ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR

DEPARTMENT OF PHYSICS

B.Sc., Physics - CBCS Syllabus (2022-2023 Onwards)

I SEMESTER				
PART	**SUB. CODE**	**PAPER**	**HRS**	**CR**
I	22UTAL11/ 22UHNL11/ 22UFNL11	Tamil/Hindi/French	6	4
II	22UENA11/ 22UENB11	English through Prose & Short Story – Stream A English through Prose & Short Story – Stream B	5	4
III	22UPYC11 22UPYP12	**CORE** Mechanics & Properties of Matter Physics Lab – I	 6 3	 5 --
	22UMAB11	**ALLIED -1** Ancillary Maths	 5	 4
	22UPYB11	Allied Physics (for Maths)		
	22UPYR12	Allied Physics Lab (for Maths)		
IV	22USBE11	Skill Based Elective-1 Office Automation & Design	1	1
	22USBP11	Office Automation & Design - Practical	2	1
	22UFCE11	FC-Personality Development	1	1
	22UCSH12	Communication Skill	1	--
	22UBRC11	Bridge Course	--	1
V	22UNCC/NSS/ PHY.EDU./ YRC /ROT/ ACF/ NCB12	NCC/NSS/PHY.EDU./YRC/ROT/ACF/NCB	--	--
Total			30	21
II SEMESTER				
I	22UTAL22/ 22UHNL22/ 22UFNL22	Tamil/Hindi/French	6	4
II	22UENA22 22UENB22	English through Prose & Poetry – Stream – A English through Prose & Poetry – Stream - B	5	4
III	22UPYC22 22UPYP12	**CORE** Electricity & Electromagnetism Physics Lab – I	 6 3	 5 3
	22UMAB22	**ALLIED -2** Ancillary Maths	 5	 4
	22UPYB22	Ancillary Physics (for Maths)		
	22UPYR12	Allied Physics Lab (for Maths)		
IV	22USBE22	Skill Based Elective-2 Programming in C	2	1

	22USBP22	Programming in C – Practical	1	1
	22UFCH22	FC-Social Responsibility and Global Citizenship	1	1
	22UCSH12	Communication Skill	1	1
V	22UNCC/NSS/ PHY.EDU./ YRC /ROT/ ACF/ NCB12	NCC/NSS/PHY.EDU./YRC/ROT/ACF/NCB	--	1
Total			**30**	**25**
III SEMESTER				
I	22UTAL33/ 22UHNL33/ 22UFNL33	Tamil/Hindi/French	6	4
II	22UENG22	English through Literature-I	6	4
III		**CORE**		
	22UPYC33	1. Basic Electronics	6	6
	22UPYP24	2. Physics Lab – II	3	---
	22UPYB33	**Allied Physics-1 (For Chemistry)**	3	3
	22UPYR24	Allied Practical	2	
	22UCHB33	Allied Chemistry		
	22UCHR24	Allied Chemistry Lab		
IV	22UCHN13	Basic Tamil/Advanced Tamil/Non Major Elective -1 (Arts) Popular Physics	3	2
	22UFCE33	FC-Social Analysis and Human Rights	1	1
V	22UNCC/NSS/ PHY.EDU./ YRC /ROT/ ACF/ NCB24	NCC/NSS/PHY.EDU./YRC/ROT/ACF/NCB	--	--
	22UARE14	ARISE		
Total			**30**	**20**
IV SEMESTER				
I	22UTAL44/ 22UHNL44/ 22UFNL44	Tamil/Hindi/French	6	4
II	22UENG22	English through Literature-II (Stream-A)	6	4
III		**CORE**		
	22UPYC44	Heat and Thermodynamics	6	6
	22UPYP24	Physics Lab – II	3	3
	22UPYB44	**Allied Physics-2 (For Chemistry)**	3	3
	22UCHB44	Allied Chemistry		
	22UCHR24-	Allied Chemistry Lab		
	22UPYR24	Allied Physics Practical (For Chemistry)	2	2
IV	22UCHN24	Basic Tamil/Advanced Tamil/Non Major Elective (Science) Basics of Applied Physics	3	2

	22UFCH44	FC-Religious Literacy and Peace Ethics	1	1
V	22UNCC/NSS/ PHY.EDU./ YRC /ROT/ ACF/ NCB24	NCC/NSS/PHY.EDU./YRC/ROT/ACF/NCB	--	1
	22UARE14	ARISE	--	1
Total			**30**	**27**
V SEMESTER				
		CORE		
III	22UPYC65	Modern Physics	5	5
	22UPYC75	Optics & Spectroscopy	5	5
	22UPYC85	Mathematical Physics	5	5
	22UPYC95	Digital Electronics	4	4
	22UPYP36	Physics Lab – III	3	--
	22UPYP46	Physics Lab – IV	3	--
		CORE ELECTIVE		
	22UPYE15	Astrophysics / Information Technology	3	2
IV	22UINT15	Internship	-	1
	22USSI16	Soft Skill	2	--
Total			**30**	**22**
VI SEMESTER				
PART		**PAPER**	**HRS**	**CR**
III		**CORE**		
	22UPYD06	Classical, Statistical and Relativistic Mechanics	5	5
	22UPYD16	Nuclear Physics	5	5
	22UPYD26	Solid state Physics	5	5
	22UPYD36	Nanophysics	4	4
	22UPYP36	Physics Lab – III	3	3
	22UPYP46	Physics Lab – IV	3	3
		CORE ELECTIVE		
	22UPYE26	Basic Electric Principles & Applications/ Medical Physics / **Optoelectronics**	3	2
IV	22USSI16	Soft Skills	2	2
Total			**30**	**29**

SEMESTER	**I**	**II**	**III**	**IV**	**V**	**VI**	**TOTAL**
CREDITS	**21**	**25**	**20**	**27**	**22**	**29**	**144**

PART	CREDITS
Part -I	16
Part -II	16
Total	**32**
Part -III	
Core	72
Allied	16
Core Electives	04
Internship	01
Total	**93**
Part -IV	
Non - Major Elective	04
Skill Based Elective	04
Value Education	04
Communication Skill	01
Soft Skill	02
Total	**15**
Part -V	02
Bridge Course & ARISE	02
TOTAL	**144**

Elective for **ARTS** students : Popular Physics (III Sem.)

Elective for **OTHER SCIENCE** Students : Basics of Applied Physics (IV Sem.)

SELF LEARNING COURSES			
Semester	**Sub.Code**	**Paper**	**Credit**
III	22UPYSL3	Space Physics	3
IV	22UPYSL4	Novel Materials	3
V	22UPYSL5	Thin film Science	3
VI	22UPYSL6	Optical Communication	3

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1: Understand the basic concepts of physics for the applications in various scientific and industrial arena.

PSO2: Acquire the problem-solving skills and experimental skills keeping in mind the needs of the society and environment.

PSO3: Formulate, conduct, analyze, interpret the theory and experiments in Physics effectively as an individual or a leader of a group.

PSO4: Utilize the experimental tools and numerical techniques with an understanding of physics concepts.

PSO5: Demonstrate and communicate the theoretical and experimental Physics ideas towards higher education.

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Physics**	**Part**	**: III Core-1**
Semester	**: I**	**Hours**	**: 90**
Subject Code	**: 22UPYC11**	**Credit**	**: 5**

MECHANICS & PROPERTIES OF MATTER

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand the impact of elastic bodies and the principle involved in the projectile motion.
- To analyze the concept of centre of gravity and grasp the properties of oscillations and waves.
- To enrich the knowledge of mechanical properties of solids and fluids.

Unit 1 Impact of Elastic Bodies and Projectile motion (18 hrs)

Impact of Elastic Bodies: Impulse of a force – collision – Fundamental Principles of Impact – Oblique impact of a smooth sphere on a fixed smooth plane - Direct Impact of Two Smooth Spheres – Loss of K.E. due to a direct impact of two smooth spheres - Oblique impact of a two smooth spheres - Loss of K.E. due to Oblique impact. **Projectile motion:** Range on an inclined plane – Maximum Range – Two directions of Projections– Two-body problem and the reduced mass.

Unit 2 Centre of Gravity (18 hrs)

Introduction – Distinction between C.G and C.M – centre of Gravity of a solid cone - centre of Gravity of a hollow right circular cone (without base) - centre of Gravity of a solid hemisphere - centre of Gravity of a hollow hemisphere - centre of Gravity of a solid tetrahedron - centre of Gravity of a compound body – centre of Gravity of remainder – Stable, unstable and Neutral Equilibrium.

Unit 3 Oscillations and Waves (18 hrs)

Oscillations: Simple Harmonic Motion (SHM), Composition of two SHM in straight line and perpendicular to each other. Lissajous figures. Free vibrations, Damped vibrations, Forced vibrations, Resonance- Sharpness of resonance. **Waves:** Wave motion, types, Differential equation of wave motion, Principle of superposition, Stationary waves, Beats, Doppler effect: expression for apparent frequency- relative motion between source and observer, applications.

Unit 4 Elasticity **(18 hrs)**

Elastic Moduli– Definitions – Poisson's Ratio – Relation between Elastic Constants – Limiting Values of Poisson's Ratio – Torsion – Torsion of a cylinder - Torsional Pendulum – Theory and Experiment – Work done by twist – Bending of Beams – Bending Moment – Cantilever Depression – Theory and Experiment – Uniform and Non – Uniform Bending – Theory and Experiment.

Unit 5 Viscosity and Surface Tension **(18 hrs)**

Viscosity: Equation of continuity– Bernoulli's theorem (Explanation, Proof). Streamed line motion – turbulent motion – coefficient of viscosity and its dimension – Poiseuille's formula for the Rate of flow of liquid in a capillary tube – Stokes' Formula – Terminal velocity – Stokes' method for the coefficient of viscosity of a viscous liquid. **Surface tension**: Definition and dimension of surface tension – Work done in increasing the area of a surface – Pressure difference across a liquid surface - Excess of pressure over curved surfaces.

Books for Study:

1. Murugesan, R., Mechanics & Mathematical Physics, S Chand & Co, New Delhi, 2016.
   Unit 1: 1.1 -1.6, 2.1- 2.4.
   Unit 2: 3.1- 3.9.
   Unit 5: 5.1, 5.4.
2. Subrahmanyam and Brijlal., Waves and Oscillations, S Chand & Co, New Delhi, 2ed
   Unit 3: 2.1,2.2,2.4,2.9; 4.1- 4.6, 4.12; 6.1,6.2,6.4,6,12,6.13; 9.1- 9.4
3. Murugesan, R., Properties of Matter, S Chand & Sons, New Delhi, 2020.
   Unit 3: 11.1 -11.4
   Unit 4: 1.2, 1.7, 1.9, 1.13, 1.14, 1.15, 1.16, 1.21
   Unit 5: 2.1, 2.2, 2.3, 2.8, 2.9, 3.1, 3.3, 3.8, 3.9.

Books for Reference:

1. Murugeshan, R. Mechanics & Mathematical Methods, S Chand & Co, New Delhi, 2014
2. Narayanamurthy, M. & Nagarathnam, Dynamics - National Publishing, New Delhi, 1991.
3. Mathur, D.S., Mechanics, Sultan Chand, New Delhi, 2020.
4. Halliday and Resnik., Principles of Physics, Wiley India PVT, New Delhi, 2011.
5. P. Duraipandian, Laxmi Duraipandian and Muthamizh Jayapragasam, Mechanics Sixth S. Chand & company Ltd, New Delhi, 2005.
6. D.S.Mathur, Elements of Properties of Matter - S.Chand& Co., New Delhi, 2007.
7. Brijlal and Subramanyam, Properties of Matter- S. Chand Publishers, New Delhi, 2006.
8. R.N.Chaudhuri., Waves and Oscillations, New Age International Publishers, New Delhi,2010.

9. Richard P. Feynman, Robert B. Leighton & Mathew Sands, Feynman Lectures on Physics, Narosa Publishers, New Delhi, 2008.

Course outcomes

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

CO 1: Understand the properties of elastic bodies with experiments and the principle involved in the projectile motion.

CO 2: Explain the concept of Centre of gravity along with its effect on the stability of objects.

CO 3: Analyze the various principles and properties of Oscillations and Waves.

CO 4: Evaluate the elastic parameters of materials.

CO 5: Discuss the phenomena of viscosity and surface tension.

Mapping of Cos with PSOs & POs:

SEMESTER I	**Subject Code: 22UPYC11**								**Title of Paper: Mechanics and Properties of Matter**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		3	3	3			3	2	3	3	3	29
CO2	3	3		3	3	3		1	3	3	2	3	3	30
CO3	3	3		3	2	3			3	3	3	3	3	29
CO4	3	2		2	1	3		1	3	2	3	2	2	24
CO5	3	3		3	3	2			3	3	3	3	3	29
Grand total of COs with PSOs and POs														141
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{141}{52}\right)$														2.71

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.71
Observation	**COs of Mechanics and Properties of Matter Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Maths**	**Part**	**: III Allied-1**
Semester	**: I**	**Hours**	**: 45**
Subject Code	**: 22UPYB11**	**Credit**	**: 3**

ALLIED PHYSICS – 1

(For Maths students)

MECHANICS, PROPERTIES OF MATTER, THERMAL PHYSICS and OPTICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To provide knowledge in the field of mechanics, properties of matter, thermal physics and optics for maths students

Unit 1: Waves and Oscillations (9 Hrs.)

Simple harmonic motion - laws of transverse vibrations of strings - Melde's string - transverse and longitudinal modes - ultrasonic's - production - application and uses - reverberation - factors for good acoustics of hall and auditorium.

Unit 2: Properties of Matter (9 Hrs.)

Elasticity - different moduli of elasticity - poisson's ratio - energy stored in a stretched wire - bending of beam -Young's modulus by uniform and non - uniform bending - torsion pendulum - determination of rigidity modulus by torsional pendulum. Viscosity: Streamline flow and turbulent flow - Coefficient of viscosity.

Unit 3: Thermal Physics (9 Hrs.)

Postulates of the kinetic theory of gases – Van der waals equation of states -Joule - Kelvin effect - porous plug experiment. Laws of thermodynamics - heat engine - entropy - change of entropy in reversible and irreversible processes.

Unit 4: Geometrical Optics (9 Hrs.)

Refraction- Refraction through a thin prism – dispersion through a prism- expression for the dispersive power of material of a thin prism - combination of two prisms to produce dispersion without deviation - direct vision spectroscope - defects of images-coma- - spherical aberration in lens – methods of minimizing spherical aberration - chromatic aberration in lens - removal of chromatic aberration.

Unit 5: Physical Optics (9 hrs)

Interference – Interference in thin films - air wedge - determination of diameter of a thin wire by air wedge - Diffraction - theory of transmission grating- Normal incidence - polarization- double refraction- Nicol prism.

Books for Study:

1. R. Murugesan (2016) Allied Physics, First Edition, S.Chand and Co., New Delhi-110005.

Unit 1 : 1.1, 1.7, 1.9, 1.11, 1.12, 1.13, 1.14, 1.15, 1.16, 1.17, 1.18, 1.19

Unit 2 : 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 2.12, 2.13, 2.14, 2.15

Unit 3 : 3.1, 3.2, 3.4, 3.5, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21, 3.22

Unit 4 : 5.1, 5.6, 5.10, 5.11, 5.12, 5.13, 5.14, 5.16, 5.18, 5.19, 5.22, 5.25

Unit 5 : 6.2, 6.3, 6.5, 6.8, 6.10, 6.11, 6.12, 6.13, 6.14, 6.16, 6.17

Books for Reference:

1. Brijlal and Subramanyan (2002), Properties of Matter, S Chand Publication, New Delhi.
2. NN Bhargava, DC Kulshreshtra, SC Gupta, (1984). Sixteenth Edition, Basic Electronics and Linear Circuits, Tata McGraw-Hill Publishing Co., New Delhi.

Course outcomes

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

CO 1: Describe the wave nature

CO 2: Explain the properties of elastic bodies with experiments.

CO 3: Characterize the basic concepts of thermodynamics.

CO 4: Interpret the change of entropy.

CO 5: Understand the dispersion of light through various medium.

CO 6: Analyze the interference and diffraction in various medium.

Mapping of COs with PSOs & POs:

SEMESTER I	**Subject Code: 22UPYB11**								**Title of Paper: Allied Physics – 1 Mechanics, Properties of Matter and Thermal Physics**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	1		1	2	2	1	1	2	1	3	1	3	21
CO2	3	2		3	3	2			3	2	3	1	3	25
CO3	3	3		2	3	2			3	2	2	2	2	24
CO4	3	2		3	3	2			3	2	2	3	2	25

CO5	3	2		2	1	3		1	2	2	3	2	3	24
Grand total of COs with PSOs and POs														119
Mean value of COs with PSOs and POs=$\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{119}{52}\right)$														2.29

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.29
Observation	**COs of Allied Physics – 1 Mechanics, