MAR IVANIOS COLLEGE (AUTONOMOUS) THIRUVANANTHAPURAM

DEPARTMENT OF PHYSICS

Syllabus for FDP

Bachelor of Science in Physics

Academic Year (2019)

PREAMBLE

The primary mission of the First Degree Programme in Physics is to provide an outstanding education for students. Our curriculum serves the undergraduate students who 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 to students. 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 caliber 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 the 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 CORE PHYSICS

Programme Specific Outcomes

Objectives

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

PSO1: attained a common level in heat, thermodynamics, 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 laboratories.

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

PSO3: been introduced to a wide range of topics in electrodynamics, classical and relativistic mechanics.

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 and disaster management.

PSO7: experienced the enthusiasm of independent work such as projects, seminars etc.

PSO8: developed their skills in experiments on optics, electrical, electronics and computer programs.

I. GENERAL STRUCTURE FOR THE FIRST DEGREE PROGRAMME IN PHYSICS

(ESE-End Semester Examination), 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	Heat and Thermodynamics	2	2	3	20	80
2.	AUPY241	Basic Mechanics and Properties of Matter **(Foundation Course 2)**	2	2	3	20	80
3.	AUPY341	Electrodynamics	3	3	3	20	80
4.	AUPY441	Classical and Relativistic Mechanics	3	3	3	20	80
		Practicals					
	AUPY44PI	Mechanics, Properties of Matter, Error Measurements andHeat	3	3	3	20	80
5.	AUPY541	Statistical Physics, Research Methodology and Disaster Management	4	4	3	20	80
	AUPY542	Quantum Mechanics	4	4	3	20	80
	AUPY543	Electronics	4	4	3	20	80
	AUPY544	Atomic and Molecular Physics	4	4	3	20	80
	AUPY581	**Open Course**					
	AUPY581.a	Applied Physics	3	2	3	20	80
	AUPY581.b	Astronomy and Astrophysics	3	2	3	20	80
	AUPY581.c	Biophysics	3	2	3	20	80
6.	AUPY641	Solid State Physics	4	4	3	20	80
	AUPY642	Nuclear and Particle Physics	4	4	3	20	80
	AUPY643	Classical and Modern Optics	4	4	3	20	80
	AUPY644	Digital Electronics and Computer Science	4	4	3	20	80
	AUPY691	**Elective Course**					
	AUPY691.a	Space Science	3	2	3	20	80
	AUPY691.b	Electronic Instrumentation	3	2	3	20	80
	AUPY691.c	Nanoscience and Technology	3	2	3	20	80
		Practicals					
	AUPY64PII	Optics, Electricity and Magnetism	3	2	3	20	80
	AUPY64PIII	Digital Electronics andComputer Science	3	2	3	20	80
	AUPY645	Project and 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 and Properties of Matter	2	2	3	20	80
2.	AUPY231.2b	Thermal Physics	2	2	3	20	80
3.	AUPY331.2b	Optics, Magnetism and Electricity	3	3	3	20	80
4.	AUPY431.2b	Atomic Physics, Quantum Mechanics and 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 and Properties of Matter	2	2	3	20	80
2.	AUPY231.2c	Heat and Thermodynamics	2	2	3	20	80
3.	AUPY331.2c	Optics, Magnetism and Electricity	3	3	3	20	80
4.	AUPY431.2c	Modern Physics and Electronics	3	3	3	20	80
		Practicals					
	AUPY43.2cPI	Complimentary Practical Physics	2	4	3	20	80

CREDITS (For each semester)

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

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
Problem /Short essay(Not to exceed 120 words)	9	6	4	24
Long essay	4	2	15	30
Total	**35**	**26**		**80**

I. OPEN/ELECTIVECOURSES

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). OpenCourses

The Department of Physics offers the following Open Courses during the fifth semester for the students of other departments.

Open Course
Applied Physics
Astronomy and Astrophysics
Biophysics

The Department of Physics offers the following Elective Courses during the sixth semester for the students of the same department.

(b). ElectiveCourses

Elective Course
Space Science
Electronic Instrumentation
Nanoscience and Technology

II. EVALUATION & GRADING

The evaluation of each course consists of two parts

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

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

The CE/CA and ESE/ESA ratio will be 1:4 for all courses with or without practicals. **There will be a maximum of 80 marks for ESE/ESA and maximum of 20 marks for CE/CA for all Courses (Theory and Practicals).** 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 & above	9 & above	A+ Outstanding
80 to < 90	8 to <9	A Excellent
70 to <80	7 to <8	B Very Good
60 to < 70	6 to <7	C Good
50 to < 60	5 to <6	D Satisfactory
40 to < 50	4 to <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

III. TESTS: (MAX. MARKS: 10)

For each course there will 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.

IV. 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
75 %	1
76 to 80 %	2
81 to 85 %	3
86 to 90 %	4
Above 90 %	5

V. 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 shall be carried out/conducted in supervision with the concerned department.

VI. PROJECT/DISSERTATIONWORK:

For each First Degree Programme there will 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 Project/Dissertation work. A board of two examiners appointed by the Controller of Examinations 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 Board of Studies.

Guidelines for preparation and submission of Project/Dissertation 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 fourth 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 sixth 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.

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, conducted individually, based on the project/dissertation and study tour/field trip. The various components to be considered in the viva-voce are given below.

Components	Marks
Understanding the objective of the project work/study tourreport	5
Background knowledge of project and 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.

Components	Weight
Dissertation	3
Viva-voce	1

There shall be no continuous evaluation for the project.

VII. 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 semester 5 examinations and before the commencement of semester 6 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.

V. 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 semester 4. The examiners shall be selected from a panel of experts prepared by the Controller of Examinations. There shall be two external examiners and one internal examiner. The internal examiner shall be one 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 Examinations 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: HEAT AND THERMODYNAMICS

Total Teaching Hours: 36 | **No. of Lecture Hours/Week: 2**

Max. Marks: 80 | **Credits: 2**

Course Outcomes

Students who complete this course will

CO1. get knowledge about the basics of conduction and radiation.

CO2. understand the laws of thermodynamics.

CO3**.** get a detailed analysis of thermodynamic processes.

CO4**.** be fascinated with the description of heat engines.

CO5**.** be familiar with the concepts of entropy

Unit 1. Heat Transfer (8 hours)

Thermal conductivity - determination by Lee's Disc method for bad conductor - radial flow of heat - cylindrical flow - thermal conductivity of rubber - Wiedemann-Franz law - ultraviolet catastrophe - Planck's radiation law - Stefan's law – determination of Stefan's constant – solar constant – determination of solar temperature.

Unit 2. Introduction to Thermodynamics (18 hours)

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 of refrigerator - working and efficiency - Otto engine and Diesel engine - working and efficiency.

Unit 3. Entropy (10 hours)

Definition of entropy - change of entropy in reversible and irreversible cycle - Clausius inequality and second law of thermodynamics - entropy and available energy - entropy - probability and disorder - heat death of the universe - Nernst theorem and third law of thermodynamics - phase transition - phase diagram - first order and second order phase transitions - Clausius-Clapeyron equation

Books for study:

1. Heat and Thermodynamics: D. S. Mathur, S. Chand & Sons, New Delhi (1995)
2. Heat Thermodynamics and Statistical Physics: Brij Lal, N. Subrahmanyam and P. S. Hemne, S. Chand & Co. Ltd., New Delhi (2000)

3. Thermal Physics and Statistical Mechanics: S. K. Roy, New Age International Publishers, New Delhi (2001)

Books for reference:

1. Modern Trends in B Sc Physics Physics: C. J. Babu, S. Chand & Co. Ltd., New Delhi (2010)
2. Heat and Thermodynamics: M. Zemansky, McGraw-Hill, New Delhi (2007)

AUPY241: BASIC MECHANICS & PROPERTIES OF MATTER

Total Teaching Hours: 36 **No. of Lecture Hours/Week: 2**

Max Marks: 80 **Credits: 2**

Course Outcomes

Students who complete this course will 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

CO2. Young's modulus of the materials and rigidity modulus of the materials

CO3. the theory and experimental procedures to determine the surface tension and viscosities of liquids

CO4. the properties and specifications of girders.

Unit 1. Dynamics of Rigid Bodies (7 hours)

Equations of motion for rotating rigid bodies - angular momentum and moment of inertia - 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 - kinetic energy of rotating and rolling bodies – torque - determination of M.I. of a flywheel (theory, experiment and applications).

Unit 2. Conservation of Energy (3 hours)

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 (12 hours)

Simple harmonic motion - energy of harmonic oscillators - simple pendulum - mass on a spring -

oscillation of two particles connected by a spring - compound bar pendulum - interchangeability 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 - 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.

Unit 4. Elasticity (8 hours)

Modulus of elasticity (revision) - relations connecting the three elastic moduli - 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 5. Properties of Fluids (6 hours)

Surface tension - expression for excess of pressure on a curved liquid surface - determination of surface tension by Jaeger's method - variation of surface tension with temperature - viscosity - Reynolds number - absolute/dynamic and kinematic viscosity- Stokes formula - theory and experiment.

Books for study:

1. Mechanics: H. S. Hans & S. P. Puri, Tata McGraw-Hill, New Delhi, 2nd Edition (2006)
2. Mechanics: J. C. Upadhyaya, Ram Prasad Publication (2017)
3. Elements of Properties of Matter: D. S. Mathur, S. Chand & Co. Ltd., New Delhi (1962)
4. Fundamentals of Physics: D. Halliday, R. Resnick and J. Walker, John Wiley & Sons Inc., 10th Edition (2013)

Books for reference:

1. Properties of Matter: Brij Lal & N. Subrahmanyam, S. Chand & Co. Pvt. Ltd., New Delhi (2002)
2. Principles of Physics: P. V. Naik, PHI, 4th Edition (2010)

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.

AUPY341: ELECTRODYNAMICS

Total Teaching Hours: 54 **No. of Lecture Hours/Week: 3**

Max Marks: 80 **Credits: 3**

Course Outcomes

Students who complete this course may be able to learn

CO1**.** the basics of 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 discussions 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.

