. *(Book 1: Chapter 9, art.9.1 to 9.11).*	

Unit 6 Dielectric and Optical properties of materials	**Teaching Hours:9**
Introduction-dielectric constant and polarisability-local field-sources of polarisability- dipolar polarisability- dipolar dispersion-dipolar polarization in solids-ionic polarisability-piezielectricity-ferroelectricity. Absorption processes-photoconductivity-photoelectric effect-photovoltaic effect- photolumonescece-colour centres. *(Book 1: Chapter 8, Book 2: Chapter 15, art. 15.1 to 15.6).*	
Unit 7 Superconductivity	**Teaching Hours:**
Introduction- Zero resistance-perfect diamagnetism -The Meissner effect-The critical field-Type I & II superconductors -intermediate state -electrodynamics of superconductors-BCS Theory of superconductivity- tunneling and the Josephson Effect. *(Book 1: Chapter 10).*	
Book for study and reference.	

1. **M.A. Omar Elementary Solid State Physics – Principles and Applications.**
2. **M.A.Wahab, Solid State Physics – Structure and Properties of Materials, , 2nd Edition Narosa Publishing House.**
3. C. Kittel Introduction to Solid State Physics, Wiley & Sons, 7th Edn.
4. A. Beiser Concepts of Modern Physics by, Tata McGraw Hill, 5th Edn, 1997.
5. Saxena-Gupta-Saxena Fundamentals of Solid State Physics, 9th Edn (2004-05), Pragathi Prakasan, Meerut.
6. D.Halliday, R.Resnick and J.Walker, Fundamentals of Physics, 6th Edn, Wiley. NY, 2001.
7. D.Halliday, R.Resnick and K.S.Krane, Physic s, 4th Edn, Vols I, II & II Extended by,Wiley, NY. 1994.
8. R. P. Feynman, RB Leighton and M Sands,The Feynman Lectures on Physics, VoIs. I, II, and III, Narosa, New Delhi, 1998.
9. H.P.Myers Introductory Solid State Physics, Viva books, New Delhi, 1998

AUPY642 – NUCLEAR AND PARTICLE PHYSICS

Total Teaching Hours for Semester:72	**No of Lecture Hours/Week:4**
Max Marks:80	**Credits:4**
Course Outcomes	

Students who complete this course may be able to

CO1: understand the importance of models in describing the properties of nuclei

CO2: make quantitative estimates of phenomena involving nuclei

CO3: attain phenomenological understanding of fundamental interactions

CO4: understand the quark model and modern classification of elementary particles

CO5: understand how various types of nuclear radiation detectors and accelerators work and understand differences between them

CO6: make quantitative estimates for nuclear phenomena

CO7: achieve basic understanding of the Standard Model employed in particle physics.

Unit-1 Introduction to the nucleus	**Teaching Hours:14**

Constituents of nuclei- nuclear charge -binding energy-angular momentum of the nucleus-magnetic moment-nuclear quadruple moment-nuclear stability-models of nuclear structure-The liquid drop model-shell model-collective model. *(Book 2, art.17.1-17.13, pages 322-343 & Book 1, art. 27.1-27.12, pages 391-405).*

Unit-2 Radioactivity	**Teaching Hours:10**

Alpha, beta and gamma rays - rate of decay-half life and mean life-units of radioactivity-conservation laws in radioactive series-decay series-radioactive equilibrium-secular and transient equilibrium -radioactive dating-range of alpha particles-Geiger-Nuttal law- alpha decay- Gamow's theory-alpha particle disintegration energy-beta ray spectra-magnetic spectrograph-origin of line and continuous spectrum -neutrino energy of beta decay-gamma decay-radio isotopes-applications. *(Book 2, art. 18.1-18.10.1, p. 344-364 & Book 1, art. 31.1-31.36, p. 442-476).*

Unit-3 Nuclear forces	**Teaching Hours:8**

Two-nucleon system, deuteron problem-nucleon-nucleon potential-spin and magnetic moment-

results of proton-proton and proton-neutron scattering experiments-meson theory of nuclear forces. *(Book 2 art. 17.11.1-17.13, pages 337-343).*

Unit-4 Nuclear radiation detectors and particle accelerators	**Teaching Hours:8**

G.M Counter-scintillation counter-Van de Graf generator-cyclotron-synchrocyclotron-betatron. *(Book 1 art. 30.1-30.8, pages 428-441 & Book 2 art. 20.1-20.2, pages 382-385)*

Unit-5 Nuclear reactions	**Teaching Hours:10**

The Q value equation for a nuclear reaction-threshold energy-nuclear reactions - conservation laws-energy balance in nuclear reaction and Q value-threshold energy of an endoergic reaction-scattering cross section-determination of cross section-reaction mechanism-compound nucleus. *(Book 1 : art. 3 4.1-34.8, pages 483-491 & Book 2 art. 19.3-19.3.1, pages 368-369)*

Unit 6 Nuclear fission and fusion	**Teaching Hours:12**

Nuclear fission-energy released in fission-Bohr and Wheeler's theory-chain reaction-multiplication factor-critical size-atom bomb-nuclear reactors-breeder reactors-uses of nuclear reactors. Nuclear fusion-sources of stellar energy-thermonuclear reactions-hydrogen bomb-controlled thermo-nuclear reactions-magnetic bottle-Tokamak- inertial confinement-nuclear power in India. *(Book 1 art. 35.1 -35.9, pages 503-516 & Book 3, pages 566 -577)*

Unit 7 Cosmic rays and elementary Particles	**Teaching Hours:10**

Discovery of cosmic rays -latitude effect-altitude effect- primary cosmic rays - secondary cosmic rays-cosmic showers-origin of cosmic rays. Fundamental interactions in nature-classification of elementary particles-conservation law s-lepton conservation-baryon conservation-strangeness-iso-spin-hyper charge-resonance particles-The quark model-Bremstrahling effect-Cerenkov radiations. *(Book 1, pages 523-529 & Book 2, pages 394 -412 & Book 3, pages 159-161).*

Book for study and reference.

