DEPARTMENT OF PHYSICS

MAR IVANIOS COLLEGE (AUTONOMOUS), THIRUVANANTHAPURAM

(AFFILIATED TO THE UNIVERSITY OF KERALA)

SYLLABUS FOR FIRST DEGREE PROGRAMME IN

PHYSICS (CORE) WITH MATHEMATICS AND MACHINE LEARNING AS COMPLEMENTARY COURSES

UNDER

CHOICE BASED-CREDIT & SEMESTER-SYSTEM (CBCSS)

(2022 admission onwards)

Preamble

The primary mission of the First Degree Programme in Physics is to provide an outstanding education for students. Our curriculum serves undergraduate students who seek, by the study of Physics, to acquire critical thinking skills and to develop the understanding and problem-solving abilities which are increasingly needed in our technological society. The undergraduate courses of study provide solid foundation in physics and they introduce a broad spectrum of modern trends in physics and experimental, computational and mathematical skills of students which are essential to further advancement. The syllabus is framed in accordance with the Outcome Based Education (OBE) 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.

The objectives of the programme is

(i) By the end of the second semester, the students would have, attained a higher level of knowledge in Basic Mechanics, Properties of Matter, Thermodynamics and Classical Mechanics and would have laid a secure foundation in mathematics for their future courses.

(ii) By the end of the fourth semester, the students would have been introduced to a wide range of new generation topics, namely, Python Programming, Artificial Intelligence, Machine Learning, Classical Mechanics and Electrodynamics. Also, they would have developed their experimental and data analysis skills through a wide range of mechanical and heat experiments in the practical laboratories.

(iii) By the end of sixth semester, the students would have covered a range of topics in almost all areas of physics including Quantum Mechanics, Solid State Physics, Electronics, Digital Electronics, Digital Image Processing, Classical and Modern Optics, Biophysics, Nuclear Physics, Particle Physics and Statistical Physics. Also, they would have developed their experimental and data analysis skills through a wide range of experiments in optics, electricity, magnetism, electronics and digital electronics in the practical laboratories. The students would have been introduced to an Industry Based Course and have attained hands-on training on experimental skills. They would have acquired knowledge of IPR and Entrepreneurship development and also would have experienced the contentment of independent work through projects, seminars, etc. They would also have visited reputed research and academic centers or industries and would have acquired knowledge of the works going on in such institutions/organizations.

Programme Outcomes (PO) – FDP PROGRAMME

At the completion of the FDP Programme, the student will be able to accomplish the following programme outcomes.

PO No.	Programme Outcomes
PO1	**Quality education**: Education and training of best quality at the undergraduate level that nurture graduates of the caliber sought by IT industries and public service, as well as academicians, teachers and researchers of global standards.
PO2	**Skill development**: Provide an intellectually stimulating environment in which the students have the opportunity to develop their knowledge and skills to the best of their potential.
PO3	**Critical thinking capacity**: Ability to involve in independent and reflective thinking in order to understand logic connections between ideas and mathematical formalism of theoretical and applied physics
PO4	**Operational communication skill:** Expansion of communication skills for effectively transmitting and receiving information that emphases on acquiring knowledge, problem solving skill, improving curiosity particularly in the physical concepts and related mathematical methods for superior employability
PO5	**Societal and national perception:** Attain consciousness towards societal issues, human values and professional and disseminating scientific knowledge wherever required and also to keep scientific temper in the society to contribute towards human scientific development
PO6	**Multidisciplinary approach:** Integrating various disciplines and specialized areas to cross border and redefine problems in order to solve interdisciplinary problems that require simultaneous implementation of concepts from different branches of physics and other related areas
PO7	**Depth of knowledge:** Acquiring information at a higher level to develop skill and job potential leading to the development of the nation on global standards
PO8	**Sustained learning practice:** Understanding the requirement of being a continued learner for self-enrichment, professional development and operative partaking in social life in the modern world.

Programme Specific Outcomes (PSO)

Upon completion of FDP in Physics with Machine Learning, the graduates will be able to attain the following Programme Specific Outcomes.

PSO No.	Programe Specific Outcomes	PO No.
PSO1	Develop conceptual understanding of Physics and its practical applications and scope in the present world.	PO1
PSO2	Enhance scientific outlook, scientific attitude and scientific spirit.	PO1

PSO3	Develop skill in experimenting, analyzing and interpreting data.	PO2
PSO4	Apply physical and mathematical theories and principles in physics and related disciplines.	PO3
PSO5	Compare experimental, theoretical and graphical methods of analysis.	PO3
PSO6	Find out the errors in experimental results and suggest methods to reduce the errors.	PO3
PSO7	Develop and construct practical model systems from their conceptual knowledge.	PO3
PSO8	Acquire conceptual understanding of Physics in general real-world situations.	PO4
PSO9	Use the knowledge of mechanics to describe the motion of objects in different force fields.	PO1
PSO10	Develop awareness of IPR, entrepreneurship development, Data Science etc.	PO5
PSO11	Understand the theory and working of some common biomedical instruments and techniques	PO5, PO6
PSO12	Integrate quantum mechanics to understand the fundamentals of other branches of physics such molecular physics, optical spectroscopy, statistical physics etc.	PO7
PSO13	Understand the atomic and molecular energy levels and transitions and to identify the structure and chemical composition of materials.	PO7
PSO14	Develop an idea of various resonance spectroscopic techniques.	PO7
PSO15	Use the knowledge of basic electronics, digital electronics and communication systems to analyse and design circuits/systems.	PO7, PO8
PSO16	Apply Lagrangian and Hamiltonian formalisms to solve various dynamical problems which involve constraints	PO7
PSO17	Get knowledge of an Industry Based Course and have attained hands-on training on experimental skills.	PO6, PO8
PSO18	Develop their knowledge on application level topics such as artificial intelligence, digital image processing, robotics, machine learning, etc.	PO6
PSO19	Visit research institutions and industrial establishments.	PO4, PO5
PSO20	Get motivated to higher levels of education in the same discipline.	PO1, PO3, PO4

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.	AUPM121	Basic Mechanics and Properties of Matter **(Foundation Course 2)**	2	2	3	20	80
2.	AUPM241	Heat and Thermodynamics (Core Course I)	2	2	3	20	80
3.	AUPM341	Electrodynamics (Core Course II)	3	3	3	20	80
4.	AUPM441	Classical and Relativistic Mechanics (Core Course III)	3	3	3	20	80
		Practical					
	AUPM44PI	Mechanics, Properties of Matter and Heat	3	3	3	20	80
5.	AUPM541	Statistical Mechanics, Biophysics, IPR and Entrepreneurship Development (Core Course IV)	4	4	3	20	80
	AUPM542	Quantum Mechanics (Core Course V)	4	4	3	20	80
	AUPM543	Electronics (Core course VI)	4	4	3	20	80
	AUPM544	Atomic and Molecular Physics (Core Course VII)	4	4	3	20	80
	AUPM581	**Open Course**					
	AUPM581.a	Applied Physics	3	2	3	20	80
	AUPM581.b	Astronomy and Astrophysics	3	2	3	20	80
	AUPM581.c	Biophysics	3	2	3	20	80
6.	AUPM641	Solid State Physics (Core Course VIII)	4	4	3	20	80
	AUPM642	Nuclear and Particle Physics (Core Course IX)	4	4	3	20	80
	AUPM643	Classical and Modern Optics (Core Course X)	4	4	3	20	80
	AUPM644	Digital Electronics, Digital Image Processing and Robotics (Core Course XI)	4	3	3	20	80
	AUPM691	**Elective Course**					
	AUPM691.a	Computer Hardware and Networking	3	2	3	20	80
	AUPM691.b	Electronic Instrumentation	3	2	3	20	80
	AUPM691.c	Nanoscience and Technology	3	2	3	20	80
	AUPM691.d	Fiber Optics Technology	3	2	3	20	80
	AUPM691.e	Data Science					

	AUPM691.f	Computer Graphics	3	2	3	20	80
		Practical/Project/Study Tour					
	AUPM64PII	Optics, Electricity and Magnetism	3	2	3	20	80
	AUPM64PIII	Electronics and Digital Electronics	3	2	3	20	80
	AUPM64PIV	Elective Course Practical	-	1	3	20	80
	AUPM645	Project and Study Tour Report	-	4	3	-	100

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

II. QUESTION PAPER PATTERN

For all Semesters

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

III. OPEN/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 E l e c t i v e 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. The Department of Physics offers the following open courses during the fifth semester for students of other Departments.