Unit 1. Electrostatic Field (10 hours)

Electric field: Introduction - Coulomb's law - electric field - continuous charge distribution (revision) - Divergence and curl of electrostatic fields: Field lines - flux and Gauss's law - divergence of E - applications of Gauss's law - 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 conditions - Work and energy in electrostatics: Work done to move a charge - energy of a point charge distribution - energy of a continuous charge distribution.

Unit 2. Electrostatic Fields in Matter (10 hours)

Polarization: Dielectrics - induced dipoles - polarization - Field of a polarized object: Bound charges - physical interpretation of bound charges - Electric displacement: Gauss's law in the presence dielectrics - boundary conditions - Linear dielectrics: Susceptibility - permittivity - dielectric constant.

Unit 3. Magnetostatics (7 hours)

Introduction - Biot-Savart law (revision) 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 - classification of magnetic materials - theory of magnetism.

Unit 4. Electromagnetic Induction (7 hours)

Electromotive force: Ohm's law - Electromagnetic Induction: Faraday's law - induced electric field - Maxwell's equations - magnetic charge.

Unit 5. Electromagnetic Waves (6 hours)

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 (7 hours)

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 (7 hours)**

AC through series LCR (acceptor circuit) and parallel LCR circuit (rejector circuit) - Q-factor - power in AC - power factor.

Books for study:

1. Introduction to Electrodynamics: David J Griffith, PHI, New Delhi, 3rd Edition (2011)
2. Electricity and Magnetism: R. Murugeshan, S. Chand & Co. Ltd., New Delhi, 9th Edition (2011)
3. Electricity and Magnetism: K. K. Tewari, S. Chand & Co. Ltd., New Delhi (2009)
4. Principles of Electromagnetics: Matthew N. O. Sadiku, Oxford University Press, 4th Edition (2009)
5. Electrodynamics: S. L. Gupta, V. Kumar and S. P. Singh, PragatiPrakashan, Meerut (2003)

Books for reference:

1. Electricity and Magnetism: Munir H. Nayfeh and Morton K. Brussel, Dover Publications, New York (2015)
2. Electricity and Magnetism: E. M. Purcell, Cambridge University Press, UK (2011)
3. Electricity and Magnetism Volume 1; J.H. Fewkes & John Yarwood, University Tutorial Press, 2nd Edition (1965)

4. Classical Electrodynamics: Walter Greiner, Springer International Edition (1998)
5. Electromagnetic Waves and Radiating Systems: E. C. Jordan and K. G. Balmain, PHI, New Delhi (1964)
6. Electromagnetics: B. B. Laud, New Age International (1987)
7. Foundations of Electromagnetic Theory: J. R. Reitz, F. J. Milford and R. W. Christy, Addison Wesley, 4th Edition (2008)
8. Electromagnetic Field Theory Fundamentals: B. S. Guru and H. R. Hizirogulu, Cambridge University Press, UK, 2nd Edition (2004)
9. Electricity and Magnetism: D. C. Tayal, Himalaya Publishing House (1989)

Topics for discussion in Tutorial session/Assignments (sample)

1. Comment on how electrostatic energy is stored in a field.
2. Discuss the electrostatic properties of conductors.
3. What is meant by electrostatic shielding? In what way it helps us?
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 applications of Ampere's circuital law.
7. Compare electrostatics and magnetostatics.
8. Why magnetic forces cannot do work?
9. Discuss about cyclotron motion and cycloid motion.
10. Discuss whether there exists any stand-off between Ohm's law and Newton'ssecond law.
11. A battery has an emf. Can this emf be 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** & 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 and wavenumber.
15. Complex representation of wavefunction 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.

AUPY441: CLASSICAL AND RELATIVISTIC MECHANICS

Total Teaching Hours: 54 **No. of Lecture Hours/Week: 3**

Max Marks: 80 **Credits: 3**

Course Outcomes

Students who complete this course will get a thorough idea about

CO1. 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. theory of motion in central force field extending up to the explanation of Kepler's laws of planetary motion,

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

CO4. theory of relativity.

Unit 1. Particle Dynamics (5 hours)

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.

Unit 2. Conservation Laws and Properties of Space and Time (6 hours)

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.

Unit 3. Motion in Central Force Field (10 hours)

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.

Unit 4. Collisions (6 hours)

Conservation laws - laboratory and centre of mass systems - kinetic energies in the lab and CM systems - Cross-section of elastic scattering.

Unit 5. Lagrangian Dynamics (9 hours)

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).

Unit 6. Hamiltonian Dynamics (7 hours)

Generalized momentum and cyclic coordinates -Hamiltonian function H - conservation of energy - Hamilton's equations - examples of Hamiltonian dynamics - one dimensional harmonic oscillator.

Unit 7. Relativity (13 hours)

Inertial frames of reference - Galilean transformation - non-inertial frames 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 - variation of mass with velocity - mass energy equivalence – transformation of relativistic momentum and energy - tachyons.

Book for study:

1. Mechanics: H. S. Hans & S. P. Puri, Tata McGraw-Hill, New Delhi, 2nd Edition (2006)
2. Introduction to Classical Mechanics: R. G. Thakwale and P. S. Puranik, Tata McGraw- Hill, New Delhi (2006)
3. Classical Mechanics: J. C. Upadhyaya, Himalaya Publishing House, Mumbai (2014)

Books for reference:

1. Classical Mechanics: H. Goldstein, John L. Safko and Charles P. Poole Jr., Addison-Wesley, 3rd Edition (2002)
2. Classical Mechanics: Vimal Kumar Jain, Ane Books Pvt. Ltd. (2009)
3. Classical Mechanics: Systems of Particles and Hamiltonian Dynamics: Walter Greiner, Springer, New York (2010)
4. Concepts of Modern Physics: Arthur Beiser, Tata McGraw-Hill, New Delhi, 6th Edition (1994)
5. Classical Mechanics: N. C. Rana and P. S. Joag, Tata McGraw-Hill, New Delhi (2001)

AUPY541: STATISTICAL PHYSICS, RESEARCH METHODOLOGY AND DISASTER MANAGEMENT

Total Teaching Hours: 72 | **No. of Lecture Hours/Week: 4**

Max Marks: 80 | **Credits: 4**

Course Outcomes

Students who complete this course will

CO1. get information about the basics of statistical physics

CO2. become aware of the three statistical distribution

CO3. be able to understand the objectives and motivation in research

CO4. get a deep knowledge about experimentation, observation and data collection

CO5**.** be able to write the thesis and research paper for publication

CO6**.** be able to do error analysis

CO7**.** be aware of various disasters and their management

Unit 1. Statistical Physics (18 hours)

Statistical probability - micro and macro states - phase space - statistical ensemble - postulate of equal a priori probability - Maxwell Boltzmann distribution - velocity distribution - indistinguishability of identical particles - Bose Einstein and Fermi Dirac distribution - comparison of three statistics - radiation law - thermionic emission.

Unit 2. Research Methodology (18 hours)

Research - objectives and motivation in research - different types of research - research approaches - significance of research - research methods and methodology - research and scientific method - various steps in a research process - importance of literature survey - criteria of good research - thesis/report 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) - conclusions - references - scope for future study.

Unit 3. Error Analysis (12 hours)

Significant figures - 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 of errors - errors with reading scales - absolute and relative errors - standard deviation - variance in measurements - error bars and graphical representation.

Unit 4. Disaster Management (24 hours)

Global natural disasters: Natural hazards and natural disasters - recent major disasters and their relief efforts - impact of global climate change and major natural disasters - human adaptability of natural disasters - fragile natural eco-environment - disaster reduction activity - achievements - challenges and future development - earthquake disaster and their effects - advancement in research of earthquake disaster - earthquake and tsunami warnings - earthquake disaster prevention - earthquake disaster mitigation - health emergencies and diseases - environmental health and diseases - disasters and emergencies - steps in disaster management - pre-disaster activity - role of water supply - need for protecting large scale water supply schemes - assessment of damaged and available water resources - water quality testing - personal hygiene - control of communicable diseases and prevention of epidemics – measures for controlling communicable diseases and epidemics - radiation emergencies - health consequence of radiation - measures to prevent sudden health emergencies due to radiation.

Books for study:

1. Heat Thermodynamics and Statistical Physics: Brij Lal, N. Subrahmanyam and P. S. Hemne, S. Chand & Co. Ltd., New Delhi (2000)
2. Statistical Mechanics: SatyaPrakash, Kedarnath Ram Nath Publishers, Meerut and Delhi (2014)
3. Thermal and Statistical Mechanics: S. K. Roy, New Age International (2001)
4. Elements of Statistical Mechanics: Kamal Singh and S. P. Singh, S. Chand & Co. Ltd, New Delhi (1999)
5. Statistical Mechanics: B. K. Agarwal and Melvin Eisner, New Age International Publishers, New Delhi, 2nd Edition (2005)
6. Research Methodology - Methods and Techniques: C. R. Kothari, New Age International Publishers, New Delhi (2007)
7. Natural Disaster Mitigation - A Scientific and Practical Approach: Science Press, Beijing (2009)
8. Environmental Health in Emergencies and Disasters - A Practical Guide: B. Wisner and J. Adams (Eds.), John & WHO, Geneva (2002)
9. Introduction to Disaster Management: Satish Modh, Macmillan (2010)

Books for reference:

1. Introduction to Statistical Mechanics: S. K. Sinha, Alpha Science International Ltd. (2005)
2. Introduction to Statistical Physics: Kerson Huang - CRC Press (2001)

3. Modern Trends in B Sc Physics Physics: C. J. Babu, S. Chand & Co. Ltd., New Delhi (2010)

4. Disaster Management: Harsh K Gupta, Universities Press (2003)

AUPY542: QUANTUM MECHANICS

Total Teaching Hours: 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 (18 hours)

Limitations of classical physics - black body radiation curve –

Unit 2. Wave Mechanics (22 hours)

Wave nature of particles - electron diffraction - standing wave of electron in the orbit - uncertainty principle - uncertainty relation among canonically conjugate pairs – application - non-existence of electrons in the nucleus - ground state energy of hydrogen atom - width of spectral lines - properties of wave function - conditions for physical acceptability of wave function (admissibility conditions of wave function) - normalization and orthogonality condition - superposition principle - wave packets - relation between particle velocity, group velocity and phase velocity - probability interpretation of wave function - statistical interpretation of wave function - probability current density in one dimension - expectation value - Ehrenfest's theorem - time dependent Schrodinger equation - time independent Schrodinger equation - stationary states.