1. **1. R. Murugesan Modern Physics, S. Chand & Co., Reprint, 2008.**
2. **G. Aruldas and P. Rajagopal Modern Physics-, PHI, New Delhi, 2005.**

3. **D. C. Tayal, Nuclear Physics –, Himalaya Publishing House, 4th Edn.**
4. A.Beiser Concepts of Modern Physics,Tata McGraw-Hill, NewDelhi, 6th Ed.
5. N .Subramaniam and Brijlal Atomic and Nuclear Physics –, S.Chand & Co.
6. N.Ghoshal Nuclear Physics – S, S.Chand & Co.
7. Kaplan "Nuclear Physics (Narosa)
1. J.B.Rajam, Atomic Physics –, S.Chand & Co.

Topics for assignments/discussion in the tutorial session (sample)

1. Fusion reactors.
2. History of the Universe (elementary particle).
3. Linear accelerator.
4. Ionization chamber and Wilson cloud chamber.
5. Solid state detectors and proportional counter.

AUPY643- CLASSICAL AND MODERN OPTICS

Total Teaching Hours for Semester:72	**No of Lecture Hours/Week:4**
Max Marks:80	**Credits:4**
Course Outcomes	

Students who complete this course may be able to

CO1: understand the broad discipline of optics and its role in the modern society
CO2: get a thorough fundamental knowledge of interferometry, coherence, polarization and diffraction.
CO3: get a thorough knowledge of the polarization of light and its changes upon reflection and transmission
CO4: get acquainted with Fresnel's and Fraunhofer's diffraction and their validity requirements
CO5: distinguish between normal and anomalous dispersion, principle of holography and its applications
CO6: attain knowledge on different light sources including lasers
CO7: understand the differences between Step Index and Graded index fibers, single mode and multimode fibers
CO8: understand the advantages of fiber optic communication system.

Unit-1 Interference of light	**Teaching Hours:12**
The principle of superposition - coherent sources –Double slit interference (theory of interference fringes and band width)- Interference by division of wave front and amplitude– Fresnel's biprism - interference in thin films – fringes of equal inclination- fringes of equal thickness - wedge shaped films- testing of optical flatness - Newton's rings (reflected system)- refractive index of a liquid - Michelson interferometer –determination of wavelength*(Book 1: Chapter 14 & 15 and Book 3: chapter 12 & 13)*	
Unit-2 Diffraction	**Teaching Hours:12**
Fresnel diffraction: - Half-period zones - explanation of rectilinear propagation of light– diffraction at a straight edge-zone plate. Fraunhofer diffraction: - Diffraction at a single slit, double slits – plane transmission grating - Rayleigh's criterion for resolution - resolving power of diffraction grating. *(Book 1: Chapter 17, 18 & 19 and Book 3: Chapter 16 & 17)*	
Unit-3 Polarisation	**Teaching Hours:12**
Plane polarized light - polarization by reflection – Brewster's law - pile of plates - Malus law - Double refraction - Huygens explanation for double refraction in uniaxial crystals - Nicol prism - Nicol prism as a polarizer and analyzer – Theory of production and analysis of plane, circularly and elliptically polarized light - quarter and half wave plates. *(Book 1: Chapter 20 and Book 3: chapter 19).*	
Unit-4 Dispersion	**Teaching Hours:6**
Normal dispersion - Elementary theory of dispersion - Cauchy's and Hartmann dispersion formula - anomalous dispersion *(Book 2: Chapter 11).*	
Unit-5 Fibre Optics	**Teaching Hours:8**
Introduction, optical fibre, the numerical aperture, coherent bundle, pulse dispersion in step index fibre, graded index fibre, single mode fibre, multimode fibre, Fibre optic sensors (qualitative), fibre optic communication (qualitative), Advantages of fibre optic communication system. *(Book 1: Chapter 24 and Book 3: chapter 24)*	

Unit 6 Holography	**Teaching Hours:8**
Principle of holography, recording of holograms, reconstruction of images (Theory not needed), application of holography, different types of holograms, transmission and reflection types. *(Book 1: Chapter 23).*	
Unit 7 Laser	**Teaching Hours:14**
Basic principle of laser operation Einstein coefficient, light propagation through medium and condition for light amplification population inversion by pumping and cavity threshold condition, line shape function- optical resonators (qualitative) Q factor various laser systems – Ruby laser - He-Ne laser, Dye laser, semiconductor laser, (working principle only) Application of lasers-characteristics of laser beams -spatial coherence -Temporal coherence and spectral energy density Nonlinear optics : Nonlinear Polarization –second harmonic generation – phase matching. *(Book 2: Ch. 12, Book 1: Ch. 22, Book 3: chapter 23 and Book 4: Ch. 6).*	
Book for study and reference.	
1. Subramaniam & Brijlal, M.N.Avadhanulu, Text Book of Optics., 23rd edition (2006) **2. R.Murugesan, Optics and spectroscopy -.** **3. Ajoy Ghatak, Optics -** **4. K.R.Nambiar, Lasers: Principles, Types and applications –** 5. P.Vivekanandan, Optics 6. Jenkins and White, Fundamentals of Optics - 7. Geoffrey Brooker,.Modern Classical Optics – 8. B. K. Mathur, Principles of Optics - 9. Khanna and Gulati, Fundamentals of Optics. 10. B. B. Laud, Lasers &Non-Linear Optics. 11. Dennis Roddy & John Coolen, Electronic Communications.	
Topics for assignments/discussion in the tutorial session (sample)	
1. Michelson's interferometer-Standardization of metre. 2. Diffraction at a rectangular aperture and circular aperture	

3. Optical activity-Fresnel's theory of optical rotation.
4. Resolving power of prism and telescope
5. Constant deviation spectrometer.
6. Laurent's half shade polarimeter.
7. Harmonic generation.
8. Laser applications.
9. Study of Fraunhofer lines using spectrometer.
10. Study of absorption spectra of KMnO4.
11. Determination of refractive index of liquid by Newton's rings method.
12. Comparison of radii of curvature by Newton's rings method.

AUPY644 - DIGITAL ELECTRONICS AND COMPUTER SCIENCE

Total Teaching Hours for Semester:72	**No of Lecture Hours/Week:4**
Max Marks:80	**Credits:4**
Course Outcomes	

Discusses the basics of digital electronics, computer fundamentals, programming in C language and computer oriented numerical methods

Students who complete this course may be able to

CO1 understand binary and hexadecimal number systems and their mathematical operations

CO2 understand Boolean algebra and logic gates

CO3 analyse arithmetic and sequential digital circuits

CO4 attain knowledge on the basics of hardware, software and memory systems

CO5 be trained in programming in C language

CO6 understand theory and problems based on iterative methods, interpolation, regression and numerical integration and differentiation.