(a) Open Courses

Open Course
Applied Physics
Astronomy & Astrophysics
Biophysics

The Department of Physics offers the following elective course during the sixth semester for students of Physics Department.

(b) Elective Courses

Elective Course
Space Science
Electronic Instrumentation
Nanoscience and Technology
Fiber Optics Technology
Data Science
Computer Graphics

IV. EVALUATION AND GRADING

The evaluation of each course shall consist of two parts

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

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

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

Criteria for Grading

Percentage of marks	CCPA	Letter Grade
90 and above	9 and above	A+ Outstanding
80 to < 90	8 to < 9	A Excellent
70 to <80	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 one)	5
Attendance	5

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

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

V. TESTS (MAXIMUM MARKS 10)

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

VI. ATTENDANCE (MAXIMUM MARKS 5)

A student must secure a minimum of 75 % aggregate attendance for all the courses of a semester taken together to become eligible to register for each End Semester Examination. The attendance percentage will be calculated from the day of commencement of the semester to the last working day of that semester. Attendance eligibility will be checked both at the time of registration for the End Semester Examination as well as at the time of issue of the hall tickets. Those students who fail to secure the minimum aggregate attendance will have to repeat the semester with the next batch by seeking re-admission. The award of attendance for CE/CA shall be given course-wise. A student who fails to get 75 % attendance can apply for condonation from the College, if duly recommended by the Faculty Advisor and Head of the Department, for a

maximum of 10 days in a semester for valid reasons, twice during the entire programme. Condonation thus granted shall not be considered for the award of CE marks. A student who seeks condonation on genuine medical grounds should produce a medical certificate clearly stating the inability of the student to attend classes with the recommendation of the Faculty Advisor and Head of the Department on condition that the matter pertaining to leave of absence has been given in writing by the parent/guardian to the concerned Head of the Department within 3 working days from the commencement of leave. The decision of the Principal shall be final in such matters. Reappearance of course(s) will be distinctly indicated in the final mark/grade sheet. Marks shall be allotted for course-wise attendance, for individual courses in which a student has registered, as follows.

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

VII. ASSIGNMENTS/SEMINARS (MAXIMUM 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.

VIII. PROJECT/DISSERTATION WORK

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

The topic of the project work shall either be allotted by the supervising teacher or be selected by the students in consultation with the supervising teacher during Semester 4. The experimental or theoretical work related to the project shall be carried out during Semester 5 with

the help of the supervising teacher, and the dissertation work shall be completed before the end of Semester 5. However, the Project Dissertation shall be submitted to the Department in duplicate before the completion of the sixth semester. There shall be no continuous assessment for Dissertation /Project work. A board of two Examiners appointed by the Controller of Examination shall evaluate the report of the Project/Dissertation work. The detailed guidelines regarding the conduct and evaluation of the Project/Dissertation will be framed by the Board of Studies.

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

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

The project shall be done individually or as a group of maximum 5 students. The projects are to be identified during the Semester 4 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 Semester 6 well before the commencement of the examination. The reports are to be produced before the external examiners appointed by the institution as per guidelines for valuation.

VIII. 2. 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
Total	**75**

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

Components	Marks
Understanding the objective of the project work/study tour report	5
Background knowledge of project &subject	5
Knowledge on the content	15
Total	**25**

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

	Weight
Dissertation	3
Viva-voce	1

There shall be no continuous evaluation for the project.

IX. STUDY TOUR

Students shall also be encouraged to conduct a field work/field tour/study tour to any of the regional or national scientific laboratory at which any type of scientific research in the areas of physical, chemical or mathematical sciences is carrying out. They can also visit any of the university teaching and research departments. The field trip shall be conducted after the examinations of Semester 5 and before the commencement of the 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.

X. EVALUATION OF PRACTICAL EXAMINATION

The practical examinations for the core subjects shall be conducted by the institution at the end of Semesters 4 and 6 with a common time table and questions set by the College. Similarly, the practical examination for the complementary course shall be conducted by the college at the end of the Semester 4. The examiners shall be selected from a panel of experts prepared by the Controller of Examination. **There shall be two external examiners and one internal examiner who is not in charge of the practical classes of respective batches.** The examination of AUPM64PIV Elective Course Practical may be conducted internally. The mark sheet duly certified by the Head of the Department should be sent to the Controller of Examination of the college soon after the examination. 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.

AUPM121: BASIC MECHANICS AND PROPERTIES OF MATTER

Total Teaching Hours: 36 Number of Lecture Hours/Week: 2

Max. Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Analyse the moment of inertia of rigid bodies of different geometry and their role in machine parts	An, U	PSO1, PSO2
CO2	Analyse the theory of mechanical oscillations and their significance in wave propagation which is a mode of energy transfer	An, U	PSO3, PSO7
CO3	Understand the theory and experimental procedures to determine the surface tension and viscosities of liquids	U	PSO1, PSO8
CO4	Evaluate the importance of elastic properties of materials in designing bridges and girders	E	PSO8
CO5	Apply the principle and theory of mechanics on practical applications	Ap	PSO8, PSO9
CO6	Evaluate the errors in experimental measurements and can suggest methods to reduce them	E	PSO6

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Dynamics of Rigid Bodies (7 hours)

Equations of motion for rotating rigid bodies - angular momentum and moment of inertia - theorems on moment of inertia - calculation of moment of inertia 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 moment of inertia of a flywheel (theory, experiment and applications) - gyroscope - spinning top.

Unit 2. Error Analysis (5 hours)

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 3. Oscillations (8 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 points 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 - 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 (8 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 - flow of liquid through a capillary tube - derivation of Poiseuille’s formula - limitations - Ostwald’s viscometer - variation of viscosity with temperature.

Books for study:

1. Mechanics: J. C. Upadhyaya and Ram Prasad, S. Chand Publications (2017)
2. Mechanics: Hans H. S. and Puri S. P., TMH, 2nd Edition (2006)

3. Mechanics: D. S. Mathur, S. Chand Publications (2017)
4. Elements of Properties of Matter: D. S. Mathur, S. Chand Publications (2008)
5. Fundamentals of Physics: D. Halliday, J. Walker and R. Resnick, Wiley India Pvt. Ltd. (2006)
6. Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, John R. Taylor, University Science Books (1997)

Books for reference:

1. Properties of Matter: Brij Lal and N. Subrahmanyam, S. Chand & Co. (2004)
2. Principles of Physics: P. V. Naik, PHI Learning Pvt. Ltd., 5th Edition (2012)

Seminar/Assignment Topics

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

AUPM241: HEAT AND THERMODYNAMICS

Total Teaching Hours: 36 Number of Lecture Hours/Week: 3

Max. Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Differentiate the different modes of heat transfer in thermal systems	U, An	PSO4
CO2	Analyse the heat transfer phenomena in connection with global warming	An	PSO8
CO3	Understand the laws of thermodynamics and thermodynamic processes	U	PSO1, PSO8
CO4	Apply the concepts of heat engines in reducing energy loss and to increase its efficiency	Ap	PSO7

CO5	Familiarize the concepts of entropy to appreciate the evolution of universe	U	PSO7, PSO8
CO6	Identify the different types of transitions in thermal systems	U, Ap	PSO5

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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 - Maxwell's thermodynamical relations - applications of Maxwell's thermodynamic relations - thermodynamic potentials and its significance.