Unit 3. One Dimensional Energy Eigen Value Problems (14 hours)

Free particle Schrodinger equation - square-well potential with infinite walls - square well potential with finite walls - square potential barrier - the harmonic oscillator (Schrodinger method).

Unit 4. General Formalism of Quantum Mechanics (18 hours)

Linear vector space - linear operator - eigen values and eigen functions - Hermitian operator - postulates of quantum mechanics - equation of motion - Schrodinger representation - momentum representation.

Books for study:

1. Quantum Mechanics: G. Aruldhas, PHI, 2nd Edition (2002)
2. A Textbook of Quantum Mechanics: P. M. Mathews and K. Venkatesan, Tata McGraw-Hill, 2nd Edition (2010)
3. Quantum Mechanics: Robert Eisberg and Robert Resnick, Wiley, 2nd Edition (2002)
4. Quantum Mechanics: Leonard I. Schiff, Tata McGraw-Hill, 3rd Edition (2010)
5. Concepts of Modern Physics: Arthur Beiser, Tata McGraw-Hill, New Delhi, 6th Edition (1994)

Books for reference:

1. Quantum Mechanics: Eugen Merzbacher, John Wiley & Sons Inc. (2004)
2. Introduction to Quantum Mechanics: David J. Griffith, Pearson Education, 2nd Edition (2005)
3. Quantum Mechanics: Walter Greiner, Springer, 4th Edition (2001)
4. Quantum Mechanics: Bruce Cameron Reed, Jones & Bartlett (2008)
5. Quantum Mechanics for Scientists & Engineers: D. A. B. Miller, Cambridge University Press (2008)

AUPY543: ELECTRONICS

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

Course Outcome

Students who complete this course may be able to

CO1. **do** the analysis of Thevenin's and Norton's theorems, maximum power transfer theorems

CO2. get basic ideas about the theory of semiconductors

CO3. understand the basics of p-n junction diode and different types of diodes

CO4. understand the transistor circuits, biasing and amplifiers

CO5. understand the basics of different types of power amplifiers

CO6. get idea of feedback and different types of oscillators

CO7. get knowledge on the principles of modulation and communication

CO8. analyze JFET, MOSFET, UJT and SCR

CO9. attain the basic ideas of differential and operational amplifiers

Unit 1. Circuit Theory (4 hours)

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

Unit 2. Diode Circuits(14 hours)

Extrinsic semiconductor - n-type and p-type semiconductors - pn junction - pn junction under forward and reverse biased conditions – rms 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 and photodiode (basics).

Unit 3. Bipolar Junction Transistors (16 hours)

Theory of BJT operation - CB, CE and CC characteristics - alpha, beta and gamma - relation between transistor currents - biasing circuits (CE configuration) - stability factors – selection of operating point - ac and dc load lines - Q point - transistor biasing - collector feed back, base resistor and potential divider methods - small signal BJT amplifiers - input and output resistances - graphical analysis of the small signal CE amplifier (frequency response, bandwidth and gain in dB) - small signal CC amplifier (emitter follower) - h parameters (basic idea).

Unit 4. Power Amplifiers (4 hours)

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 - multistage amplifiers - frequency responses - distortion in amplifiers.

Unit 5. Feedback and Oscillator Circuits (8 hours)

Feedback principles - negative feedback - emitter follower - advantages of negative feedback - positive feedback - principle of sinusoidal feedback oscillation - Barkhausen criterion for oscillations - Hartley, Colpitt's, RC phase shift and Wien bridge oscillators (derivations not required).

Unit 6. Modulation (6 hours)

Fundamentals of modulation - AM, FM and PM - analysis of AM – frequency spectrum of AM - power in AM - linear demodulation of AM signal - frequency spectrum for FM – superhetrodyne AM receivers.

Unit 7. Special Devices (8 hours)

JFET - MOSFET - depletion and enhancement MOSFET - UJT - SCR (basic construction, theory of operation, characteristics and applications).

Unit 8. Operational amplifiers (IC741) (12hours)

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, non-inverting, summing, subtracting, differentiating and integrating amplifiers.

Books for study:

1. Basic Electronics-Devices, Circuits and IT Fundamentals: SantiramKal, PHI, New Delhi (2009)
2. Basic Electronics-Solid State: B. L. Theraja, S. Chand & Co. Ltd., New Delhi (2006)
3. Principles of Electronics: V. K. Mehta and Rohit Mehta, S. Chand & Co. Ltd., New Delhi (2012)
4. A First Course in Electronics: Anwar A. Khan and Kanchan K. Dey, PHI, New Delhi (2006)

Books for reference:

1. Electronic Devices and Circuits: Theodore F. Bogart Jr,. Jeffrey S. Beasley, Guillermo Rico, Pearson Prentice Hall, 6th Edition (2004)
2. Electronic Devices and Circuit Theory: Robert L. Boylestad & Louis Nashelsky, Pearson Prentice Hall, 9th Edition (2009)
3. Electronic Fundamentals and Applications: Integrated and Discrete Systems: John D. Ryder, Prentice Hall of India Pvt. Ltd., 5th Edition (2007)
4. Electronic Communications: Dennis Roddy and John Coolen, Pearson, 4th Edition (1995)

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

1. Electronic projects using flipflops.
2. Electronic projects using logic gates.
3. Electronic projects using IC741 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: 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 (10 hours)

Bohr's theory, correspondence principle - Sommerfeld's atom model and explanation of fine structure of H line in Balmer series of hydrogen atom - limitation of Sommerfeld atom model - vector atom model - various quantum numbers associated with vector atom model - L-S and j-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-Gerlach experiment - spin-orbit coupling.

Unit 2. Atomic Spectra (14 hours)

Optical spectra - Spectral terms and notations - selection rules - intensity rule and interval rule - effect of spin-orbit interaction on energy levels - fine structure of hydrogen and sodium D lines - hyperfine structure - spectrum of He - singlet and triplet levels - alkali spectra - Zeeman effect - Larmor's theorem - quantum mechanical explanation of normal Zeeman effect - Anomalous Zeeman Effect - sodium D lines - Paschen-Back effect - Stark effect.

Unit 3. X-rays (8 hours)

Discovery - properties - continuous and characteristic X-ray spectra - Duane-Hunt law - Moseley’s law - hydrogen like character of X-ray spectrum - X-ray diffraction - absorption of X-rays - Compton effect - measurement of X-ray wavelength by ruled grating - applications of X-rays

Unit 4. Molecular spectra (28 hours)

Width of spectral lines - intensities of spectral lines - valence bond and molecular orbital methods - hydrogen molecule ion - bonding and antibonding orbitals - hydrogen molecule singlet and triplet states - hybridisation and hybrid orbitals.

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 - IR spectrometer - Raman scattering - classical description of Raman scattering - quantum theory of Raman scattering - vibrational Raman spectra - diatomic molecules - polyatomic molecules - rotational Raman spectra - Raman spectrometer - electronic spectra - sequences and progressions - Frank-Condon principle.

Unit 5. Resonance Spectroscopy (12 hours)

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 - Mossbauer spectroscopy - principle - isomer shift.

Books for study and reference:

1. Modern Physics: G. Aruldhas and P. Rajagopal, PHI, New Delhi (2014)
2. Modern Physics: R. Murugeshan and K. Sivaprasath, S. Chand & Co. Ltd., 12th Edition (2006)
3. Atomic Structure and Chemical Bond: Including Molecular Spectroscopy: Manas Chanda, Tata McGraw-Hill, 3rd Edition (1991)
4. Atomic Physics: J. B. Rajam, S. Chand & Co. Ltd., New Delhi (2010)
5. Concepts of Modern Physics: Arthur Beiser, Tata McGraw-Hill, New Delhi, 6th Edition (1994)

6. Fundamentals of Molecular Spectroscopy: C. N. Banwell and Elaine M. McCash, Tata McGraw-Hill, 4th Edition (2016)
7. Spectroscopy: S. D. Walker and H. Straw, Chapman & Hill, 2nd Edition (1976)
8. Molecular Structure and Spectroscopy: G. Aruldhas, PHI, New Delhi, 2nd Edition (2008)

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

1. History of atom model.
2. Rutherford experiment leading to atom model.
3. Molecular bond and electron sharing.
4. X-ray diffraction for identification of samples.

AUPY581: OPEN COURSES

AUPY 581.a. APPLIED PHYSICS

Total Teaching Hours: 54 **No. of Lecture Hours/Week: 3**

Max Marks: 80 **Credits: 2**

Course Outcomes

Students who complete this course will

CO1. be able to use the different electronic equipments

CO2. have a thorough knowledge of X-rays and lasers and their applications

CO3. have a thorough knowledge of holograms, construction and reconstruction

CO4. understand the basics of fibre optic communication

Unit 1. Electric and electronic equipments (14 hours)

Electric motor - principles of working - microwave oven – principle - technical specifications - applications - advantages - public address system - block diagram representation - function of each unit - CD player and drives - DVD player and drives - telephonic communication (cable and cellular) - principles (qualitative study using block diagram) - cell phone - SIM card - technical specifications - radio - history of radio revolution - different types of radios - television – working (qualitative) - touch screens and ATM (Automatic Telling machine).

Unit 2. X-ray and its Applications (11 hours)

Discovery of X-rays - gas filled tube - Coolidge X-ray tube - properties of X-ray - X-ray spectra - continuous and characteristic spectra - CT Scan - basic principle, applications and advantages - MRI

Scan - principle, applications and advantages.

Unit 3. Lasers (13 hours)

Introduction - interaction of light with matter - absorption - spontaneous emission - stimulated emission - light amplification - population inversion - metastable states - components of laser - principal pumping schemes - role of resonant cavity - ruby laser - He-Ne laser - applications.

Unit 4. Holography (6 hours)

Introduction - principle of holography - recording of the hologram – reconstruction of the image-applications.

Unit 5. Fibre optic communication (10 hours)

Introduction - optical fibre - necessity of cladding - optical fibre system – total internal reflection - propagation of light through an optical fibre - critical angle of propagation - modes of propagation - types of rays-classification of optical fibres - applications.

Books for study and reference:

1. Audio and Video Systems: Principles, Maintenance and Troubleshooting, R. G. Gupta, McGraw-Hill, New Delhi, 2nd Edition (2010)
2. Mobile Satellite Communication Network: Ray E. Sherrif and Y. Fun Hu, John Wiley & Sons Ltd. (2001)
3. Television Engineering & Video System: R. G. Gupta, Tata McGraw-Hill, 2nd Edition (2017)
4. A Textbook of Electrical Technology (Vol 1 & 2): B. L. Theraja and A. K. Theraja, S. Chand & Co.
5. A Textbook of Optics: N. Subrahmanyam and Brij Lal, M. N. Avadhanulu S. Chand & Co. Ltd. (2015)
6. Modern Physics: R. Murugeshan and K. Sivaprasath, S. Chand & Co. Ltd., 12th Edition (2006)
7. Atomic and Nuclear Physics: V. W. Kulkarni, Himalaya Publishing House, New Delhi (2015)

AUPY581.b. ASTRONOMY AND ASTROPHYSICS

Total Teaching Hours: 54 **No. of Lecture Hours/Week: 3**

Max. Marks: 80 **Credits: 2**

Course Outcomes

Students who complete this course will

CO1. be aware of 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 (4 hours)

Astronomy and Astrophysics - importance of astronomy - methods of astronomy and astrophysics - the scientific methods - scope of astronomy.

Unit 2. Astronomy (15 hours)

Birth of the universe - ancient astronomy - medieval astronomy – renaissance astronomy - modern astronomy.

Unit 3. The Objects in the Sky (15 hours)

The microwave background radiation - the sun - the stars - neutron stars and black holes - supernovae – galaxies

Unit 4.The Solar System (15 hours)

Sun and planets - formation of the planets - comets - planets and satellites - asteroids - meteorites.

Unit 5. Earth in Space (5 hours)

Motion of the Earth - the calendar - the seasons.

Book for study and reference:

1. Planet Earth: Cesare Emiliani, Cambridge University Press (1995)
2. Astrophysics: K. D. Abhayankar, University Press (2001)
3. Fundamentals of Geophysics : William Lowrie, Cambridge University Press (1997)
4. Modern Physics: R. Murugeshan and K. Sivaprasath, S. Chand & Co. Ltd., New Delhi (2006)

5. Introduction to Astrophysics: Baidyanadh Basu, Tanuka Chattopadhyay and Sudhindra Nath Biswas, PHI, 2nd Edition (2010)
6. Modern Trends in B Sc Physics Physics: C.J. Babu, S.Chand & Co. Ltd., New Delhi (2010)
7. Space Science: Lousie K. Harra and Keith O. Mason, Imperial College Press, London (2004)
8. The Great Universe: G. K. Sasidharan, S. Chand & Co. Ltd., New Delhi (2008)

AUPY581.c. BIOPHYSICS

Total Teaching Hours: 54 **No. of Lecture Hours/Week: 3**

Max. Marks: 80 **Credits: 2**

Course Outcomes

Course Outcomes

Students who complete this course will have

CO1**.** a good knowledge of the physics of audition and vision

CO2**.** a good knowledge of biological systems

CO3**.** a good knowledge of biological measuring instruments and bioinformatics

Unit 1. Introduction (18 hours)

Biomechanics - biophysics and fluid flow - Gas transport - physics of audition - physics of vision

Unit 2. Cellular Molecular Biophysics (18 hours)

Cell - components - nucleic acids - physics of biomembranes - thermodynamics of biosystems

Unit 3. Radiation Biophysics (18 hours)

Bioelectronics and Bioinstrumentation - Bioinformatics - demonstration of biophysics experiments

Books for study and reference:

1. Essentials of Biophysics: P. Narayanan, New Age International Publishers, 2nd Edition (2007)
2. A Textbook of Biophysics: R. N. Roy, New Central Book Agency, Kolkata (2001)
3. Elementary Biophysics: P. K. Srivastava, Narosa Publishing House, New Delhi 2nd Edition (2011)
4. Introduction to Biophysics: Pranab Kumar Banerjee, S. Chand & Co., New Delhi (2010)
5. Biological Science: N. P. O. Green, G. W. Stout and D. J. Taylor, Cambridge University Press, 3rd Edition (2005)

AUPY641: SOLID STATE PHYSICS

Total Teaching Hours: 72 **No. of Lecture Hours/Week: 4**

Max. Marks: 80 **Credits: 4**

Course Outcomes

Students who complete this course will

CO1. be able to account for inter atomic 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 Structure (18 hours)

Solids - amorphous and crystalline materials - lattice translation vectors - lattice with a basis - unit cell - elements of symmetry - types of lattices - two and three dimensional - Miller indices - reciprocal lattice - Brillouin zones - diffraction of X-rays by crystals - Bragg’s law - X-ray diffraction techniques - inter atomic forces - types of bonding.

Unit 2. Conduction in Metals - Free Electron Model (12 hours)

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 - AC conductivity and optical properties - failure of free electron model.

Unit 3. Band Theory (10 hours)

Bloch theorem - Kronig-Penney model - band gaps – conductors - semiconductors and insulators - p and n type semiconductors - conductivity of semiconductors - mobility - Hall effect - Hall coefficient - construction of Brillouin zones.

Unit 4. Dielectric Properties of Materials (12 hours)

Polarization - local electric field at an atom - depolarization field - electric susceptibility - polarizability - Clausius-Mossotti Equation - classical theory of electric polarizability - normal and anomalous dispersion - Cauchy and Sellmeier relations - Langevin-Debye equation - complex dielectric constant - optical phenomena - application - plasma oscillations - plasma frequency - plasmons.

Unit 5. Magnetic Properties of Matter (12 hours)

Dia, para, ferri and ferromagnetic materials - classical Langevin theory of dia and paramagnetic domains - quantum mechanical treatment of paramagnetism - Curie's law - Weiss theory of ferromagnetism and ferromagnetic domains - discussion of B-H curve - hysteresis and energy loss.

Unit 6. Superconductivity (8 hours)

Critical temperature - critical magnetic field - Meissner effect - type I and type II superconductors - London's equation and penetration depth - isotope effect - BCS theory - tunneling and Josephson effect (qualitative study)

Books for study:

1. Elements of Solid State Physics: J.P. Srivastava, Prentice Hall of India , 2nd Edition(2009)
2. Elementary Solid State Physics: M. Ali Omar, Pearson India (1999)
3. Solid State Physics: M. A. Wahab, Narosa Publication (2011)

Books for reference:

1. Introduction to Solid State Physics: Charles Kittel, Wiley India Pvt. Ltd., 8th Edition (2004)
2. Introduction to Solids: Leonid V. Azaroff, Tata McGraw-Hill (2004)
3. Solid State Physics: Neil W. Ashcroft and N. David Mermin, Cengage Learning (1976)
4. Solid State Physics: Rita John, McGraw-Hill (2014)
5. Solid State Physics: H. Ibach and H. Luth, Springe (2009)

AUPY642: NUCLEAR AND PARTICLE PHYSICS

Total Teaching Hours: 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

CO6. make quantitative estimates for nuclear phenomena

CO7. achieve basic understanding of the nuclear reactors

CO8. aquire basic information about cosmic rays

Unit 1. General Properties of Nuclei (14 hours)

Constituents of nucleus and their intrinsic properties-quantitative facts about nuclear size - mass-charge density (matter energy) - binding energy- average binding energy and its variation with mass number- main features of binding energy versus mass number curve- nuclear stability- angular momentum- parity- magnetic moment - nuclear quadrupole moment - Nuclear forces-meson theory.

Unit 2. Nuclear Models (10 hours)

Liquid drop model -semi empirical mass formula and significance of various terms -shell model-evidence for nuclear shell structure - nuclear magic numbers - collective model.

Unit 3. Radioactivity (12 hours)

Half life and mean life - units of radioactivity - decay series - radioactive equilibrium - secular and transient equilibrium - radioactive dating - range of alpha particles - Geiger-Nuttal law- alpha decay - Gamow's theory - energy of alpha particles - beta decay - beta ray spectra - magnetic spectrograph - origin of line and continuous spectrum – neutrino energy of beta decay– gamma decay - radioisotopes-applications.

Unit 4.Nuclear Reactions (9 hours)

Nuclear reactions - types of reactions - conservation laws - nuclear reaction kinetics - Q value - threshold energy - reaction cross section - reaction mechanisms - compound nucleus - direct reactions.

Unit 5. Particle Detectors and Accelerators (5 hours)

GM counter - scintillation counter - linear accelerator - cyclotron – synchrocyclotron – betatron.

Unit 6.Nuclear Fission and Fusion (12 hours)

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.

Unit 7. Cosmic Rays and Elementary Particles (10 hours)

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 laws - lepton number - baryon number - strangeness isospin - hypercharge - resonance particles - the quark model - Bremsstrahlung effect - Cerenkov radiations.