Unit-1 Number systems	**Teaching Hours:20**

Decimal number system-binary number system-conversion of binary number to decimal and decimal number to binary-binary addition and subtraction-1's complement-2's complement-binary subtraction using 2's complement-signed arithmetic operation-conversion of real numbers-conversion

of decimal fraction to binary fraction-binary coded decimal- hexa decimal number system-conversion of hexa- decimal number to decimal, decimal to hexadecimal, binary to hexa - decimal and hexa-decimal to binary-ASCII code.*(Textbook 1)*

Boolean algebra and logic gates: - Logic gates AND, OR, NOT, NAND, NOR

And Ex-OR gate-realization of other logic functions using NAND / NOR gates-tri state logic gate-Boolean laws- Demorgan's theorem-Simplification of Boolean equations using Boolean laws. Karnaugh map *(Textbook 1)*

Arithmetic circuits:-Half adder-full adder-controlled inverter-binary adder- subtractor. *(Textbook2)*

Sequential circuits:-Flip-Flop,S-R Flip Flop,J-K Flip-flop, Master slave JK Flip- Flop *(Textbook1)*

Unit-2 Basics of computers	**Teaching Hours:10**

Hardware- input and output units- memory unit-ALU-control unit–basic operational concepts-Software – operating systems *(Textbook 3 and 4)*

Memory systems:- Basic concepts-semiconductor RAM- internal organization memory chips-static memories-asynchronous and synchronous DRAMs-structure of large memories–ROM,PROM,EPROM, EEPROM–flash memory-speed size and cost-Basic concepts of cache memory and virtual memories. Secondary storage-magnetic hard disks-optical disks-magnetic tape systems.*(Textbook 3)*

Unit-3 Programming in C	**Teaching Hours:26**

Importance of C-basic structure of C program-C constants and variables-data types-declaration of variables-assigning values to variables-defining symbolic constants-operators and expressions-input and output functions-reading and writing a character-formatted input-formatted output-control statements-simple IF -IF ELSE -nested IF ELSE-SWITCH - GOTO statements- loop control structures-WHILE - DO -FOR loops-jumps in loops- arrays and subscripted variables-functions in C- user defined functions-the form of C functions-callinga function-category of functions-recursion-standard library functions-basics of structures and pointers (introduction only)-sequential file management-defining and opening a sequential file-input and output operations on files-closing a file. Simple C programs for solving problems in physics. *(Textbook 5)*

Unit-4 Computer oriented numerical methods	**Teaching Hours:16**

Iterative methods-method of successive bisection to find the roots of an equation-Newton–Raphson iterative method-polynomial equation–interpolation-Lagrange interpolation-least

square approximation of functions-linear regression-regression coefficients-algorithm for linear regression-polynomial regression-fitting exponential functions-numerical differentiation and integration-Simpson's rule-Trapezoidal rule-algorithms for integrating tabulated function and known function–numerical solution of differential equations-Euler's method- Runge-Kutta method(second order method only) *(Text book 6)*

Book for study and reference.

1. **B. Ram, Dhanpat, Fundamentals of microprocessors and micro-computers Rai Publications (p) Ltd, NewDelhi (sixth edition)**
2. **Albert.P. Malvino and P.Leach, Digital principles and applications, TMH,New Delhi (Fourth edition)**
3. **Carl Hamcher, Zvonko Vranesic and Safwat Zaky, Computer organization (Fifth International edition Indian print)McGraw-Hill**
4. **V. Rajaraman, Fundamentals of computers PHI, New Delhi(Fourth edition)**
5. **E. Balagurusamy, Programming in ANSIC TMH Publishing company Ltd, New Delhi (Fourth edition).**
6. **V. Rajaraman, Computer oriented numerical methods PHI, New Delhi(Third edition)**
7. Introduction to digital electronics-NIIT-PHI.
8. Sanjay Saxena, A first course in Computers- -Vikas publishing house PvtLtd
9. Byron S Gottfried, Schaum series-, Theory and problems of programming with C.
10. Yashavant Kanetkar, Graphics under C- - BPB Publications-NewDelhi
11. Neil Mathew and Richard Stones, Beginning Linux programming- -Wiley India Pvt Ltd.
12. V K Mittal, RC Verma and SC Gupta Computational Physics- Ane Books India
13. Pallab, Numerical methods with Computer programs in C++-

PRACTICALS

AUPY44PI- MECHANICS, PROPERTIES OF MATTER, ERROR MEASUREMENTS,

HEAT AND ACOUSTICS

(Minimum 16 experiments to be done)

1. Simple pendulum-Study of variation of period with length, mass and amplitude.
2. Spring mass system-spring constant
3. Fly Wheel - Moment of Inertia
4. Compound Bar Pendulum – Symmetric
5. Compound Bar Pendulum – Asymmetric
6. Uniform Bending---Y---Pin and Microscope
7. Uniform bending—Y- optic lever method
8. Non-uniform bending-Y-Optic lever& telescope
9. Rigidity modulus –Static torsion
10. Torsion pendulum-Rigidity modulus
11. Kater's pendulum-Acceleration due to gravity
12. Melde's string-----Frequency of fork
13. Phase transition-determination of M.P of wax.
14. Determination of thermal conductivity of rubber
15. Lee's disc-determination of thermal conductivity of a bad conductor
16. Viscosity of a liquid-----Stoke's method
17. Viscosity-Continuous flow method using constant pressure head.
18. Viscosity-Variable pressure head arrangement
19. Surface tension-Capillary rise
20. Sonometer-frequency of A.C
21. Kundt's tube-determination of velocity of sound.
22. Comparison of least counts of measuring instruments.
23. Evaluation of errors in simple experiments.