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 Thermodynamics and Statistical Physics: Brij Lal, N. Subrahmanyam and P. S. Hemne, S. Chand & Co. Ltd., New Delhi (2000)
2. Thermal Physics and Statistical Mechanics: S. K. Roy, New Age International Publishers, New Delhi (2001)
3. Concepts of Modern Physics: Arthur Beiser, Tata McGraw-Hill, New Delhi, 6th Edition (1994)

Books for reference:

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

2. Heat and Thermodynamics: M. Zemansky, McGraw-Hill, New Delhi (2007)
3. Heat and Thermodynamics: Rose C. McCarthy, The Rosen Publishing Group, Inc. NY (2005)
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics: F. W. Sears andG. L. Salinger, Addison-Wesley Publishing Company, 3rd Edition (1975)

Seminar/Assignment Topics

- Contributions of Fowler
- Contributions of Claussius
- Development of Steam Engine
- Gibbs Free energy
- Helmholtz Free energy

AUPM341: ELECTRODYNAMICS

Total Teaching Hours: 54 Number of Lecture Hours/Week: 3

Max. Marks: 80 Credits: 3

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Compare the electrostatic fields due to charges and also that in a matter.	U	PSO1
CO2	Compare the properties of electromagnetic waves in vacuum, matter and conductors	U	PSO1
CO3	Analyse the growth and decay of transient currents in different electrical circuits.	An	PSO1, PSO2
CO4	Compare the properties of different ac circuits.	U	PSO1
CO5	Understand the principle and working of various ac bridges.	U, Ap	PSO4

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Unit 1. Electrostatic Field (7 hours)

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. Special Technique for Calculating Potential (9 hours)

Laplace's equations in three dimensions - boundary conditions and uniqueness theorem - conductors and second uniqueness theorem - the method of images - classic image problem – induced surface charge – force and energy

Unit 3. Electrostatic Fields in Matter (9 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 4. Electromagnetic Induction (7 hours)

Electromagnetic Induction: Faraday's law - induced electric field - Maxwell's modification of Amperes law - Maxwell's equations - magnetic charges - Maxwell's equations inside matter - boundary conditions.

Unit 5. Electromagnetic Waves (8 hours)

Waves in one dimension: The wave equation - boundary conditions for reflection and transmission - polarisation - Electromagnetic waves in vacuum: The wave equation for E and B - monochromatic plane waves - energy and momentum in electromagnetic waves - Poynting's vector - Electromagnetic waves in matter - Electromagnetic waves in conductors - skin depth.

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 - AC bridges - Anderson bridge and Owens bridge.

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, Pragati Prakashan, 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 and John Yarwood, University Tutorial Press, 2nd Edition (1965)

Seminar/Assignment Topics

- Story of Faraday
- Coulomb's Law
- Mathematical Formulation of Gauss Law
- Contributions of Oliver Heaviside
- Contributions of Hertz

AUPM441: CLASSICAL AND RELATIVISTIC MECHANICS

Total Teaching Hours: 54 Number of Lecture Hours/Week: 3

Max. Marks: 80 Credits: 3

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Explain the conservation of linear momentum, angular momentum and energy on the basis of linear uniformities and rotational invariance of space and homogeneity of flow of time	U	PSO1, PSO9
CO2	Recognize the theory of motion in central force field extending up to the explanation of Kepler's laws of planetary motion.	U	PSO2, PSO8, PSO9
CO3	Compare the Lagrangian, Hamiltonian and Newtonian approaches in mechanical systems	An	PSO1, PSO16
CO4	Differentiate the different types of frames of references.	U	PSO1

CO5	Recognize the theory of motion in central force field extending up to the explanation of Kepler's laws of planetary motion	U, Ap	PSO1, PSO2, PSO9

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

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 (3 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 (8 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 (5 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 (8 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 - two dimensional harmonic oscillator using Cartesian coordinates (comparison of Newtonian, Lagrangian and Hamiltonian approach).

Unit 7. Frames of Reference and Galilean Transformation (4 hours)

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

Unit 8. Special Theory of Relativity (14 hours)

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

Books for study:

1. Mechanics: H. S. Hans and 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)

Seminar/Assignment Topics

- Foucault's Pendulum
- Contributions of Galileo
- Contributions of ECG Sudharshan
- Contributions of Aristotle, Ptolemy

AUPM541: STATISTICAL MECHANICS, BIOPHYSICS, IPR AND ENTREPRENEURSHIP DEVELOPMENT

Total Teaching Hours: 72 Number of Lecture Hours/Week: 4

Max. Marks: 80 Credits: 4

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Differentiate classical statistics and quantum statistics	U	PSO1, PSO12
CO2	Apply the laws of thermodynamics in biological systems	Ap	PSO11
CO3	Understand the theory and working of different biomedical instruments	U	PSO11
CO4	Distinguish and explain various forms of IPRs	U	PSO10
CO5	Identify the significance of practice and procedure of Patents	U, R	PSO10
CO6	Understand the different aspects of entrepreneurship, namely, organisational services and institutional support	U	PSO10

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Statistical Physics (22 hours)

Statistical probability - macro and micro states - phase space - Liouville's theorem - statistical ensembles - Ergodic hypothesis - micro canonical ensemble - canonical ensemble - grand canonical ensemble - postulate of equal a priori probability - partition function - Maxwell-Boltzmann statistics - MB velocity distribution - quantum statistics - Bose Einstein statistics - BE distribution law - Bose Einstein condensation (basic idea), properties of liquid He (qualitative description) - Planck radiation law - Fermi Dirac statistics - FD distribution law - free electron gas in a metal - specific heat of metals - thermionic emission - comparison of three statistics.

Unit 2. Biophysics (24 hours)

Thermodynamics and Bioelectric Potentials (6 hours)

Concept of energy in the biological system in the light of thermodynamics - living body as a thermodynamic system - comparison of living and non-living systems as a thermodynamic system - resting and action potential - the heart - action potential in a cardiac muscle - electrical changes in the heart - blood flow - measurement of blood flow - blood pressure - measurement of blood pressure.

Biomedical Instrumentation and Techniques (14 hours)

Biomedical instrumentation (basics) - transducers – electrodes - electrocardiography - electroencephalography - electromyogram - X-ray imaging - magnetic resonance imaging - fibre optic endoscopy - heart-lung machine - centrifugation technology - ultra sonography - diagnostic and theraputic - ultrasonic surgery - echocardiography - pulse oximeter - dialysis and dialyser - extracorporeal shock wave lithotripsy.

Radiation Biophysics (4 hours)

Measurement of radiation (Dosimetry) - radioisotopes - production of radionuclides - applications of radioactive tracers - biological effects of radiation - radiation protection and therapy

Unit 3. Intellectual Property Rights (6 hours)

Introduction to Intellectual Property Rights - types of IPR - agencies responsible for intellectual property registration - WIPO - Indian IPR scenario - Patents - type of patents.

Unit 4. Entrepreneurship Development (20 hours)

Entrepreneurship: concept, meaning, definition - entrepreneurship as a career - characteristics of a successful entrepreneur - qualities and skills of a successful entrepreneur - training and other support - organizational services - phases of EDP - feasibility study - entrepreneurial personality - preparation of a good project report - institutional support: DIC, SIDCO, SIDBI, SISI, KUIC - MSME Act 2006.

Books for study:

1. Statistical Mechanics: Satya Prakash, Kedarnath Ram Nath Publishers, Meerut and Delhi (2014)
2. Elements of Statistical Mechanics: Kamal Singh and S. P. Singh, S. Chand & Co. Ltd, New Delhi (1999)
3. Statistical Mechanics: B. K. Agarwal and Melvin Eisner, New Age International Publishers, New Delhi, 2nd Edition (2005)
4. A text book of Biophysics: R.N Roy, New Central Book Agency (P) Ltd, Kolkatta, Revised Edition (2005)
5. Elementary Biophysics - An Introduction: P. K. Srivastava, Narosa Publishing House, (2005)
6. Essentials of Biophysics: P. Narayanan, New Age International (P) Ltd (200
7. Biophysics: N. Gautham and Vasantha Pattabhi, Narosa Publishing House, 2nd Edition (2011)
8. Managing Intellectual Property: Vinod V. Sople, Prentice Hall of India Pvt. Ltd, (2012)

9. Intellectual Property: Deborah E. Bouchoux, Cengage Learning, New Delhi, 4th Edition (2013)
10. Introduction to Artificial Intelligence: Rajendra Akerkar, PHI Learning Pvt. Ltd., Delhi, 2nd Edition (2014)
11. Artificial Intelligence and Deep Learning for Decision Makers - A Growth Hacker's Guide to Cutting Edge Technologies: Dr. Jagreet Kaur and Navadeep Singh Gill, BPB Publications (2019)
12. Introduction to Artificial Intelligence and Expert Systems: Dan W Patterson, PHI Learning Pvt. Ltd. (1997)

Seminar/Assignment Topics

- Relation between Thermodynamics and Statistical Mechanics
- Connection between Planck's law and BE Statistics
- Humanoid Robot
- Examples of National and International Journals
- Merits and Demerits of AI

AUPM542: QUANTUM MECHANICS

Total Teaching Hours: 72 Number of Lecture Hours/Week: 4

Max. Marks: 80 Credits: 4

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Apply the postulates of quantum mechanics to predict the outcome of measurement on model systems	Ap	PSO1, PSO2, PSO12
CO2	Apply principles of quantum mechanics to calculate observables on known wave functions	Ap	PSO4, PSO12
CO3	Understand the mathematical foundations of quantum mechanics	U, R	PSO4, PSO12
CO4	Solve the Schrodinger equation for simple configurations	E, Ap	PSO5, PSO12

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. The Emergence of Quantum Mechanics (18 hours)

Limitations of classical physics - black body radiation curve- Planck‘s quantum hypothesis - photoelectric effect -specific heat of solids-Compton effect - quantum theory of specific heat of solids - optical spectra postulates-The correspondence principle.