Books for study:

1. Modern Physics: R. Murugeshan and K. Sivaprasath, S. Chand & Co. Ltd., New Delhi, 12^{th} Edition (2006)
2. Modern Physics: G. Aruldhas and P. Rajagopal, PHI, New Delhi (2014)
3. Nuclear Physics: D. C. Tayal, Himalaya Publishing House, Revised & Enlarged Edition (2012)
4. Concepts of Modern Physics: Arthur Beiser, Tata McGraw-Hill, New Delhi, 6^{th} Edition (2003)
5. Atomic and Nuclear Physics: N. Subramaniam and Brij Lal, S. Chand & Co. Ltd., New Delhi (2007)
6. Atomic Physics: J. B. Rajam, S. Chand & Co. Ltd., New Delhi (2010)
7. Introduction to Elementary Particles: D. Griffith, John Wiley & Sons (2008)
8. Nuclear Physics: S. N. Ghoshal, S. Chand & Co., New Delhi (2008)

Books for reference:

1. Concepts of Nuclear Physics: Bernard L. Cohen, Tata McGraw-Hill (1998)
2. Nuclear Physics: Irving Kaplan, Narosa Publications (2002)
3. Introductory Nuclear Physics: Kenneth S. Krane, Wiley India Pvt. Ltd. (2008)
4. Introduction to the Physics of Nuclei and Particles: R. A. Dunlap and Thomson Asia (2004)

5. Quarks and Leptons: F. Halzen and A. D. Martin, John Wiley & Sons, New York (1984)
6. Basic Ideas and Concepts in Nuclear Physics - An Introductory Approach: K. Heyde, Institute of Physics Publishing (2004)
7. Radiation Detection and Measurement: G. F. Knoll, John Wiley & Sons (2000)
8. Theoretical Nuclear Physics: J. M. Blatt and V. F. Weisskopf, Dover Pub. Inc. (1991)

AUPY643: CLASSICAL AND MODERN OPTICS

Total Teaching Hours: 72 **No. of Lecture Hours/Week: 4**

Max Marks: 80 **Credits: 4**

Course Outcomes

Students who complete this course may be able to

CO1. get a fundamental knowledge of interferometry, coherence, polarization and diffraction.

CO2. get knowledge of the polarization of light and its changes upon reflection and transmission

CO3. get acquainted with Fresnel's and Fraunhofer's diffraction and their validity requirements

CO4. distinguish between normal and anomalous dispersion

CO5. attain knowledge on principle of holography and its applications

CO6. Aquire good knowledge on different light sources including lasers

CO6. understand the differences between step index and graded index fibers, single mode and multimode fibers

CO7. understand the advantages of fiber optic communication system.

Unit 1. Interference of Light (12 hours)

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 - classification of fringes - wedge shaped films-testing of optical flatness - Newton’s rings (reflected system) - refractive index of a liquid - Michelson interferometer - determination of wavelength.

Unit 2. Diffraction (14 hours)

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.

Unit 3.Dispersion (5 hours)

Normal dispersion - Cauchy's dispersion formula - Hartmann's formula - anomalous dispersion - Sellmeier formula - Wood's experiment for anomalous dispersion - elementary theory of dispersion.

Unit 4. Polarisation (12 hours)

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 - production and analysis of plane, circularly and elliptically polarized light - quarter and half wave plates.

Unit 4. Laser (14 hours)

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.

Unit 5.Fibre Optics (8 hours)

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.

Unit 6. Holography (7 hours)

Principle of holography - recording of holograms - reconstruction of images (theory not needed) - application of holography - different types of holograms - transmission and reflection types.

Books for study:

1. A Textbook of Optics: N. Subrahmanyam, Brij Lal and M. N. Avadhanulu 23rd Edition (2006)
2. Optics: Ajoy Ghatak, Tata McGraw-Hill (2005)
3. Optics and Spectroscopy: R. Murugeshan and K. Sivaprasad, S. Chand & Co. Ltd. (2010)
4. Lasers: Principles, Types and Applications: K. R. Nambiar, New Age International Pvt. Ltd. (2006)

5. Optics: Eugene Hecht, Addison-Wesley (2001)

Books for reference:

1. Fundamentals of Optics: Francis A. Jenkins and Harvey E. White, McGraw-Hill Education (2001)
2. Modern Classical Optics: Geoffrey Brooker, Oxford University Press (2003)
3. Fundamentals of Optics: Geometrical Physical and Quantum: D. R. Khanna and H. R. Gulati, R. Chand (1984)
4. Lasers and Non-Linear Optics: B. B. Laud, New Age International Pvt. Ltd. (2011)
5. Electronic Communications: Dennis Roddy & John Coolen, Pearson, 4th Edition (1995)

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. Laurent's half shade polarimeter.
6. Laser applications.
7. Study of Fraunhofer lines using spectrometer.
8. Determination of refractive index of liquid by Newton's rings method.
9. Comparison of radii of curvature by Newton's rings method.

AUPY644: DIGITAL ELECTRONICS AND COMPUTER SCIENCE

Total Teaching Hours: 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 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**.** write C++ programs

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

Unit 1.Digital Electronics (22 hours)

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 hexadecimal number to decimal - decimal to hexadecimal - binary to hexadecimal and hexadecimal to binary-ASCII code - logic gates AND, OR, NOT, NAND, NOR and XOR 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.

Half adder - full adder - controlled inverter - binary adder - subtractor - flip flop - SR flip flop - JK flip flop - master slave JK flip flop.

Unit 2. Fundamentals of Computers (10 hours)

Hardware - input and output units - memory unit - ALU-control unit - basic operational concepts - software operating systems - basic concepts - memory - 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.

Unit 3. Programming in C++ (26 hours)

Features of C++ - basic structure of C++ programs - header files - in and out functions – compilation and execution - data types - constants and variables - global variables - operators and expressions of C++ - flow control - conditional statements - iterative statements - switch statements - conditional operators as an alternative to IF-nested loops - break - structured data types - arrays - storage classes - multidimensional arrays - sorting of strings – functions - built in and user define accessing function and passing arguments to functions - calling functions with arrays - scope rule for functions and variables - structures in C++ - classes and objects - definition - class declaration - function definitions - creating objects - use of pointers in the place of arrays - file handling in C++ - basic file operations

Unit4. Basics of microprocessors (14 hours)

Evolution of microprocessors - microcontrollers and digital signal processors - Intel 8085 8 bit microprocessor - pin description - functional description - 8085 instruction format - addressing modes of 8085 - interrupts of 8085 - memory interfacing - 8085 machine cycles and bus timings - assembly language programming of 8085.

Books for study:

1. Fundamentals of Microprocessors and Microcontrollers: B. Ram, Dhanpat Rai Publications Co. Ltd., New Delhi (2012)
2. Digital Principles and Applications: Albert P. Malvino and Donald P. Leach, McGraw-Hill, New York, 4th Edition (1986)
3. Computer Organization: Carl Hamcher, Zvonko Vranesicand Safwat Zaky, McGraw-Hill Higher Education, 5th Edition (2002)
4. Fundamentals of Computers: V. Rajaraman and Neehara Adabala, PHI, New Delhi, 6th Edition (2015)
5. Programming in C++: D. Ravichandran Tata McGraw-Hill (2011)
6. Programming in C++: M. T. Somasekhara, PHI Pvt. Publishing (2005)
7. The 8085 microprocessor: K. Udayakumar and B. S. Umasankar, Dorling Kindersley Pvt. Ltd., India (2008)

Books for reference:

1. Introduction to Digital Electronics: NIIT-PHI.
2. A first course in Computers 2003 Edition: Sanjay Saxena, Vikas Publishing House Pvt. Ltd.
3. Beginning Linux Programming: Neil Mathew and Richard Stones: Wiley Publishing Co., Indiana, 4th Edition (2008)

AUPY691: ELECTIVE COURSES

AUPY 691.a SPACE SCIENCE

Total Teaching Hours: 54	**No. of Lecture Hours/Week: 3**
Max Marks: 80	**Credits: 2**

Course Outcomes

Students who complete this course will get an elaborate knowledge about

CO1. the different structures in the universe

CO2. classification and evolution of stars

CO3. solar activity

CO4. earth’s atmosphere and magnetic field

Unit 1. Universe (12 hours)

Large Scale Structure of the Universe: Astronomy and Cosmology - our galaxy - galaxy types - radio sources - quasars - structures on the largest scale - coordinates and catalogues of astronomical objects - expansion of the universe

Unit 2. The Evolution of Stars (9 hours)

Introduction - classification of stars: the Harvard classification - Hertzsprung – Russel diagram - stellar evolution - white dwarfs - electrons in a white dwarf star - Chandrasekhar limit - neutron stars - black holes - supernova explosion - photon diffusion time - gravitational potential energy of a star - internal temperature of a star -internal pressure of a star.

Unit 3. The Active Sun (10 hours)

Introduction - sunspots and solar storms - sunspots and solar activity - cosmic rays of solar origin - solar wind - solar corona and the origin of the solar wind - disturbed solar wind.

Unit 4. The Earth's Atmosphere (15 hrs)

Introduction - nomenclature and temperature profile - temperature distribution in the troposphere - temperature of stratosphere - temperature of mesosphere and thermosphere - temperature variability - the pressure profile - scale height - density variation.

The Ionosphere: Effect on scale height - ionospheric electric fields - ionization profile - Layer of charge - ionospheric hydrogen and helium.

Unit 5.Magnetosphere (8 hours)

Introduction - magnetic field of earth - earth's variable magnetic field - solar activity and earth's magnetic weather - solar wind interaction - The Chapman Ferraro closed magnetosphere - Dungey's open magnetosphere - structure of the magnetosphere: Magneto tail and Plasma sheet - plasma sphere - earth's radiation belts.