References

1. Yarwood and Wittle; Experimental Physics for Students, Chapman &Hall Publishers.

2. Chathopadhyaya, Rakshit and Saha, An advanced course in practical physics, , New central agency, Kolkata.

3. S.Viswanathan & Co A text book of practical physics,., Chennai.

4. L.Worsnop and H.T.Flint, Advanced Practical Physics, B., Khosla Publishers, Delhi.

AUPY64PII-OPTICS, ELECTRICITY AND MAGNETISM

(Minimum 20 experiments to be done)

1. Spectrometer-A, D and n of a solid prism.
2. Spectrometer –Dispersive power and Cauchy's constants
3. Spectrometer Grating—Normal incidence- N & wavelength
4. Spectrometer-i-d curve
5. Spectrometer- Hollow prism
6. Liquid lens-refractive index of liquid and lens
7. Newton's Rings—Reflected system
8. Air wedge-diameter of a wire
9. Potentiometer-Resistivity.
10. Potentiometer-Calibration of ammeter
11. Potentiometer –Reduction factor of T.G
12. Potentiometer –Calibration of low range voltmeter
13. Potentiometer – Calibration of high range voltmeter
14. Thermo emf-measurement of emf using digital multimeter.
15. Carey Foster's bridge-Resistivity
16. Carey Foster's bridge-Temperature coefficient of resistance.
17. Mirror galvanometer-figure of merit.
18. BG- Absolute capacity of a condenser
19. Conversion of galvanometer into ammeter and calibration using digital Multimeter
20. Conversion of galvanometer into voltmeter and calibration using digital Voltmeter.
21. Circular coil-Calibration of ammeter.
22. Study of network theorems-Thevenin's & Norton's theorems and maximum power transfer theorem.
23. Circular coil-Study of earth's magnetic field using compass box.
24. Absolute determination of m and Bh using box type and Searle's type vibration magnetometers.
25. Searle's vibration magnetometer-comparison of magnetic moments.

References

1. Yarwood and Wittle; Experimental Physics for Students, Chapman & Hall Publishers.

2. Chathopadhyaya, Rakshit and Saha An advanced course in practical physics, New Central Agency, Kolkata.
3. S.Viswanathan & Co, A text book of practical physics,Chennai.
4. B.L.Worsnop and H.T.Flint, Advanced Practical Physics, Khosla Publishers, Delhi.

AUPY64PIII—ELECTRONICS AND COMPUTER SCIENCE

(Minimum 20 experiments to be done – 5 from Computer Science)

ELECTRONICS

1. PN junction Diode (Ge & Si) characteristics-To draw the characteristic curves of a PN junction diode and to determine its ac and dc forward resistances.
2. Full wave (centre tapped) rectifier-To construct a full wave rectifier using junction diode and to calculate the ripple factor with and without shunt filter (10 readings for R_L 100 Ω to 5000Ω).
3. Full wave (centre tapped) rectifier-To construct a full wave rectifier using junction diode and to study effect of L,C, and LC filters on the ripple factor (for different R_L).
4. Bridge rectifier-To construct a bridge rectifier using junction diodes and to calculate the ripple factor with and without shunt filter (10 readings for R_L 100 Ω to 5000Ω).
5. Bridge rectifier- Dual power supply-To construct a dual power supply using bridge rectifier and measure the output voltages for different pair of identical load resistors.
6. Zener diode characteristics-To draw the I-V characteristic of a Zener diode and to find the break down voltage and the dynamic resistance of the diode.
7. Zener diode as a voltage regulator-To construct a voltage regulator using Zener diode and to study the output voltage variation (i) for different RL and (ii) for different input voltage with same R_L.
8. Transistor characteristics-CE-To draw the characteristic curves of a transistor in the CE configuration and determine the current gain, input impedance and output impedance.
9. Transistor characteristics-CB-To draw the characteristic curves of a transistor in the CB configuration and determine the current gain, input impedance and output impedance.
10. Single stage CE amplifier-To construct a single stage CE transistor amplifier and study its frequency response.
11. OP amp. IC741- Inverting amplifier-To construct an inverting amplifier using IC741 and

determine its voltage gain.

12. OP amp. IC741- Non inverting amplifier

To construct a non-inverting amplifier using IC741 and determine its voltage gain.

13. OP amp. IC741- Differentiator-To construct an OP amp. Differentiator, determine its voltage gain and study the output response to pulse and square wave.

14. OP amp. IC741- Integrator-To construct an OP amp. Integrator, determine its voltage gain and study the output response to pulse and square wave.

15. Phase shift oscillator-To construct a phase shift oscillator using transistor and measure the Frequency of the output waveform.

16. Logic gates- OR and AND-To verify the truth tables of OR and AND gates using diodes.

17. Logic gate- NOT-To verify the truth tables of NOT gate using a transistor.

18. Network theorems (Superposition, Thevenin's & Norton's theorems)

To verify the (i) Superposition, (ii) Thevenin's & (iii) Norton's theorems

19. RC-Filter circuits (Low pass)-To construct an RC –low pass filter circuit and to find the upper cut off frequency.

20. RC-Filter circuits (High pass)-To construct an RC –high pass filter circuit and to find the lower cut off frequency.

COMPUTER SCIENCE (C- Programs)

1. Program to find the roots of a quadratic equation (both real and imaginary root)

2. Program to sort a given list containing the name of students and their total marks and print the rank list.

3. Programs to plot the functions Sin x, Tan x and e^{-x}.

4. Program to find the product of two n×n matrices.

5. Program to find the dot product and cross product of vectors

6. Program to simulate the trajectory of the projectile thrown (a) horizontally and (b)at an angle.

7. Program to study the motion of a spherical body in a viscous fluid.

8. Program to study the motion of a body under a central force field.

9. Program to fit a straight line through the given set of data points using least square fitting algorithm.

10. Program to integrate a given function using Simpson's rule.

11. Program to integrate a given function using Trapezoidal rule.

12. Program to find the solution of differential equation by RK2 method.

References

1. N.N. Bhargava, D.C. Kulshreshtha, S.C.Gupta, Basic electronics and linear circuits.
2. Ramakant A. Gayakwad, OP- Amps and linear integrated circuits.
3. Santiram Kal, Basic electronics.
4. B. L. Theraja, Basic electronics.
5. V. K. Mehta, Principles of electronics.
6. Anwar A. Khan, Kanchan K. Dey, A first course in Electronics

AUPY691 ELECTIVE COURSES

AUPY 691.c NANOSCIENCE AND TECHNOLOGY

Total Teaching Hours for Semester:54	**No of Lecture Hours/Week:3**
Max Marks:80	**Credits:2**
Course Outcomes	

Students who complete this course may be able to

CO1: understand the basics and advanced topics in nanoscience and nanotechnology as it is an elective paper

CO2: attain knowledge on the historical background and natural demonstrations of nanoscience and nanotechnology

CO3: explain the nanoscale paradigm in terms of properties at the nanoscale dimension

CO4: understand the concepts in materials science, chemistry, physics, biology and engineering to the field of nanotechnology.