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)

Squarewell potential with infinite walls - square well potential with finite walls - square potential barrier - the harmonic oscillator (Schrodinger method and Operator Method) - The free particle.

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, 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)

Seminar/Assignment Topics

- Stern-Gerlach Experiment
- Contributions by Bohr
- Contributions by Sommerfeld
- Discussion on Solvay Conference
- Discussion between Bohr and Einstein

AUPM543: ELECTRONICS

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

Max. Marks: 80 Credits: 4

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Execute the analysis of Thevenin's and Norton's theorems, Maximum power transfer theorem and Superposition theorem	An, Ap	PSO2, PSO3, PSO15
CO2	Design and construct circuits using different types of diodes and filter circuits	Ap, E	PSO3, PSO15
CO3	Design and construct transistor circuits as voltage amplifiers, power amplifiers and oscillators	Ap, E	PSO3, PSO15
CO4	Interpret the feedback circuits and can construct and study the characteristics of different types of oscillators	An	PSO7, PSO15
CO5	Describe the principles of modulation, different types of modulation and their techniques	U	PSO15
CO6	Design and construct circuits using special devices like JFET, MOSFET, UJT and SCR	U, Ap	PSO5, PSO15
CO7	Acquire basic ideas on differential and operational amplifiers	U	PSO7, PSO15

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Circuit Theory (4 hours)

Ideal voltage and current sources - Thevenin's and Norton's theorem - maximum power transfer theorem - superposition theorem.

Unit 2. Diode Circuits (14 hours)

pn junction 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) - clipping and clamping circuits - breakdown mechanisms in diodes - Zener diode - voltage regulator - LED - photo diode - solar cells - tunnel diode (basics).

Unit 3. Bipolar Junction Transistors (16 hours)

Theory of BJT operation - CB, CE and CC characteristics - transistor biasing - stability factors - selection of operating point - ac and dc load lines - Q point - biasing circuits - fixed bias/base bias, emitter feedback bias, collector feedback bias and potential divider bias - 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 applied to two port networks - hybrid equivalent circuit of transistor.

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 - advantages of negative feedback - positive feedback - principle of sinusoidal feedback oscillation - Barkhausen criterion for oscillations - Hartley, Colpitts, 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 - analysis of FM - frequency spectrum for FM - Superhetrodyne AM receivers.

Unit 7. Special Devices (8 hours)

SCR - UJT - JFET - MOSFET - depletion and enhancement MOSFET (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 - dual input, balanced output differential amplifier - voltage gain, input and output resistances - differential mode and common mode - CMRR - virtual

ground principle - parameters of OP amp - inverting, non-inverting, summing, subtracting, differentiating, integrating and logarithmic amplifiers.

Books for study:

1. Basic Electronics - Devices, Circuits and IT Fundamentals: Santiram Kal, 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 and 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)

Seminar/Assignment Topics

- Vacuum Tube
- Triode Valve
- Nano electronics
- Moore's Law
- Quantum Mechanical Tunnelling

AUPM544: ATOMIC AND MOLECULAR PHYSICS

Total teaching hours: 72 | Number of lecture hours/week: 4

Maximum mark: 80 | Credit: 4

Course Outcomes

CO No.	Course Outcomes *Students who complete this course will be able to*	Cognitive Level	PSO No.

CO1	Get knowledge about the different atomic models, their significances, properties, merits and demerits	U	PSO2, PSO13
CO2	Determine the crystal structure and particle size using the X-ray diffraction method	Ap, E	PSO5
CO3	Apply the basic knowledge of classical and quantum mechanics at the atomic and molecular level	Ap	PSO13
CO4	Understand the fine structure of spectral lines	U	PSO13
CO5	Compare the principles and properties of NMR, ESR and Mossbauer spectroscopy	U	PSO14

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Vector Atom Model (10 hours)

Bohr's theory - correspondence principle - Sommerfeld 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)

Introduction - diffraction of X-rays - Bragg's law of X-ray diffraction - Debye-Scherrer powder method - determination of crystal structure by X-ray diffraction method - X-ray spectra and their origin - Moseley's law - absorption of X-rays - Compton effect.

Unit 4. Molecular spectra (28 hours)

Characterization of electromagnetic radiation - the quantization of energy - regions of the spectrum - basic elements of practical spectroscopy - the width and intensity of spectral transitions - 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 - Franck-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:

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)

Seminar/Assignment Topics

- J J Thompson Model
- Rutherford Model
- Bohr Model
- History of Raman Effect
- Discovery of X Rays

AUPM581: OPEN COURSES

AUPM 581.a: APPLIED PHYSICS

Total Teaching Hours: 54 Number of Lecture Hours/Week: 3

Max Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Understand the principles of working and the specifications of the different electronic equipments	U	PSO15 PSO17
CO2	Get a thorough knowledge of X-rays and lasers and their applications	U	PSO17
CO3	Get a thorough knowledge of holograms, construction and reconstruction	U	PSO17
CO4	Understand the basics of fibre optic communication	U	PSO15

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

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 - reconstructionof the image - applications.

Unit 5. Fibre Optic Communication (10 hours)

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

Books for study:

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. (2020)
5. A Textbook of Optics: N. Subrahmanyam and Brij Lal, M. N. Avadhanulu, S.Chand & 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)

AUPM581.b: ASTRONOMY AND ASTROPHYSICS

Total Teaching Hours: 54 Number of Lecture Hours/Week: 3

Max. Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Explain the historical developments in astronomy and astrophysics	U, R	PSO2, PSO8
CO2	Assess the various theories on origin of the Universe and celestial bodies in the sky	U, R	PSO2, PSO5

CO3	Explain the life of stars, their birth and death leading to white dwarfs, neutron stars, black holes, nova and supernova	U, R	PSO1, PSO2
CO4	Get a thorough knowledge on the Solar system	U	PSO1

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Introduction (5 hours)

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

Unit 2. Astronomy (10 hours)

Ancient astronomy - medieval astronomy - renaissance astronomy - modern astronomy.

Unit 3. The theories of Universe (12 hours)

The Newton's universe - the Einstein's universe - the expanding universe - the steady state universe - the perfect cosmological principle - open and closed universe -spinning universe.

Unit 4. The Objects in the Sky (14 hours)

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

Unit 5. The Solar System (13 hours)

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

Books for study:

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. Facts and Speculations in Cosmology: Jayanth V. Narlikar, Geoffrey Burbidge, Cambridge University Press India Pvt. Ltd, New Delhi (2009)
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 Number of Lecture Hours/Week: 3

Max. Marks: 80 Credits: 2

Course Outcomes

CO No.	Course Outcomes *Students who complete this course will be able to*	Cognitive Level	PSO No.
CO1	Explain the physics of audition and vision	U	PSO11
CO2	Get a knowledge of biological systems	U	PSO11
CO3	Familiarise with the biological measuring instruments and bioinformatics	U, An	PSO5, PSO11
CO4	Familiarize the biological application of radiation physics	U, An	PSO8, PSO11

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Introduction (18 hours)

Biomechanics: Biostatics - biophysics of muscle - strength of bones - biodynamics - locomotion on land - locomotion in air - locomotion in water - role of gravity. Biophysics and fluid flow: Steady laminar flow - Poiseuille's formula - energetics of fluid flow - turbulence - hemodynamics - fluid flow in plants. Biophysics and gas transport: The ideal gas - convective transport of gases - diffusion of gases - Fick's laws - physiology of respiration. Physics of Audition: Transverse and longitudinal waves - physiological characteristics of sound - human ear - phase sensitivity and determination of direction - doppler effect - Physics of vision: Wave nature of light - geometrical optics - refractive power - retina and photoreceptors - photoreceptors and fibre optics - resolving power of eye - polarisation and vision.