Books for study:

1. Introduction to Space Science: Robert C Hymes, John Wiley & Sons Inc. (1971)
2. Earth's Proximal Space: ChanchalUberoi, Universities Press (India) (2000)
3. Introduction to Cosmology: J. V. Narlikar, Cambridge University Press (1993)
4. Modern Physics: R. Murugeshan andKiruthikaSivaprasath, S.Chand & Company Ltd. (2007)

Books for reference:

1. Space Physics and Space Astronomy: Michael D Papagianni, Gordon and Breach Science

Publishers Ltd.
2. Introductory Course on Space Science and Earth's environment: S. S. Degaonkar , Gujarat University (1978)
3. An Introduction to the Ionosphere and Magnetosphere: J. A. Ratcliffe, Cambridge University Press (1972)
4. The Physics of Atmospheres: John T. Houghton, Cambridge University Press(1977)
5. Introduction to Ionospheric Physics: Henry Rishbeth and Owen K. Garriot, Academic Press (1969)
6. Space Science: Louise K. Harra and Keith O. Mason, Imperial College Press, London (2004)
7. Introduction to Space Physics: Margaret G. Kivelson and Christopher T. Russel, Cambridge University Press(1995)
8. An Introduction to Astrophysics: B. Basu, T. Chattopadhyay and S. N. Biswas, PHI, New Delhi (2010)
9. Astrophysics: Stars and Galaxies: K. D. Abhayankar, University Press (2001)

AUPY691: ELECTIVE COURSES

AUPY 691.a. SPACE SCIENCE

Total Teaching Hours: 54 **No. of Lecture Hours/Week: 3**

Max Marks: 80 **Credits: 2**

Course Outcomes

Students who complete this course will get an elaborate knowledge about

CO1. the different structures in the universe

CO2. classification and evolution of stars

CO3. solar activity

CO4. earth's atmosphere and magnetic field

Unit 1. Universe (12 hours)

Large scale structure of the universe: astronomy and cosmology - our galaxy - galaxy types - radio sources - quasars - structures on the largest scale - coordinates and catalogues of astronomical objects - expansion of the universe.

Unit 2. The Evolution of Stars (9 hours)

Introduction - classification of stars: the Harvard classification - Hertzsprung-Russel diagram - stellar evolution - white dwarfs - electrons in a white dwarf star - Chandrasekhar limit - neutron stars

- black holes - supernova explosion - photon diffusion time - gravitational potential energy of a star - internal temperature of a star - internal pressure of a star.

Unit 3. The Active Sun (10 hours)

Introduction - sunspots and solar storms - sunspots and solar activity - cosmic rays of solar origin - solar wind - solar corona and the origin of the solar wind - disturbed solar wind.

Unit 4. The Earth's Atmosphere (15 hours)

Introduction - nomenclature and temperature profile - temperature distribution in the troposphere - temperature of stratosphere - temperature of mesosphere and thermosphere - temperature variability - the pressure profile - scale height - density variation.

The Ionosphere: Effect on scale height - ionospheric electric fields - ionization profile - layer of charge - ionospheric hydrogen and helium.

Unit 5.Magnetosphere (8 hours)

Introduction - magnetic field of earth - earth's variable magnetic field - solar activity and earth's magnetic weather - solar wind interaction - The Chapman Ferraro closed magnetosphere - Dungey's open magnetosphere - structure of the magnetosphere: Magneto tail and Plasma sheet - plasma sphere - earth's radiation belts.

Books for study:

1. Introduction to Space Science: Robert C Hymes, John Wiley & Sons Inc. (1971)
2. Earth's Proximal Space: Chanchal Uberoi, Universities Press (India) (2000)
3. Introduction to Cosmology: J. V. Narlikar, Cambridge University Press (1993)
4. Modern Physics: R. Murugeshan and Kiruthika Sivaprasath, S. Chand & Company Ltd. (2007)

Books for reference:

1. Space Physics and Space Astronomy: Michael D Papagianni, Gordon and Breach Science Publishers Ltd.
2. Introductory Course on Space Science and Earth's Environment: S. S. Degaonkar , Gujarat University (1978)
3. An Introduction to the Ionosphere and Magnetosphere: J. A. Ratcliffe, Cambridge University Press (1972)
4. The Physics of Atmospheres: John T. Houghton, Cambridge University Press (1977)

5. Introduction to Ionospheric Physics: Henry Rishbeth & Owen K. Garriot, Academic Press (1969)
6. Space Science: Louise K. Harra & Keith O. Mason, Imperial College Press, London (2004)
7. Introduction to Space Physics: M. G. Kivelson and C. T. Russel, Cambridge University Press (1995)
8. An Introduction to Astrophysics: Baidyanadh Basu, Tanuka Chattopadhyay and Sudhindra N. Biswas, PHI, New Delhi (2010)
9. Astrophysics: Stars and Galaxies: K. D. Abhayankar, University Press (2001)

AUPY691.b ELECTRONIC INSTRUMENTATION

Total Teaching Hours: 54 **No. of Lecture Hours/Week: 3**

Max Marks: 80 **Credits: 2**

Course Outcomes

Students who complete this course will

CO1. be able to use the basic measuring devices like ammeter, voltmeter etc. and their digital versions, effectively

CO2. be able to use oscilloscopes for measurements

CO3. have a thorough knowledge of the transducers and wave generators

Unit 1. Basic Instruments (14 hours)

Basic concepts of measurements - Instruments for measuring basic parameters - ammeter - voltmeters - multimeter - digital voltmeter - accuracy and resolution of DVM.

Unit 2. Oscilloscopes (14 hours)

Cathode ray tubes - CRT circuits - vertical deflection system - delay line - horizontal deflection system - multiple trace - oscilloscope probes and transducer - storage oscilloscopes.

Unit 3. Transducers (10 hours)

Basic principles - classification of transducers - passive and active transducers - strain gauges - temperature measurements - thermistors - photosensitive devices.

Unit 4. Signal Generation and Analysis (16 hours)

Sine wave generator - frequency synthesizer - sweep generator – astable multivibrator - laboratory pulse generator - function generator- wave analysers harmonic distortion analyzer - wave meter - spectrum analyzer (qualitative idea only).

Books for study:

1. Modern Electronic Instrumentation and Measurement Techniques: Albert D. Helfrick& William D. Cooper, Simon & Schuster, Singapore (1994)
2. Electronic Instrumentation: H. S. Kalsi, Tata McGraw-Hill, 2nd Edition (2006)
3. Instrumentation-Devices and Systems: C. S. Rangan, G. R. Sarma, V. S. V. Mani, McGraw-Hill Education, 2nd Edition (2017)
4. Electronic Instruments and Instrumentation Technology: M. M .S. Anand, PHI Ltd. (2004)

Books for reference:

1. Sensors and Transducers: D. Patranabis, PHI Learning, 2nd Edition (2013).
2. Industrial Electronics and Control: S. K. Bhattacharya & S. Chatterjee, McGraw-Hill Edu. (2017)
3. Electronic Measurement and Instrumentation: K. B. Klaassen, Cambridge University Press, UK (2002)
4. Measurement Systems: Applications and Design: Ernest O. Doebelin, McGraw-Hill, 5th Edition (2004)
5. Principles of Measurement Systems: John P. Bentley, Pearson Education, 3rd Edition (2000)

AUPY691.c. NANOSCIENCE AND TECHNOLOGY

Total Teaching Hours: 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

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 characterization 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 (6 hours)

General introduction to the history, scope and applications of nanoscience and nanomaterial - classification of nano structured materials - quantum confinement - fascinating nanostructures - nanowires - nanorods - nanoshells - nanotubes - nanofluids- applications of nanomaterial - nature the best nano technologist - challenges and future prospects.

Unit 2. Unique Properties of Nanomaterials (10 hours)

Microstructure and defects in nanocrystalline materials - dislocations - twins stacking faults and voids - multiply twinned nanoparticles - effect of nano dimension on materials behavior - elastic properties - melting point - diffusivity - grain growth characteristics - enhanced solid solubility - magnetic properties - electrical properties - optical properties - thermal properties - mechanical properties - band structure and density of state at nano scale - energy bands - density of states at low dimensional structures.

Unit 3. Introductory Quantum Mechanics for Nanoscience (8 hours)

Size effects in small systems - quantumbehaviors of nano metric world - applications of Schrödinger equation - infinite potential well - potential step - potential box - trapped particle in 3D (nanodot) - electron trapped in 2D plane (nanosheet) - electrons moving in 1D (nanowire, nanorod, nanobelt) - Excitons - quantum confinement effect in nanomaterials.

Unit 4. Synthesis Routes (8 hours)

Bottom up approach- physical vapor deposition - inert gas condensation - laser ablation - chemical vapor deposition -thermally activated CVD - plasma enhanced CVD - molecular beam epitaxy - sol-gel process - wet chemical synthesis - self-assembly.

Top down approach-mechanical alloying - nanolithography consolidation of nanopowders - shock wave consolidation - hot isotactic press and cold isotactic press - spark plasma sintering.

Unit 5. Tools to Characterize Nanomaterial (qualitative ideas only) (8 hours)

XRD (Debye Scherrer equation) - microscopy - scanning electron microscope (SEM) - tunneling electron microscope (TEM) - atomic force microscope (AFM) - scanning tunneling microscope (STM).

Unit 6. Nano Structured Materials with High Application Potential (elementary idea only) (4 hours)

Quantum dots - semiconductor nanocrystal QDs - Self assembled QDs - applications of QDs -carbon nanotubes (CNT) - single walled and multi walled CNT - chirality - electric arc discharge method for the synthesis of CNT.

Unit 7. Applications of Nanomaterial (elementary ideas only) (10 hours)

Applications of nanotechnology in electronics - optoelectronic devices - MEMS and NEMS - Nanosensors - CNT sensors - polymeric nanofibers and nanocomposites - SQUID based nanosensors - biosensors - magnetic nanoparticles - applications of nanoscience in food, agriculture, cosmetics, consumer goods, structural engineering, automotive industry, water treatment and environment, nanomedicines, textile, paints, energy, defense and space.