CO5: understand the basic principles of nanoscience and nanoscale engineering

CO6: understand the basic interdisciplinary nature of nanotechnology; (physics, chemistry, electronic and mechanical properties, bio nanotechnology)

CO7: understand the basic concepts of various techniques of Synthesis and characterisation using different instrumentation tools.

CO8: familiarize the processing and characteristics of carbon nanostructures

CO9: understand thoroughly the application of Nanotechnology in industry.

Unit-1 Introduction to Nanoscience and Nanotechnology	**Teaching Hours:10**

Historical development, Natural demonstrations of nanotechnology- scope and applications *[Book 1, Chapter 1]*.

Comparison of bulk and nanomaterials-, classification of nanostructured materials: one, two and three dimensional confinement, size and dimensionality effects – quantum size effects, - conduction electrons and dimensionality, Fermi gas and density of states, Quantum wells, Partial confinement, Properties dependent on density of states, excitons**.** *[Book 2 Chapter 9.1***,** *9.3, 9.4]*

Unit-2 Properties of nanomaterials and scaling laws	**Teaching Hours:6**

Introduction, size dependent properties, Properties of nanomaterials-chemical reactivity, solubility, melting points, electronic energy levels, electrical conductivity, Superparamagnetism, Electron confinement, Integrated optics, Optical properties, Mechanical properties, Thermodynamic properties, scaling laws.*[Book 1 Chapter 3.1 to 3.4]*

Unit-3 Synthesis and characterisation	**Teaching Hours:16**

Top –Down and Bottom-Up approach Synthesis of nanoscale materials and structures, Zero Dimensional materials-Inert gas condensation, Inert gas expansion, Sonochemical processing, Sol-gel deposition, Molecular self-assembly, 1D and 2D- Foil beating, Electro-deposition,

PVD, CVD, 3D- Rapid solidification, Equiangle extrusion, Milling and Mechanical alloying, Micromachining, Consolidation of nanoclusters and milled powders, Methods for nano-profiling.*[Book 3 chapter 8.1]*

Electron microscopy, Scanning probe microscopy, Optical microscopy, XRD *[Book 4, Chapter 2.1 to 2.4, 2.6]*

IR and Raman Spectroscopy, Photoemission and X-ray spectroscopy *[Book 2 Chapter 3.4]*

Unit-4 Carbon nanostructures	**Teaching Hours:10**

Carbon nanostructures-carbon molecules, carbon clusters, Fullerene-structure of C-60 and its crystal-larger and smaller fullerenes-other bucky balls. Graphene, Carbon nanotubes-fabrication-structure-electrical properties-vibrational properties-mechanical properties. Applications of carbon nano tubes-Field Emission and shielding- computers-fuel cells-chemical sensors-catalysis-mechanical reinforcement. [Book 2, Chapter 5]

Unit-5 Nanomachines and nanodevices	**Teaching Hours:12**

Resonant Tunneling diode (RTD), Quantum Cascade Lasers, Single Electron Transistors-operating principles and applications.*[Book 5, Chapter 9.1 to 9.4]*

Book for study and reference.

1. **Thomas Varghese and KM Balakrishna, Nanotechnology, An Introduction to synthesis, Properties and Applications of Nanomaterials, Atlantic Publishers and Distributors (P) Ltd, New Delhi**
2. **Charles P. Poole Jr and Frank J Ovens, Introduction to Nanotechnology, Wiley Interscience, USA**
3. **Michael F Ashby, Paulo J Ferreira and Daniel L Schodek, Nanomaterials, Nanotechnologies and design, Elsevier Publishers, UK**
4. **T. Pradeep, Nano, The Essentials, , Tata Mc Graw Hill, New Delhi**
5. **W.R. Fahrner, Nanotechnology and Nanoelectronics, , Springer, Newyork.**
6. H.S.Nalwa, Encyclopedia of Nanoscience and Nanotechnology, (Ed),American Scientific Publishers, Los Angels
7. C.N.R. Rao and Govindraj, Nanotubes and Nanowires, RSC Publishing
8. Jeremy J Ramsden, Nanotehnology, An Introduction, Elsevier Publishers, UK

9. Mick Wilson, Kamali Kannagara, Geoff Smith, Michelle Simmons and Burkhard Raguse, Nanotechnology, Overseas Press, New Delhi
10. A. S. Edelstein and R. C. Cammarata, Nanomaterials: Synthesis, properties and applications. Institute of Physics Publishing, Bristol, UK.

FDP COMPLEMENTARY PHYSICS

SEMESTER 1 (CHEMISTRY MAIN)

AUPY131.2b – ROTATIONAL DYNAMICS AND PROPERTIES OF MATTER

(36 HOURS-2 CREDITS)

Total Teaching Hours for Semester:36	**No of Lecture Hours/Week:2**
Max Marks:80	**Credits:2**
Course Outcomes	

Students will be able to understand the

CO1: concepts of rotational dynamics of rigid bodies and their applications in bodies having different shape.

CO2 : the basics of simple harmonic motion and its applications in physics

CO3: the concept of Young's modulus, bulk modulus and shear in materials.

CO4: properties of fluids such as surface tension and viscosity and their applications with examples.

Unit-1	**Teaching Hours:26**

Dynamics of rigid bodies (7 hours)

Theorems of M.I with proof-Calculation of M.I of bodies of regular shapes rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid cylinder, solid sphere-K.E of a rotating body-spinning top.

Oscillations and waves (13 hours)

Examples of S.H oscillator-compound pendulum-determination of g-torsion pendulum-oscillations of two particles connected by a spring-vibration state of a diatomic molecule Wave motion-general equation of wave motion-plane progressive harmonic wave energy density of a

plane progressive wave-intensity of wave and spherical waves-

Mechanics of solids (6 hours)

Bending of beams-bending moment-cantilever-beam supported at its ends-and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity.

Unit-2	**Teaching Hours:10**

Surface Tension (5 hours)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger' method-equilibrium of a liquid drop over solid and liquid surfaces.

Viscosity (5 hours)

Flow of liquid through a capillary tube-derivation of Poiseuille's formula-limitations-Ostwald's viscometer-variation of viscosity with temperature-Stokes formula determination of viscosity of a highly viscous liquid by Stokes method.

Book for study and reference.

1. Mechanics: J.C.Upadhyaya, Ram Prasad & Sons

2. Oscillations & Waves: K.Rama Reddy, S.Bbadami & V.Balasubramaniam (University Press)

3. Complementary Physics, P.S.Sebastian Kunju,VAS Publications, Trivandrum

SEMESTER 2 (CHEMISTRY MAIN)

AUPY231.2b – THERMAL PHYSICS

(36 HOURS-2 CREDITS)

Total Teaching Hours for Semester:36	**No of Lecture Hours/Week:2**
Max Marks:80	**Credits:2**
Course Outcomes	

Students will be able to understand the

CO1. basics of diffusion.

CO.2. concept of conduction and radiation.

CO.3. idea about different motor engines starting from Carnot's engine.

CO.4. idea about the concept of entropy.

Unit-1 Diffusion	**Teaching Hours:4**
Graham's law of diffusion in liquids-Fick's law-analogy between liquid diffusion and heat conduction-methods of estimating concentrations-determination of coefficient of diffusivity.	
Unit-2 Transmission of Heat	**Teaching Hours:16**
Thermal conductivity and thermometric conductivity-Lee's disc experiment-Radial flow of heat-cylindrical flow of heat-thermal conductivity of rubber-Weidmann and Franz law (statement only)-Radiation of heat-black body radiation-Kirchoff's laws of heat radiation-absorptive power-emissive power-Stefan's law (no derivation) –energy distribution in the spectrum of black body and results-Wien's displacement law-Rayleigh-Jeans law-their failure and Planck's hypothesis-Planck's law-comparison solar constant-temperature of sun.	
Unit-3 Thermodynamics	**Teaching Hours:8**
Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity. Heat engines-carnot's cycle-derivation of efficiency-petrol and diesel engine cycles efficiency in these two cases-second law of thermodynamics-Kelvin and Clausius statements. Phase transition- first order and second order-liquid helium-super fluidity.	
Unit-4 Entropy	**Teaching Hours:8**
Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second law in terms of entropy-calculation of entropy when ice is converted into steam.	
Book for study and reference.	
1. The general Properties of matter: F.H.Newman & V.H.L.Searle 2. Heat & Thermodynamics: N.Subramaniam & Brijlal, S.Chand & Co 3. Heat & Thermodynamics: W.Zemansky, McGraw Hill 4. Heat & Thermodynamics: C.L.Arora. 5. Complementary Physics, P.S.Sebastian Kunju,VAS Publications, Trivandrum	

SEMESTER 3 (CHEMISTRY MAIN)

AUPY331.2b – OPTICS, MAGNETISM AND ELECTRICITY

(54 HOURS-3 CREDITS)

Total Teaching Hours for Semester:54	**No of Lecture Hours/Week:3**
Max Marks:80	**Credits:3**
Course Outcomes	

Students will be able to

CO1: understand the optical phenomena like Interference and Diffraction

CO2: understand the principle behind the experiments like Newton's rings and air wedge, diffraction grating etc.

CO3: understands the basics of the phenomena polarisation

CO4: get an idea about half wave plate, quarter wave plate, elliptically and circularly polarised light etc.

CO5: understand the basic principle of laser and optic fiber

CO6: attain knowledge on the basics of magnetic properties like para magnetism , dia magnetism and ferro magnetism

CO7: understand the theory of magnetism

CO8: understand the production of AC and its characteristics

CO9: understand the effect of passage AC through various components like Resistors, Capacitors, Inductors and their combination circuits.

Unit-1	**Teaching Hours: 34**

Interference (10 hours)

Analytical treatment of interference-theory of interference fringes and bandwidth. Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness. Newton's rings-reflected system-measurement of wavelength.

Diffraction (10 hours)

Phenomenon of diffraction-classification-Fresnel and Fraunhofer. Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge Fraunhofer

diffraction at a single slit, two slits and N slits. Plane transmission grating determination of wavelength-Resolving power of grating.

Polarisation (8 hours)

Experiments showing the transverse nature of light-plane polarized light-polarization by reflection-Brewster's law-double refraction-Nicol prism-propagation of light in uni-axial crystals-positive and negative crystals-principal refractive indices-half wave plate and quarter wave plate-elliptically and circularly polarized light-optical activity-Fresnel's theory and applications-polarimeters-determination of specific rotation.

Laser and Fibre Optics (6 hours)

Principle of operation of laser-population inversion-optical pumping-ruby laser applications of lasers. Light propagation in optical fibres-step index fibre-graded index fibre-applications.

Unit-2	**Teaching Hours:20**

Magnetism (10 hours)

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability. Magnetic properties-diamagnetism paramagnetism-ferromagnetism-antiferromagnetism. Electron theory of magnetism explanation of ferromagnetism.

Electricity (10 hours)

EMF induced in a coil rotating in a magnetic field-peak, mean, *rms* and effective values of A.C. Ac circuits-AC through RC, LC, LR and LCR series circuits resonance-sharpness of resonance-power factor and choke coil-transformers.

Book for study and reference.

1. A text book of optics – Brijlal & Subramaniam
2. Electricity and Magnetism – R.Murugeshan, S.Chand & Co Ltd.
3. A text book of B.Sc subsidiary Physics – P.Vivekanandan.
4. Complementary Physics, P.S.Sebastian Kunju,VAS Publications, Trivandrum.

SEMESTER 4 (CHEMISTRY MAIN)

AUPY431.2b– ATOMIC PHYSICS, QUANTUM MECHANICS AND ELECTRONICS

(54 HOURS-3 CREDITS)

Total Teaching Hours for Semester:54	**No of Lecture Hours/Week:3**
Max Marks:80	**Credits:3**
Course Outcomes	

Students will be able to understand the

CO1: basic features of Bohr atom model, Bohr's correspondence principle, vector atom model, various quantum numbers, Pauli's exclusion principle etc.

CO2: the basics of superconductivity, types of super conductors and applications of superconductors

CO3: the Plank's hypothesis, quantum principles, Schrodinger equation,

CO4: the concept of Schrodinger equation for a particle in a potential box

CO5: principle of spectroscopic techniques like Absorption spectra, emission spectra, etc.

CO6: basics of NMR and ESR spectroscopy

CO7: basics of electronics

CO8: working of various electronic components like diodes, transistor,

CO9: working principle of CE amplifier

Unit-1 Atomic physics	**Teaching Hours:12**

Basic features of Bohr atom model-Bohr's correspondence principle-vector atom model-various quantum numbers-magnetic moment of orbital electrons-electron spin-Spin-Orbit coupling-Pauli's exclusion principle-periodic table.