Unit 2. Cellular Molecular Biophysics (18 hours)

Prokaryotes and eukaryotes - molecular components of cell - carbohydrates - lipids - proteins - nucleic acids - hetero macromolecules - molecular forces - strong force - inter-molecular weak forces - structural organization of proteins - structural organization of nucleic acids - molecular mechanism of genetic information transfer - genetic code - transfer of genetic information - molecular mechanism of protein synthesis - principle of molecular recognition.

Unit 3. Radiation Physics (10 hours)

Radiodiagnosis - radiation therapy - radiation dosimetry - radiation hazards - quality assurance.

Unit 4. Biospectroscopy (8 hours)

FTIR spectroscopy - Raman Spectroscopy - finger print region - data analysis.

Books for study:

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)

Seminar/Assignment Topics

- India Based Neutrino Observatory

AUPM641: SOLID STATE PHYSICS

Total Teaching Hours: 72 Number of Lecture Hours/Week: 4

Max. Marks: 80 Credits: 4

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Identify the different types of crystal systems and the symmetry operations involved	U, An	PSO20
CO2	Identify the crystal structure using X-ray and neutron diffraction techniques	U, An	PSO1, PSO2
CO3	Explain the concept of conduction in metals and free electron model	An, Ap	PSO4
CO4	Differentiate conductors, insulators and semiconductors based on band theory	An	PSO8
CO5	Account for what the Fermi surface is and how it can be measured	U, E	PSO5
CO6	Understand the theory of properties of dielectric and magnetic materials	U	PSO1, PSO4
CO7	Understand the phenomenological theory and properties of superconductors	U	PSO1, PSO4

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Crystal Structure (18 hours)

Solids**:** amorphous and crystalline materials - lattice translation vectors - lattice with a basis - unit cell - elements of symmetry - diffraction of X rays by crystals - Bragg‘s law - Laue condition - X-ray diffraction techniques - reciprocal lattice - types of lattices - two and three dimensional lattices- diffraction condition in reciprocal lattice - Ewald construction- Brillouin zones - Miller indices - atomic and geometrical factor - inter atomic forces and types of bonding.

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

Introduction - conduction electrons - free electron gas - electrical conductivity and Ohm’s law - electrical resistivity versus temperature - heat capacity of conduction electrons - Fermi surface - effects of the Fermi surface - thermal conductivity in metals - Hall effect and magneto resistance - ac conductivity and optical properties - failures of free electron model.

Unit 3. Band Theory (10 hours)

Bloch theorem - Kronig Penny model - band gaps - construction of Brillouin zones - effective mass of an electron - conductors, semiconductors and insulators - p and n type semiconductors - mobility of charge carriers - electrical conductivity of semiconductors - Hall effect - Hall coefficient.

Unit 4. Dielectric Properties of Materials (12 hours)

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

Unit 5. Magnetic Properties of Matter (12hours)

Dia, para, ferri and ferromagnetic materials - classical Langevin theory of dia and paramagnetic domains - quantum mechanical treatment of para magnetism - Curie‘s law, Weiss’s 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 - idea of BCS theory - tunnelling and Josephson effect (qualitative study).

Books for study:

1. Solid State Physics: M. A. Wahab, Narosa Publication, 3rd Edition (2015)

2. Solid State Physics: S. O. Pillai, New Age International Publishers, 3rd Edition (1997)
3. Elementary Solid State Physics: M. Ali Omar, Pearson India (1999)
4. Solid State Physics: R. K. Puri and V. K. Babbar, S. Chand Publisher (2004)
5. Elements of Solid State Physics: J. P. Srivastava, Prentice Hall of India, 2nd Edition (2009)

Books for reference:

1. Introduction to Solid State Physics: Charles Kittel, John Wiley India Pvt. Ltd., 8th Edition (2004)
2. Introduction to Solids: Leonid V. Azaroff, Tata Mc-Graw 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, Springer (2009)

Seminar/Assignment Topics

- History of superconductors
- High temperature superconductors
- Ohms law
- Quasi Crystals
- Liquid Crystals
- Nonexistence of fivefold symmetry

AUPM642: NUCLEAR AND PARTICLE PHYSICS

Total Teaching Hours: 72 Number of Lecture Hours/Week: 4

Max Marks: 80 Credits: 4

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Explain the general properties of nuclei, concept of binding energy and nuclear forces	U, R	PSO4
CO2	Analyse the properties of nuclei based on the different nuclear models	An	PSO7
CO3	Make quantitative estimates of phenomena involving radioactivity and of nuclear reactions	Ap, E	PSO4

CO4	Discuss the principle, construction and working of various types of nuclear radiation detectors and accelerators work	U	PSO1, PSO3
CO5	Estimate the energy release through nuclear fission and fusion reactions in reactors	E	PSO4
CO6	Explain the different phenomena involving cosmic rays and elementary particles	U	PSO8

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

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- 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)

Radioactive 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 spectra - neutrino theoryof beta decay-gamma decay - applications of radioactivity.

Unit 4. Nuclear Reactions (9 hours)

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

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 - longitude 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 - the quark model - resonance particles - Bremsstrahlung effect - Cerenkov radiations.

Books for study:

1. Modern Physics: R. Murugeshan and K. Sivaprasath, S. Chand & Co. Ltd., New Delhi, 12th 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, 6th Edition (2003)
5. Atomic and Nuclear Physics: N. Subrahmanyam 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. An Introduction to the Physics of Nuclei and Particles: Richard A. Dunlap, Thomson Learning Belmont (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)

Seminar/Assignment Topics

- Beta Decay and Nonexistence of electrons inside nucleus
- History of Quarks

- Large Hadron Collider
- Higgs Boson
- CERN

AUPM643: CLASSICAL AND MODERN OPTICS

Total Teaching Hours: 72 Number of Lecture Hours/Week: 4

Max. Marks: 80 Credits: 4

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Explain phenomena like interference, diffraction, dispersion and polarization	U	PSO2, PSO4
CO2	Compare principles and theory of Fresnel and Fraunhofer diffraction	U, An	PSO3, PSO4
CO3	Distinguish between normal and anomalous dispersion	An	PSO8
CO4	Understand the differences between step index and graded index fibers, single mode and multimode fibers	U	PSO17
CO5	Attain knowledge on principle of holography and its applications	U	PSO17
CO6	Acquire good knowledge on different light sources including lasers	U	PSO20

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

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 Publications (2011)
4. Lasers and Non-Linear Optics: B. B. Laud, New Age International Pvt. Ltd. (2011)
5. Electronic Communications: Dennis Roddy and John Coolen, Pearson, 4th Edition (1995)

Seminar/Assignment Topics

- Michelson's interferometer-Standardization of metre
- Diffraction at a rectangular aperture and circular aperture
- Optical activity - Fresnel's theory of optical rotation
- Resolving power of prism and telescope
- Laurent's half shade polarimeter
- Laser cooling and laser trapping
- Applications of lasers in medical field
- Study of Fraunhofer lines using spectrometer
- Determination of refractive index of liquid by Newton's rings method
- Comparison of radii of curvature by Newton's rings method

AUPM644: DIGITAL ELECTRONICS, DIGITAL IMAGE PROCESSING AND ROBOTICS

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

Max Marks: 80 Credits: 4

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Use binary and hexadecimal number systems and their mathematical operations	U, An	PSO1
CO2	Understand Boolean algebra and logic gates	U, An, Ap	PSO1
CO3	Analyse arithmetic and sequential digital circuits	An	PSO15
CO4	Understand the concepts of digital imaging	U, Ap	PSO3

CO5	Familiarize the basic processes involved in digital image processing	Ap, C	PSO18
CO6	Know how digital images are generated and represented	U	PSO18
CO7	Be familiar with the principal mathematical tools used in digital image processing	U, Ap	PSO4
CO8	Understand the mechanics of spatial filtering, and how spatial filters are formed	U	PSO2, PSO20
CO9	Understand the basic concepts of robotics	U	PSO20

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Digital Electronics (24 hours)

Number Systems: 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 Logic simplification: 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 - De Morgan's theorem - simplification of Boolean equations using Boolean laws - Karnaugh map.

Arithmetic Circuits: Half adder - full adder - controlled inverter - binary adder - subtractor

Sequential Circuits: Flip flop - SR flip flop - JK flip flop - master slave JK flip flop.

Unit 2. Digital Image Processing (36 hours)

Introduction - Digital Image Fundamentals: elements of visual perception - light and electromagnetic spectrum - image sensing and acquisition - image sampling and quantization - some basic relationship between pixels - Intensity Transformations: basics of intensity transformations - some basic intensity transformation functions - histogram processing.

Spatial filtering: fundamentals of spatial filtering - smoothing and sharpening filters - Frequency domain filtering: Background - preliminary concepts – sampling - Fourier transforms and DFT - 2-D DFT and properties - frequency domain filtering - low pass filters - high pass filters - implementation.

Image restoration and reconstruction: Noise models - restoration in the presence of noise - linear-positive invariant degradations - inverse filtering - Wiener filtering - constrained least square filtering - geometric mean filter.

Unit 3. Robotics (12 hours)

Introduction: Definition - classification - robot components - degree of freedom - robot characteristics, application of robots.

Robotics and AI - embedded Systems - Agent-Task environment model - embodied systems - synthetic approaches to science.

Mobile Robots - position and orientation -translational and dynamics - lying and swimming robots - articulated robots - transformations - path planning and trajectories.

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. Digital Image Processing: Rafael C. Gonzalez, Richard E. Woods, Pearson, 4th Edition (2017)
4. Fundamentals of Digital Image Processing: Jain A. K. Englewood Cliffs, NJ: Prentice Hall (1989)
5. Digital image processing: Pratt, W. K. PIKS Scientific inside (Vol. 4). Hoboken, New Jersey: Wiley- Interscience (2007)
6. Introduction to Digital Image Processing with Matlab: Alasdair McAndrew , Cengage Learning (2004)
7. Engineering of Mind: Albus J. I. and Meystel A. M., J. Wiley & Sons (2001)
8. Robots and Manufacturing Automation: C. Asfahl, J. Wiley & Sons (1992)
9. Robot Analysis and Control: H. Asada and J. J. Slotine, J. Wiley & Sons (1986)

Seminar/Assignment Topics

- History of Number system
- History of different types of Calculators
- History of Microprocessors
- History of Computers
- Comparison of different programming languages
- History of Computer Programming

AUPY691: ELECTIVE COURSES

AUPY691.a: COMPUTER HARDWARE AND NETWORKING

Total Teaching Hours: 54 Number of Lecture Hours/Week: 3

Max Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Identify the different types of hardwares	U, An	PSO17
CO2	Discuss the classification of memory devices	U	PSO17
CO3	Differentiate the different types of input/output devices	U, An	PSO15 PSO17
CO4	Familiarise with different types of viruses and vaccines	U	PSO2
CO5	Get knowledge about the different computer networking technologies	U, An	PSO17
CO6	Get a knowledge of the different protocols and IP addresses	U	PSO17 PSO20

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1 Computer Architecture (3 hours)

P.C. Architecture - functional block diagram of a computer - processors - introduction to microprocessor - CISC, RISC processors - type of processors and their specification - Intel: Celeron - Pentium family - PII, PIII, PIV, dual core, core 2duo - AMD-K5, K6 series

Unit 2 Mother Board (10 hours)

Motherboards: Motherboard components - types - form factor - different components of motherboard (BIOS, CMOS,BICMOS, RAM, CMOS Battery, I/O slots, I/O connectors) - Riser architecture - Main Memory (SIMM, DIMM, RIMM) - extended/expanded/cache memories - Chipsets (Intel & AMD) ROM, DRAM, SDRAM, CDRAM, RDRAM, WRAM - Bus standards: Types of Buses (PC,ISA, MCA, AGP, PCI, USB, IEEE FireWire) - Add on Cards Different latest Add on Cards (TV Tuner Card, DVR card, Video Capture, Internal Modem, Sound Card)

Unit 3. Drivers (9 hours)

Floppy Disk Drive - floppy drive components (overview only) - Hard Disk Drive (HDD)

types - capacity - hard disk components (Media, Read/Write Head, Spindle Motor Head Actuator) - connector - jumper setting - trouble shooting in HDD - hard disk controller (HDC) - block diagram -

working - interfacing (IDE,SCSI, ATA and SATA series) - configuration of HDD - installation - formatting - file format (FAT, NTFS) - pen drive - i-pods - Optical Disk Drive

Types (ROM, R/W, DVD ROM, DVD R/W) - Capacity - Difference between CD &DVD (capacity, format) - troubleshooting.

Unit 4. Peripherals (6 hours)

Keyboard and Mouse - operation - types of VDU (CRT, LCD, and TFT) - Resolution, and Dot pitch - Printers - Types (dot matrix, inkjet, laser) Scanner - operation - Power conditioning Device: SMPS - Block diagram - operation - UPS - Types (online, off line, Hybrid) - trouble shooting in all these devices.

Unit 5. Virus and Vaccines (4 hours) Virus - Introduction - infection methods - types of viruses - different symptoms of virus attack - precautions. Vaccine - method of vaccine - different types of antivirus used in PC - firewalls.

Unit 6. Networking Essentials (8 hours)

Introduction - need for networking - network topology - OSI model - types of networks (LAN, WAN, MAN) - protocols - LAN protocols - classification – examples - Ethernet networking -WAN Protocols - PPP, X.25, PPTP, L2TP, ISDN.

Unit 7. LAN Connectivity (8 hours)

LAN Connectivity Devices - NIC - repeater - hub - switch - bridge - internet connectivity device routers - gateways - CSU/DSU-TCP/IP Protocol Suite - What is TCP/IP - Importance OSI vs TCP/IP.

Unit 8. IP Addresses (6 hours)

IP Addressing - Overview - Address classes - Network ID - Host ID and Subnet –Mask - Addressing guidelines - Reserved IP Address - Subnetting and Supernetting (overview).

Books for study:

1. Computer Installation & Servicing: D. Balasubramanian, Tata McGraw Hill, New Delhi, 2nd Edition (2006)
2. PC Upgrade and Repair Black Book: Ron Glister, Dreamtech, New Delhi (2001)
3. PC Hardware: A Beginner’s Guide, Ron Gilster, Osborne/McGraw Hill New York (2001)
4. Upgrading and Repairing PCs: Scott Mueller, Que Publication, 13th Edition (2001)
5. Bigelow‘s Troubleshooting, Maintenance & Repairing PCs: Stephen Bigelow, McGraw Hill Education, 5th Edition (2017)
6. The Complete Reference- Networking: Craig Zacker, McGraw Hill Education, 1st Edition (2002)
7. Networking All in One for Dummies: Doug Lowe, Wiley India Pvt. Ltd., 7th Edition (2018)

Books for Reference:

1. The Complete PC Upgrade & Maintenance Guide: Mark Minasi, Sybex, 16th Edition (2005)
2. The Complete Computer Upgrade & Repair Book: C. A. Schmidt, Dreamtech
3. Modern Computer Hardware Course: Manahar Lotia, Pradeep Nair, PayalLotia, BPB Publications (2006)
4. Introduction to Networking: Richard A. Mcmohan, McGraw Hill Education (2003)

AUPY691.b: ELECTRONIC INSTRUMENTATION

Total Teaching Hours: 54 Number of Lecture Hours/Week: 3

Max Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Use the basic measuring devices like ammeter, voltmeter etc. and their digital versions, effectively	U, Ap	PSO3, PSO17
CO2	Use oscilloscopes for measurements	Ap	PSO3
CO3	Use transducers and wave generators	Ap	PSO3

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

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 - astablemultivibrator - 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 and 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. (2005)

Books for reference:

1. Sensors and Transducers: D. Patranabis, PHI Learning, 2nd Edition (2013).
2. Industrial Electronics and Control: S. K. Bhattacharya and S. Chatterjee, McGraw-Hill Education (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 Number of Lecture Hours/Week: 3

Max Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Explain the historical background and natural demonstrations of nanoscience and nanotechnology	U	PSO2, PSO20
CO2	Explain the nanoscale paradigm in terms of properties at the nanoscale dimension	U	PSO2
CO3	Understand the basic interdisciplinary nature of nanotechnology (physics, chemistry, electronic and mechanical properties, bio-nanotechnology)	U	PSO2
CO4	Synthesis materials of nano dimension by various methods of preparation	Ap	PSO2, PSO3
CO5	Characterise the prepared materials using different methods	An	PSO3, PSO5

CO6	Understand the basic principles of nanoscience and nanoscale engineering	U	PSO2, PSO20
CO7	Understand the concepts in materials science, chemistry, physics, biology and engineering to the field of nanotechnology	U	PSO2
CO8	Familiarize the processing and characteristics of carbon nanostructures	U	PSO2
CO9	Understand thoroughly the application of nanotechnology in industry	U	PSO20

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

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 (8 hours)

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

Unit 4. Synthesis Routes (10 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) - tunnelling electron microscope (TEM) - atomic force microscope (AFM) - scanning tunnelling microscope (STM).

Unit 6. Applications of Nanomaterial (elementary ideas only) (14 hours)

Applications of nanotechnology in electronics - optoelectronic devices - quantum dots- carbon nanotubes (CNT) - MEMS and NEMS - Nanosensors - CNT sensors - polymeric nanofibers and nanocomposites - SQUID based nanosensors - biosensors - magnetic nanoparticles - giant magneto resistance - 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)

AUPM691.d: FIBER OPTICS TECHNOLOGY

Total Teaching Hours: 54 Number of Lecture Hours/Week: 3

Max Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Gain knowledge on various types of optical fiber cables	U	PSO17
CO2	Familiarize the different modulation techniques	U, R	PSO15
CO3	Familiarize the fiber cabling tools	U	PSO17
CO4	Design different types of fiber optic networks and its components	Ap	PSO17
CO5	Get hands on experience on fusion splicing, cable termination, light source-power meter testing, OTDR testing etc.	Ap	PSO17

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Basics of Communications (2 hours)

Signal types - analog - digital - wave concepts - electromagnetic waves - electromagnetic spectrum - characteristics of alternating current - cycle, wavelength, frequency, amplitude, phase, phase difference - average value - rms value.

Unit 2. Modulation Techniques (6 hours)

Modulation techniques - AM, FM, PM, PCM - need for multiplexing - FDM, TDM, WDM - signal transmission P2P system - transmitter - medium - receiver - attenuation - distortion - noise - regeneration - bandwidth - digital data speed - regeneration - gain - loss - wired communications - wireless communications.

Unit 3. Basic Concepts of Optics (2 hours)

Nature of light - modes of light - single mode - multi mode - reflection - refraction - refractive index - critical angle - acceptance angle - cone of acceptance - numerical aperture, - infrared spectrum - optical windows - losses in these bands - absorption - scattering - reflection - dispersion

- intermodal dispersion - intramodal dispersion - effect on bandwidth - optical power - gain - loss – decibel.

Unit 4. Basic Optical Communications Concepts (5 hours)

P2P system - transmitter - light source - LED - laser diode - detector - PIN diode - avalanche photo diode - optical amplifiers - EDFA - regeneration - ADM - OADM - DWDM.

Unit 5. Optical Fiber (4 hours)

Core - cladding - primary buffer - types of fibers - silica core silica cladding - silica core - plastic cladding (PCS) - plastic core plastic cladding (POF) - single mode - multi mode - graded index - step index fiber.

Unit 6. Fiber Optic Cable (7 hours)

Cable construction - geometry of cable - core - cladding - plastic coating - buffer - strength member - jacket - sizes of cables in use - color coding - types of cables - simplex - duplex - multi fiber - GI - SI - tight buffer - loose tube - ribbon - breakout cable - distribution cable - hybrid cable - armored cable - composite cable - aerial cable - submarine cable.

Unit 7. Fiber Cabling Tools (7 hours)

General tools - scribe - shear - slit and ring tool - stripping tool - buffer stripper - polishing film - polishing pad - polishing puck - cleaning devices - crimping tool - inspection microscope - cleavers - fusion splicer - light source - power meter - optical loss test set - visual fault locator - mechanical splices - splice tray - closure - optical time domain reflectometer.

Unit 8. Cable Splicing (7 hours)

Fusion splicing - mechanical splicing - single fiber fusion splicing - mass fusion splicing - stages of splicing - splicing precautions - misalignment - end gap - end angle - NA mismatch - core mismatch - axial run-out - bubble - incomplete fusion.

Unit 9. Testing of Cables (7 hours)

Continuity test - light source-power meter - OLTS - visual fault locator - OTDR testing - measuring cable span - attenuation coefficient - connector/splice loss measurement - distance to fault - OTDR trace analysis - optical loss budget.

Unit 10. Fiber Optic Networks (7 hours)

Basic concepts - types of FTTH - point to point network - passive optical network - splitter - coupler - FTTH network components - feeder cable - distribution cable - drop cable - network interface device - optical network unit.

Books for study:

1. Fiber Optics Installer and Technician Guide: Bill Woodward and Emile B. Husson, Neil

Edde, San Francisco (2005)
2. Fibre-Optic Communication Systems: Govind P. Agrawal, Wiley Interscience, 3rd Edition (2002)
3. Introduction to Fiber Optics: John Crisp and Barry Elliot, Elsevier, Amsterdam, 3rd Edition (2005)
4. Troubleshooting Optical-Fiber Networks - Understanding and Using Your Optical Time-Domain Reflectometer: Duwayne R. Anderson, Larry Johnson and Florian G. Bell, Elsevier Academic press, Amsterdam , 2nd Edition (2004)
5. Introduction to Fiber Optics: Ajoy Ghatak and K. Thyagarajan, Cambridge University Press (1997)

AUPY691.e: DATA SCIENCE

Total Teaching Hours: 54 Number of Lecture Hours/Week: 3

Max Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Understand the basics of data science and its different applications	U	PSO10
CO2	Get a better insight to the concepts of statistics and probability	U, R	PSO10
CO3	Get an introduction to data analysis related to the operations of human brain	U	PSO10 PSO17
CO4	Get the analytical skill to a career as data analyst	U, An	PSO17
CO5	Familiarise in R programming	U	PSO18

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Introduction (12 hours)

Data Science - basic concepts - definition and architecture - business analytics and visualization techniques - different industrial application of data science technique.

Unit 2. Statistics and Probability (12 hours)

Statistical measures - probability - conditional probability - Baye's theorem - probability distributions and standard distributions - density functions - mathematical expectations and moments - covariance and correlation.

Unit 3. Predictive Analytics (14 hours)

Regression - decision tree - neural networks - dimensionality reduction - principal component analysis.

Unit 4. Data Analysis Using R (16 hours)

Introduction to R - R graphical user interfaces - data import and export - attribute and data types - descriptive statistics - exploratory data analysis - visualization before analysis - dirty data - visualizing a single variable - examining multiple variables - data exploration versus presentation - statistical methods for evaluation

Books for study:

1. Doing Data Science, Straight Talk From The Frontline: Cathy O'Neil and Rachel Schutt, O'Reilly Media Inc. (2014)
2. Random Data Analysis and Measurement Procedures: (vol. 729), Bendat J. S. and Piersol A. G., John Wiley & Sons (2011)
3. Linear Algebra Tools for Data Mining: D. A. Simovici, World Scientific Publishing (2012)
4. Big Data, Big Analytics: Emerging Bisiness Intelligence and Analytic Trends for Today's Businesses: Michael Minelli, Michele Chambersand Ambiga Dhiraj,, John Wiley & Sons, Inc. (2013)
5. Big Data: Related Technologies , Challenges and Future Prospects: Min Chen, Shiwen Mao, Yin Zhang, Victor C. M. Leung, Springer (2014)
6. R for Data Science: Garrett Grolemund and Hadley Wickham, O'Reilly Media Inc. (2017)

AUPY691.f: COMPUTER GRAPHICS

Total Teaching Hours: 54 Number of Lecture Hours/Week: 3

Max Marks: 80 Credits: 2

Course Outcomes

CO No.	**Course Outcomes** *Students who complete this course will be able to*	**Cognitive Level**	**PSO No.**
CO1	Understand the basics of computer graphics	U	PSO17
CO2	Prepare the algorithms for different types of figures	Ap	PSO17
CO3	Observe the graphs in different perspective	An	PSO17
CO4	Understand the techniques of digital image processing	U	PSO17

R: Remember, U: Understand, Ap: Apply, An: Analyse, E: Evaluate, C: Create

Unit 1. Basic concepts in Computer Graphics (8 hours)

Basic concepts in Computer Graphics - Types of Graphic Devices - Interactive Graphic inputs - Raster Scan and Random Scan Displays.

Unit 2. Drawing Graphs (12 hours)

Line Drawing Algorithm - DDA, Bresenham's algorithm - Circle Generation Algorithms - Mid point circle algorithm, Bresenham's algorithm - scan conversion - frame buffers - solid area scan conversion - polygon filling algorithms.

Unit 3. Viewing Graphs (14 hours)

Two dimensional geometric transformations - Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing - viewing pipeline, viewing coordinate reference frame; widow-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations - point, line, and polygon clipping algorithms**.**

Unit 4. Digital Image Processing (20 hours)

Steps in Digital Image Processing - Sampling and Quantization - Applications of Image Processing, Intensity Transformation and Spatial Filtering, Intensity Transformation Functions, Piecewise Linear Transformation Functions, Histogram Processing, Histogram Equalization, Histogram Matching, Local Enhancement, Enhancement using Arithmetic and Logic operations, Image Subtraction, Image Averaging

Books for study:

1. Computer Graphics: Donald Hearn and M. Pauline Baker, PHI, 2nd Edition, (1996)
2. Principles of Interactive Computer Graphics: William M. Newman and Robert F. Sproull, McGraw Hill, 2nd Edition (1979)
3. Digital Image Processing: Rafael C. Gonzalez, Richard E. Woods, Pearson, 4th Edition (2017)

PRACTICALS

AUPM44PI: MECHANICS, PROPERTIES OF MATTER AND HEAT

(Minimum 18 experiments to be done)

1. Spring mass system - spring constant
2. Flywheel - moment of inertia
3. Compound Bar Pendulum - symmetric
4. Compound Bar Pendulum - asymmetric
5. Cantilever Y - pin and microscope
6. Cantilever Y - angle between the tangents
7. Uniform Bending Y - pin and microscope
8. Uniform bending Y- optic lever method
9. Non-uniform bending Y- optic lever and telescope
10. Torsion pendulum - rigidity modulus
11. Rigidity modulus - static torsion
12. Kater's pendulum - acceleration due to gravity
13. Melde's string - frequency of fork
14. Melde's string - relative density of solid and liquid
15. Phase transition - determination of melting point of wax.
16. Determination of thermal conductivity of rubber
17. Lee's disc - determination of thermal conductivity of a bad conductor
18. Viscosity of a liquid - Stoke's method
19. Viscosity - variable pressure head
20. Viscosity - constant pressure head
21. Surface tension - capillary rise
22. Sonometer - frequency of AC main
23. Kundt's tube - determination of velocity of sound.

Books for reference:

1. A Textbook of Practical Physics for BSc (Main) Course: Sebastian, VAS Publications, Practical Physics: P. R. Sasi Kumar, PHI, New Delhi (2011)
2. Experimental Physics for Students: J. Yarwood and R. M. Whittle, Chapman & Hall Publishers (1973)
3. An Advanced Course in Practical Physics, D. Chathopadhyay and P. C. Rakshit, New Central

Book Agency, Kolkata (2011)
4. Practical Physics and Electronics, C. C. Ouseph, U. J. Rao and V. Vijayendran, S.Viswanathan Printers & Publishers Pvt. Ltd. (2009)
5. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Methen & Co. Ltd., London (1957)

AUPM64PII: 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. Spectrometer - small angled prism: Normal incidence
7. Spectrometer - small angled prism: Normal emergence
8. Liquid lens - refractive index of liquid and lens (Mercury given)
9. Liquid lens - refractive index of liquid and lens (Water given)
10. Newton's Rings – Reflected system
11. Air wedge - diameter of a wire
12. Potentiometer - resistivity
13. Potentiometer - calibration of ammeter
14. Potentiometer - reduction factor of TG
15. Potentiometer - calibration of low range voltmeter
16. Potentiometer - calibration of high range voltmeter
17. Circular coil - calibration of ammeter
18. Circular coil - study of earth's magnetic field using compass box
19. Absolute determination of m and B_h - deflection and box type vibration magnetometers
20. Searle's vibration magnetometer - dipole moment of a bar magnet and comparison of magnetic moments
21. Thermo emf - measurement of emf using digital multimeter
22. Carey Foster's bridge - resistivity
23. Carey Foster's bridge -temperature coefficient of resistance
24. Mirror galvanometer - figure of merit

25. BG - Absolute capacity of a condenser
26. Conversion of galvanometer into ammeter and calibration using digital multimeter
27. Conversion of galvanometer into voltmeter and calibration using digital voltmeter

Books for reference:

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

AUPM64PIII: ELECTRONICS AND DIGITAL ELECTRONICS

(Minimum 20 experiments to be done)

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. Clipper circuits - study of waveforms

7. Clamper circuits – study of waveforms

8. 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.

9. 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.

10. 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.

11. 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.

12. Single stage CE amplifier - To construct a single stage CE transistor amplifier and study its frequency response.

13. OP amp IC741 Inverting amplifier - To construct an inverting amplifier using IC741 and determine its voltage gain.

14. OP amp IC741 Non inverting amplifier - To construct an inverting amplifier using IC741 and determine its voltage gain.

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

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

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

18. Logic gates - OR, AND and NOT - To verify the truth tables of OR and AND gates using diodes.

19. Network theorems - Superposition, Thevenin’s, Norton’s and maximum power transfer theorems

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

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

22. Adder and subtractor using basic logic gates - To construct adder and subtractor circuits using XOR and NAND gates and to verify their truth tables

23. SR flip-flop using IC 7400 - To construct SR flip-flops using quad 2 input NAND gate IC 7400 and verify the truth table

24. JK flip-flop using IC 7410 - To construct JK flip-flops using triple 3 input NAND gate IC 7410 and verify the truth table

Books for reference:

1. Practical Physics for BSc Physics Main: Sebastian, VAS Publications (2003)
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)

AUPY64PIV: ELECTIVE COURSE PRACTICAL

(Minimum of 5 experiments to be done; Internal Evaluation)

1. Analysis of Powder XRD Data
2. Analysis of given Rotation - Vibration Spectrum
3. Synthesis of nanomaterial using precipitation method
4. Implementation of Polygon filling using flood fill, boundary fill, and scan line algorithms.
5. Implementation of Line Drawing algorithm using DDA
6. Implementation of Circle generation using Mid Point method and Bresenham's method.
7. Implementation of Line Clipping using Cohen- Sutherland Algorithm
8. Develop programs for the following image enhancement operations.
   (i) Image Subtraction
   (ii) Contrast enhancement
   (iii) Complement of an image
   (iv) Brightness slicing

9. Introduction to Optical Fiber Cable
   (i) Study the Composition of Fiber Optic Cable
   (ii) Single and ribbon type
   (iii) Underground and over head.
   (iv) Pig Tail
   (v) Patch Chord
   (vi) Splice Protection Sleeve
   (vii) Fusion Splicer
   (viii) Fiber Closure
   (ix) Light Source
   (x) Power Meter
   (xi) Optical Loss Test Set
   (xii) OTDR
10. Connectors
   (i) FC/SC/ST/LC/FDDI/ESCON/SMA
   (ii) Various types of ratio couplers
11. Splicing
   (i) Fusion Splicing Set Up
   (ii) Splicing Stage by Stage
   (iii) Arranging in Splice Tray
   (iv) Securing in Fiber Closure
12. Fiber Optic Testing
   (i) Fiber Continuity Test using Light Source and Power Meter
   (ii) Cable Loss Test
   (iii) OTDR Test
   (iv) Setting up of OTDR
   (v) Measuring Cable Span
   (vi) Measuring Attenuation Coefficient
   (vii) Connector/Splice Loss Measurement
   (viii) Distance to Fault
   (ix) OTDR Trace Analysis
   (x) Optical Loss Budget
13. R program to sort a vector
14. R program to find the sum of natural numbers

15. R program to check if a number is odd or even
16. R program to check if a number is positive, negative or zero
17. R program to find maximum and minimum