Books for study:

1. Textbook of Nanoscience and Technology: B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, University Press India Pvt. Ltd., Hyderabad (2013)
2. Introduction to Nanoscience and Nanotechnology: K. K. Chattopadhyay and A. N. Banerjee, PHI, Learning Pvt. Ltd., New Delhi (2009)
3. Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials: Thomas Varghese and K. M. Balakrishna, Atlantic Publishers, New Delhi (2012)
4. NANO: The Essentials - Understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw-Hill, New Delhi (2007)

Books for reference:

1. Nanoparticle Technology Handbook: M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama (Eds.), Elsevier (2007)
2. Encyclopaedia of Materials Characterization: Surfaces, Interfaces, Thin Films: Eds. Brundle, Evans and Wilson, Butterworth Heinmann (1992)
3. Springer Handbook of Nanotechnology, Bharat Bhushan (Ed.), Springer-Verlag, Germany 4th Edition (2017)
4. Nanoscience and Technology: V. S. Muralidharan and A. Subramania, Ane Books Pvt. Ltd, New Delhi (2009)
5. A Handbook on Nanophysics: John D. Miller, Dominant Publishers, Delhi (2008)

6. Introduction to Nanotechnology: Charles P. Poole Jr. and Frank J. Owens, John Wiley & Sons, USA (2003)
7. Nano- and Micromaterials: K Ohno, M. Tanaka, J. Takeda, AND Y. Kawazoe, Springer, New York (2008)

PRACTICALS

AUPY44PI: MECHANICS, PROPERTIES OF MATTER, ERROR MEASUREMENTS AND HEAT

(Minimum 16 experiments to be done)

1. Simple pendulum - g, variation of period with length, mass and amplitude.
2. Spring mass system-spring constant
3. Flywheel - 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 and telescope
9. Cantilever Y - pin and microscope
10. Rigidity modulus - static torsion
11. Torsion pendulum - rigidity modulus
12. Kater's pendulum - acceleration due to gravity
13. Melde's string - frequency of fork
14. Phase transition - determination of melting point of wax.
15. Determination of thermal conductivity of rubber
16. Lee's disc - determination of thermal conductivity of a bad conductor
17. Viscosity of a liquid - Stoke's method
18. Viscosity - variable pressure head
19. Viscosity - constant pressure head
20. Surface tension-capillary rise
21. Sonometer - frequency of AC
22. Kundt's tube - determination of velocity of sound.
23. Comparison of least counts of measuring instruments.
24. Evaluation of errors in simple experiments.

Books for reference:

1. A Textbook of Practical Physics for BSc (Main) Course: Sebastian, VAS Publications.
2. Practical Physics: P. R. Sasi Kumar, PHI, New Delhi (2011)
3. Experimental Physics for Students: J. Yarwood and R. M. Whittle, Chapman & Hall Publishers (1973)
4. An Advanced Course in Practical Physics, D. Chathopadhyay andP. C. Rakshit,New Central Book Agency, Kolkata (2011)
5. Practical Physics and Electronics, C. C. Ouseph, U. J. Rao and V. Vijayendran, S.Viswanathan Printers & Publishers Pvt. Ltd. (2009)
6. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Methen & Co. Ltd., London (1957)

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 and 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 TG
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 and 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 B_h - box type and Searle's type vibration magnetometers
25. Searle's vibration magnetometer - comparison of magnetic moments

Books for reference:

1. A Textbook of Practical Physics for BSc (Main) Course: Sebastian, VAS Publications.
2. Practical Physics: P. R. Sasi Kumar, PHI, New Delhi (2011)
3. Experimental Physics for Students: J. Yarwood and R. M. Whittle, Chapman & Hall Publishers (1973)
4. An Advanced Course in Practical Physics, D. Chathopadhyay andP. C. Rakshit,New Central Book Agency, Kolkata (2011)
5. Practical Physics and Electronics, C. C. Ouseph, U. J. Rao and V. Vijayendran, S. Viswanathan Printers & Publishers Pvt. Ltd. (2009)
6. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Methen & Co. Ltd., London (1957)

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 5000 Ω).
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 R_L 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 an 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 table of NOT gate using a transistor.
18. Network theorems -Superposition, Thevenin's and Norton's theoremsTo verify the (i) Superposition, (ii) Thevenin's and (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.

Books for reference:

1. A Textbook of Practical Physics for BSc (Main) Course: Sebastian, VAS Publications.
2. Practical Physics: P. R. Sasi Kumar, PHI, New Delhi (2011)
3. Experimental Physics for Students: J. Yarwood and R. M. Whittle, Chapman & Hall Publishers (1973)
4. An Advanced Course in Practical Physics, D. Chathopadhyay and P. C. Rakshit, New Central Book Agency, Kolkata (2011)
5. Practical Physics and Electronics, C. C. Ouseph, U. J. Rao and V. Vijayendran, S. Viswanathan Printers & Publishers Pvt. Ltd. (2009)
6. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Methen & Co. Ltd., London (1957)

FDP COMPLEMENTARY PHYSICS

SEMESTER 1 (CHEMISTRY MAIN)

AUPY131.2b. ROTATIONAL DYNAMICS AND PROPERTIES OF MATTER

Total Teaching Hours: 36 **No. of Lecture Hours/Week: 2**

Maximum Marks: 80 **Credits: 2**

Course Outcomes

Students who complete this course will get a thorough knowledge about 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 mechanical waves and their applications.

CO3. the concepts of moduli of elasticity and applications.

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

Unit 1. Dynamics of Rigid Bodies (6 hours)

Theorems of moment of inertia (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 and solid sphere - K.E of a rotating body - fly wheel.

Unit 2. Oscillations and Waves (13 hours)

Simple harmonic oscillators - compound pendulum - determination of g - torsion pendulum - oscillations of two particles connected by a spring - vibration state of a diatomic molecule.

General equation of wave motion - plane progressive harmonic wave - energy density of a plane progressive wave.

Unit 3. Mechanics of Solids (7 hours)

Bending of beams - bending moment - cantilever, uniform and non-uniform bending - experimental determination of Young's modulus using the above principles using pin and microscope - twisting couple on a cylinder - angle of twist and angle of shear.

Unit 4. 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.

Unit 5. 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.

Books for study and reference:

1. Mechanics: J. C. Upadhyaya, Ram Prasad Publication, Agra (2017)
2. Oscillations and Waves: N. Subramaniam&BrijLal, Vikas Publishing House, 2nd Edition (1994)
3. Complementary Physic: P. S. Sebastian Kunju, VAS Publications

SEMESTER 2 (CHEMISTRY MAIN)

AUPY231.2b. THERMAL PHYSICS

Total Teaching Hours: 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.

CO2. concepts of conduction and radiation.

CO3. different heat engines starting from Carnot's engine.

CO4. concept of entropy.

Unit 1.Diffusion (4 hours)

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 (14 hours)

Thermal conductivity and thermometric conductivity - Lee's disc experiment - cylindrical flow of heat - thermal conductivity of rubber – Wiedemann-Franz law (statement only).

Radiation of heat - black body radiation - Kirchoff's laws of heat radiation - absorptive power - emissive power - Stefan's law (derivation not required) - energy distribution in the spectrum of black body and results - Wien's displacement law - Wien's law - Rayleigh-Jeans law and Planck's hypothesis - Planck's law.

Unit 3. Thermodynamics (10 hours)

Isothermal and adiabatic processes - equations and work done - isothermal and adiabatic elasticity - Carnot's cycle - Otto and Diesel engines - description and derivation of efficiency - second law of thermodynamics - Kelvin and Clausius statements - Phase transition - first order and second order - liquid helium - super fluidity.

Unit 4. Entropy (8 hours)

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 of thermodynamics in terms of entropy - calculation of entropy when ice is converted into steam.

Books for study and reference:

1. The General Properties of Matter: F. H. Newman & V. H. L. Searle, Edward Arnold & Co., London (1957)
2. Heat and Thermodynamics: N. Subramaniam & Brij Lal, S. Chand & Co. Ltd. (2008)
3. Heat and Thermodynamics: W. Zemansky, McGraw-Hill (1961)
4. Heat and Thermodynamics: Including Statistical Thermodynamics: C. L. Arora S. Chand & Co. (1999)
5. Complementary Physics: P. S. Sebastian Kunju, VAS Publications

SEMESTER 3 (CHEMISTRY MAIN)

AUPY331.2b. OPTICS, MAGNETISM AND ELECTRICITY

Total Teaching Hours: 54 **No. of Lecture Hours/Week: 3**

Maximum 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, air wedge and diffraction grating.

CO3. understand the basics of polarization

CO4. get an idea about half wave plate, quarter wave plate, elliptically and circularly polarized light

CO5. understand the basic principles of laser and optical fiber

CO6. attain knowledge on the basics of magnetic properties

CO7. understand the theory of magnetism

CO8. understand the production of ac and its characteristics and also about ac circuits

Unit 1. 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.

Unit 2. Diffraction (10 hours)

Phenomenon of diffraction - Fresnel and Fraunhofer diffraction - Fresnel's theory of approximate rectilinear propagation of light - Fresnel diffraction at a straightedge - Fraunhofer diffraction at a single slit and two slits - plane transmission grating - determination of wavelength - resolving power of grating.

Unit 3. Polarization (8 hours)

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.

Unit 4. 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 5. Magnetism (10 hours)

Magnetic properties of matter - definition and relation between magnetic vectors (**B**, **H** and **M**) - Magnetic susceptibility and permeability - diamagnetism – paramagnetism - ferromagnetism - anti-ferromagnetism - electron theory of magnetism - explanation of ferromagnetism.

Unit 6. Electricity (10 hours)

The emf induced in a coil rotating in a magnetic field - peak, mean, rms and effective values of ac - ac circuits - ac through RC, LC, LR and LCR series circuits - resonance - sharpness of resonance - power factor and choke coil - transformers.

Books for study and reference:

1. A Textbook of Optics: N. Subrahmanyam, Brij Lal and M. N. Avadhanulu 23rd Edition (2006)
2. Electricity and Magnetism: R. Murugeshan, S. Chand & Co. Ltd. (2008)
3. Complementary Physics: P. S. Sebastian Kunju, VAS Publications.

SEMESTER 4 (CHEMISTRY MAIN)

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

Total Teaching Hours: 54 **No. of Lecture Hours/Week: 3**

Maximum Marks:80 **Credits:3**

Course Outcomes

Students who complete this course will be able to understand the

CO1. concept**s** of atom models and various quantum numbers.

CO2. the basics of superconductivity, types of superconductors and their applications

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

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

CO5. basics of electronics

CO6. working of various electronic components like diodes, transistor and amplifier

CO7. basics of digital Electronics

Unit 1. Atomic Physics (12 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.

Unit 2. Superconductivity (6 hours)

Properties of super conductors - 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 (12 hours)

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. Basic Electronics (18 hours)

Current-voltage characteristics of a diode - forward and reverse bias - breakdown mechanisms in p-n junction diode - Zener diode and its characteristics - rectifiers - half wave, full wave (centre tapped) and bridge rectifiers - ripple factor and 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 and voltage divider bias (qualitative study only).

Small signal CE amplifier - circuit and its operation - gain, input and output resistances - frequency response and band width.

Unit 5. Digital Electronics (6 hours)

Number systems - decimal to binary conversion - binary arithmetic - 1's and 2's compliments - logic gates - NOT, OR, AND, NOR and NAND gates - Boolean algebra - Boolean operations - logic expressions - laws of Boolean algebra - De Morgan's theorem.

Books for study and reference:

1. Modern Physics: R. Murugeshan and K. Sivaprasath, S. Chand & Co. Ltd., 12th Edition (2006)
2. Principles of Electronics: V. K. Mehta and Rohit Mehta, S. Chand & Co. Ltd., New Delhi (2012)
3. Complementary Physics, P. S. Sebastian Kunju, VAS Publications

SEMESTER 1 (MATHEMATICS MAIN)

AUPY131.2c. MECHANICS AND PROPERTIES OF MATTER

Total Teaching Hours: 36 | **No. of Lecture Hours/Week: 2**

Max Marks: 80 | **Credits: 2**

Course Outcomes

Students who complete this course will get a good knowledge about the

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

CO2. basics of simple harmonic motion and mechanical waves and their applications

CO3. the concepts of moduli of elasticity and applications

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

Unit 1. Dynamics of rigid bodies (7 hours)

Theorems of moment of inertia (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 and solid sphere - K.E of a rotating body - flywheel.

Unit 2. Oscillations and waves (14 hours)

Simple harmonic oscillator - compound pendulum - determination of g - torsion pendulum - oscillations of two particles connected by a spring - vibration state of a diatomic molecule.

General equation of wave motion - plane progressive harmonic wave - energy density of a plane progressive wave - transverse waves in stretched string - modes of transverse vibrations of strings.

Unit 3. Mechanics of Solids (7 hours)

Bending of beams - bending moment - cantilever - uniform and non-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.

Unit 4. 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.

Unit 5. Viscosity (3 hours)

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

Books for study and reference:

1. Mechanics: J. C. Upadhyaya, Ram Prasad Publication, Agra (2017)
2. Oscillations and Waves: N. Subramaniam & Brij Lal, Vikas Publishing House, 2nd Edition (1994)
3. Complementary Physics: P. S. Sebastian Kunju, VAS Publications

SEMESTER 2 (MATHEMATICS MAIN)

AUPY231.2c. HEAT AND THERMODYNAMICS

Total Teaching Hours: 36 **No. of Lecture Hours/Week: 2**

Maximum Marks : 80 **Credits: 2**

Course Outcomes

Students who complete this course will will aquire a deep knowledge about the

CO1. concepts of conduction and radiation.

CO2. different heat engines starting from Carnot's engine.

CO3. concept of entropy.

Unit 1.Transmission of Heat (14 hours)

Thermal conductivity and thermometric conductivity - Lee's disc experiment - Radial flow of heat - cylindrical flow of heat - thermal conductivity of rubber - Wiedemann-Franz law (statement only). Radiation of heat - black body radiation - Kirchoff's laws of heat radiation - absorptive power - emissive power - Stefan's law (derivation not required) - energy distribution in the spectrum of black body and results - Wien's displacement law - Wein's law, Rayleigh-Jean's law and Planck's hypothesis - Planck's law - comparison solar constant - temperature of sun.

Unit 2.Thermodynamics (14 hours)

Zeroth law and first law of thermodynamics - isothermal and adiabatic processes - equations and work done - isothermal and adiabatic elasticity - application of first law to specific heat and latent heat - Carnot's cycle - Otto and Diesel engines - description and derivation of efficiency.

Second law of thermodynamics - Kelvin and Clausius statements - phase transition - first order and second order - liquid helium - super fluidity.

Unit 3.Entropy (8 hours)

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 and Thermodynamics: N. Subramaniam & Brij Lal, S. Chand & Co. Ltd. (2008)
2. Heat and Thermodynamics: Including Statistical Thermodynamics: C. L. Arora, S. Chand &

Co. Ltd. (1999)
3. Heat and Thermodynamics: W. Zemansky, McGraw-Hill (1961)
4. Complementary Physics: P. S. Sebastian Kunju, VAS Publications.

SEMESTER 3 (MATHEMATICS MAIN)

AUPY331.2c. OPTICS, MAGNETISM AND ELECTRICITY

Total Teaching Hours for Semester:54 **No. of Lecture Hours/Week:3**

Maximum Marks:80 **Credits:3**

Course Outcomes

Students who complete this course will be able to

CO1. understand the optical phenomena like interference and diffraction

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

CO3. understand the basics of polarization

CO4. get an idea about half wave plate, quarter wave plate, elliptically and circularly polarized light

CO5. understand the basic principles of laser and optical fiber

CO6. attain knowledge on the basics of magnetic properties

CO7. understand the theory of magnetism

CO8. understand the production of ac and its characteristics

CO9. get the knowledge on ac circuits

Unit 1. 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.

Unit 2. Diffraction (14 hours)

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

Unit 3. Laser and Fibre Optics (8 hours)

Principle of operation of laser - population inversion - optical pumping - Ruby laser - He-Ne laser - dye laser - semiconductor laser - applications of lasers.
Light propagation in optical fibres - step index fibre - graded index fibre - applications.

Unit 4. Magnetism (10 hours)

Magnetic properties of matter - definition and relation between magnetic vectors (**B**, **H** and **M**) - magnetic susceptibility and permeability - diamagnetism - paramagnetism - ferromagnetism - anti-ferromagnetism - electron theory of magnetism - explanation of ferromagnetism.

Unit 5. Electricity (10 hours)

The emf induced in a coil rotating in a magnetic field - peak, mean, rms and effective values of ac - ac circuits - ac through RC, LC, LR and LCR series circuits - resonance - sharpness of resonance - power factor and choke coil - transformers.

Books for study and reference:

1. A Textbook of Optics: N. Subrahmanyam, Brij Lal and M. N. Avadhanulu 23rd Edition (2006)
2. Electricity and Magnetism: R. Murugeshan, S. Chand & Co. Ltd. (2008)
3. Complementary Physics, P. S. Sebastian Kunju, VAS Publications

SEMESTER 4 (MATHEMATICS MAIN)

AUPY431.2c. MODERN PHYSICS AND ELECTRONICS

Total Teaching Hours: 54 **No. of Lecture Hours/Week:3**

Maximum Marks:80 **Credits:3**

Course Outcomes

Students who complete this course 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 algebra

Unit 1. Modern Physics (16 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 - laws of radioactive decay - decay constant - half life and mean life - radioactive equilibrium - secular and transient equilibriums - measurement of radioactivity.

Unit 2.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 3. Basic Electronics (18 hours)

Current-voltage characteristics of a diode - forward and reverse bias - breakdown mechanisms in p-n junction diode - Zener diode and its characteristics - rectifiers - half wave, full wave (centre tapped) and 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 and voltage divider bias (qualitative study only) - small signal CE amplifier - circuit and its operation - gain, input and output resistances - frequency response and band width.

Unit 4. Digital Electronics (8 hours)

Number systems and codes - decimal numbers - binary arithmetic - 1's and 2's compliments - 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 and K. Sivaprasath, S.Chand & Co. Ltd., 12th Edition (2006)
2. Principles of Electronics: V. K. Mehta and Rohit Mehta, S. Chand & Co. Ltd., New Delhi (2012)
3. Digital Principles and Applications: Albert P. Malvino and Donald P. Leach, Tata McGraw-Hill, New Delhi, 7th Edition (2011)
4. Complementary Physics: P. S. Sebastian Kunju, VAS Publications.

COMPLEMENTARY PRACTICALS (PHYSICS)
(COMMON FOR ALL COMPLEMENTARY SUBJECTS)
AUPY43.2c PI - PRACTICAL
List of Experiments (Minimum 18 experiments to be done)

1. Torsion Pendulum - Determination of rigidity modulus by torsional oscillations
2. Torsion Pendulum - Determination of rigidity modulus and moment of inertia using equal masses
3. Flywheel - Determination of moment of inertia
4. Cantilever - Determination of Young's Modulus by mirror and telescope method
5. Uniform bending - Determination of Young's modulus by pin and microscope method
6. Symmetric bar pendulum - Determination of acceleration due to gravity and radius of gyration
7. Determination of surface tension - capillary rise method
8. Determination of coefficient of viscosity - capillary flow method
9. Determination of specific heat-method of mixtures applying Barton's correction
10. Determination of thermal conductivity of cardboard - Lee's disc method
11. Melde's string - Determination of frequency of tuning fork
12. Method of parallax - Determination of optical constants of convex lens using (i) mirror and mercury(ii) mirror and water
13. Method of parallax - Determination of refractive index of liquid.
14. Spectrometer - Determination of angle of the prism, angle of minimum deviation and refractive index
15. Spectrometer - Determination of dispersive power of a prism
16. Spectrometer - Grating - normal incidence
17. Deflection and vibration magnetometer - Determination of m and B_h
18. Circular coil - Determination of magnetization of a magnet
19. Carey Foster's bridge - Determination of resistivity

20. Potentiometer-Determination of resistivity

21. Potentiometer - Calibration of ammeter

22. Diode Characteristics

23. Half wave rectifier - Measurement of ripple factor with and without filter capacitor

24. Full wave rectifier - Measurement of ripple factor with and without filter capacitor

Books for reference:

1. A Textbook of Practical Physics for BSc (Complimentary) Course: Sebastian, VAS Publications

2. Practical Physics: P. R. Sasi Kumar, PHI, New Delhi (2011)