Unit-2 Superconductivity	**Teaching Hours:8**

Properties of superconductors-zero electrical resistance-Meissner effect-critical magnetic field-Type I and Type II superconductors-isotope effect-high temperature ceramic superconductors-applications of superconductors.

Unit-3 Quantum mechanics	**Teaching Hours:12**

Inadequacies of classical physics-experimental evidences-evidences for quantum theory-Planck's hypothesis-foundation of quantum mechanics-wave function and probability density-Schrodinger equation-time dependent and time independent particle in a potential box.

Unit-4 Spectroscopic Techniques	**Teaching Hours:6**

EM spectrum-UV, Visible, IR, Radio and microwave regions-principle of various spectrometers used in specific regions of EM spectrum-absorption spectroscopy emission spectroscopy-mass spectroscopy-qualitative ideas of ESR & NMR spectrometer.

Unit-5 Electronics	**Teaching Hours:16**

Current-voltage characteristics of a diode-forward and reverse bias-breakdown mechanism of p-n junction diode-zener diode and its characteristics-half wave and full wave rectifiers-bridge rectifier-ripple factor, efficiency. Construction and operation of a bipolar junction transistor-transistor configurations current components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits-fixed bias, emitter feedback bias, voltage divider bias (qualitative study only).Transistor amplifier-basic features of an amplifier-gain, input and output resistances frequency.response and band width-small signal CE amplifier-circuit and its operation.

Book for study and reference.

1. Modern Physics – R.Murugeshan, S.Chand & Co. Ltd.
2. A text book of B.Sc subsidiary Physics – P.Vivekanandan.
3. Principles of Electronics – V.K.Mehta.
4. Complementary Physics, P.S.Sebastian Kunju,VAS Publications, Trivandrum

SEMESTER 1 (MATHEMATICS MAIN)

AUPY131.2c – MECHANICS AND PROPERTIES OF MATTER

(36 HOURS-2 CREDITS)

Total Teaching Hours for Semester:36	**No of Lecture Hours/Week:2**
Max Marks:80	**Credits:2**
Course Outcomes	

Students will be able to understand the

CO1: concepts of rotational dynamics of rigid bodies and their applications in bodies having different shape.

CO2 : basics of simple harmonic motion and its applications in physics

CO3: concept of Young's modulus, bulk modulus and shear in materials.

CO4: properties of fluids such as surface tension and viscosity and their applications with examples.

Unit-1	**Teaching Hours:28**

Dynamics of rigid bodies (6 hours)

Theorems of M.I with proof-Calculation of M.I of bodies of regular shapes rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid sphere-K.E of a rotating body. Determination of M.I of a fly wheel (theory and experiment).

Oscillations and waves (15 hours)

Examples of S.H oscillator-compound pendulum-determination of g-torsion pendulum-oscillations of two particles connected by a spring-vibration state of a diatomic molecule. Wave motion-general equation of wave motion-plane progressive harmonic wave energy density of a plane progressive wave-intensity of wave and spherical waves transverse waves in stretched string-modes of transverse vibrations of strings longitudinal waves in rods and in gases.

Mechanics of solids (7 hours)

Bending of beams-bending moment-cantilever-beam supported at its ends and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity.

Unit-2	**Teaching Hours:8**

Surface Tension (5 hours)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger'method-equilibrium of a liquid drop over solid and liquid surfaces.

Viscosity (3 hours)

Flow of liquid through a capillary tube-derivation of Poiseuille's formula-limitations-Ostwald's viscometer-variation of viscosity with temperature.

Book for study and reference.

1. Mechanics: J.C.Upadhyaya, Ram Prasad & Sons

2. Oscillations & Waves: K.RamaReddy, S.Bbadami & V.Balasubramaniam (University Press)

3. Complementary Physics, P.S.Sebastian Kunju,VAS Publications, Trivandrum.

SEMESTER 2 (MATHEMATICS MAIN)

AUPY231.2c – HEAT AND THERMODYNAMICS

(36 HOURS-2 CREDITS)

Total Teaching Hours for Semester:36	**No of Lecture Hours/Week:2**
Max Marks:80	**Credits:2**
Course Outcomes	

Students will be able to understand the

CO1. the phenomenon like conduction and radiation.

CO2. basics of thermodynamic process including Carnot's cycle

CO3. Differences between a petrol engine and a diesel engine.

CO4. concept of entropy in different thermo dynamical environment.

Unit-1 Transmission of Heat	**Teaching Hours:13**

Thermal conductivity and thermometric conductivity-Lee's disc experiment-Weidmann and Franz law (statement only)-energy distribution in the spectrum of black body and results-Wien's displacement law-Rayleigh-Jeans law-their failure and Planck's hypothesis-Planck's law-comparison-solar constant-its determination temperature of sun.

Unit-2 Thermodynamics	**Teaching Hours:13**

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity. Heat engines-Carnot's cycle-derivation of efficiency-petrol and diesel engine cycles efficiency in these two cases-second law of thermodynamics-Kelvin and Clausius statements.

Unit-3 Entropy (10 hours)	**Teaching Hours:10**

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second law in terms of entropy-calculation of entropy when ice is converted into steam.

Book for study and reference.

1. Heat & Thermodynamics: N.Subramaniam & Brijlal, S.Chand & Co
2. Heat & Thermodynamics: W.Zemansky, McGraw Hill
3. Heat & Thermodynamics: C.L.Arora.
4. Complementary Physics, P.S.Sebastian Kunju,VAS Publications, Trivandrum.

SEMESTER 3 (MATHEMATICS MAIN)

AUPY331.2c – OPTICS, MAGNETISM AND ELECTRICITY

(54 HOURS-3 CREDITS)

Total Teaching Hours for Semester:54	**No of Lecture Hours/Week:3**
Max Marks:80	**Credits:3**
Course Outcomes	

Students will be able to understand the

CO1: optical phenomena like Interference and Diffraction

CO2: principle of the experiments like Newton's rings and air wedge, diffraction grating etc.

CO3: basic principle of laser and optic fiber

CO4: basics of magnetic properties like para magnetism , dia magnetism and ferro magnetism

CO5: theory of magnetism

CO6: production of AC and its characteristics

CO7: effect of passage AC through various components like Resistors, Capacitors, Inductors and their combination circuits.

Unit-1	**Teaching Hours:34**

Interference (12 hours)

Analytical treatment of interference-theory of interference fringes and bandwidth. Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness. Newton's rings-reflected system-measurement of wavelength and refractive index of liquid.

Diffraction (14 hours)

Phenomenon of diffraction-classification-Fresnel and Fraunhofer. Fresnel's theory of

approximate rectilinear propagation of light-Fresnel diffraction at a straight edge and circular aperture. Fraunhofer diffraction at a single slit, two slits and N slits. Plane transmission grating-determination of wavelength-Resolving power of grating.

Laser and Fibre Optics (8 hours)

Principle of operation of laser-population inversion-optical pumping-ruby laser applications of lasers. Light propagation in optical fibres-step index fibre-graded index fibre-applications.

Unit-2	**Teaching Hours:20**

Magnetism (10 hours)

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability. Magnetic properties-diamagnetism paramagnetism-ferromagnetism-antiferromagnetism. Electron theory of magnetism explanation of ferromagnetism.

Electricity (10 hours)

EMF induced in a coil rotating in a magnetic field-peak, mean, *rms* and effective values of A.C. AC circuits-AC through RC, LC, LR and LCR series circuits resonance-sharpness of resonance-power factor and choke coil-transformers.

Book for study and reference.

1. Brijlal & Subramaniam, A text book of optics –
2. Electricity and Magnetism – R.Murugeshan, S.Chand & Co Ltd.
3. A text book of B.Sc subsidiary Physics – P.Vivekanandan.
4. Complementary Physics, P.S.Sebastian Kunju,VAS Publications, Trivandrum.

SEMESTER 4 (MATHEMATICS MAIN)

AUPY431.2c – MODERN PHYSICS AND ELECTRONICS

(54 HOURS-3 CREDITS)

Total Teaching Hours for Semester:54	**No of Lecture Hours/Week:3**
Max Marks:80	**Credits:3**
Course Outcomes	

Students will be able to understand the

CO1: basic features of Bohr atom model, Bohr's correspondence principle, vector atom

model, various quantum numbers, Pauli's exclusion principle etc.

CO2: basic properties of nucleus like charge, mass, spin, magnetic moment binding energy and packing fraction

CO3: basics of radioactivity

CO4: concepts of Plank's hypothesis, quantum principles, Schrodinger equation,

CO5: Schrodinger equation for a particle in a potential box

CO6: basics of electronics

CO7: working of various electronic components like diodes, transistor,

CO8: working principle of CE amplifier

CO9: basics of the digital electronics

CO10: logic gates and Boolean expression etc.

Unit-1	**Teaching Hours:30**

Modern Physics (18 hours)

Basic features of Bohr atom model-Bohr's correspondence principle-vector atom model-various quantum numbers-magnetic moment of orbital electrons-electron spin- Spin-Orbit coupling-Pauli's exclusion principle-periodic table.Atomic nucleus-basic properties of nucleus-charge, mass, spin, magnetic moment binding energy and packing fraction-nuclear forces-salient features-radioactivity radioactive decay-decay laws-decay constant-half life and mean life-radioactive equilibrium-secular and transient equilibrium-measurement of radioactivity-Nuclear detectors (basic ideas).

Quantum mechanics (12 hours) Inadequacies of classical physics-experimental evidences-evidences for quantum theory-Planck's hypothesis-foundation of quantum mechanics-wave function and probability density-Schrödinger equation-time dependent and time independent particle in a potential box.

Unit-2	**Teaching Hours:24**

Electronics (16 hours)

Current-voltage characteristics of a diode-forward and reverse bias-breakdown mechanism of p-n junction diode-Zener diode and its characteristics-half wave and full wave rectifiers-bridge rectifier-ripple factor, efficiency. Construction and operation of a bipolar junction transistor-transistor configurations current components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits-fixed

bias,emitter feedback bias, voltage divider bias (qualitative study only).Transistor amplifier-basic features of an amplifier-gain, input and output resistances frequency response and band width-small signal CE amplifier-circuit and its operation

Digital Electronics (8 hours)

Number systems and codes-decimal numbers-binary arithmetic-1's and 2's compliment-decimal to binary conversion-octal numbers-hexadecimal numbers binary coded decimal-digital codes-logic gates-NOT, OR, AND, NOR and NAND gates.Boolean algebra-Boolean operations-logic expressions-laws of Boolean algebra-DeMorgan's theorem-Boolean expression for gate network-simplification of Boolean expression.

Book for study and reference.

1. Modern Physics – R.Murugeshan, S.Chand & Co. Ltd.
2. A text book of B.Sc subsidiary Physics – P.Vivekanandan.
3. Complementary Physics, P.S.Sebastian Kunju,VAS Publications, Trivandrum.

COMPLEMENTARY PRACTICALS (PHYSICS)

(COMMON FOR ALL COMPLEMENTARY SUBJECTS)

AUPY43.2c PI-PRACTICAL

Total Teaching Hours for Semester:36	**No of Lecture Hours/Week:2**
Max Marks:80	**Credits:2**

List of Experiments (Minimum 20 experiments to be done)

1. Torsion Pendulum- n by torsional oscillations
2. Torsion Pendulum- n and I using equal masses
3. Fly Wheel
4. Cantilever- Young's Modulus by mirror and telescope method
5. Uniform bending- Young's modulus by mirror and telescope method.
6. Symmetric bar pendulum- g and radius of gyration
7. Surface tension- capillary rise method
8. Coefficient of viscosity- capillary flow method
9. Specific heat-method of mixtures applying Barton's correction
10. Lee's disc- Thermal conductivity of cardboard

11. Melde’s string- frequency of tuning fork
12. Method of parallax- optical constants of convex lens using i) mirror and mercury ii) mirror and water
13. Method of parallax- refractive index of liquid.
14. Spectrometer- A, D and n
15. Spectrometer- dispersive power of a prism
16. Spectrometer- Grating-normal incidence
17. Deflection and vibration magnetometer- M and Bh
18. Circular coil- magnetization of a magnet
19. Carey Foster’s bridge- Resistivity
20. Potentiometer- Resistivity
21. Potentiometer- Calibration of ammeter
22. Mirror galvanometer- Current and Voltage sensitivity
23. Diode Characteristics (for Ge and Si diodes)
24. Half wave rectifier-Measurement of ripple factor with and without filter capacitor
25. Full wave rectifier- Measurement of ripple factor with and without filter capacitor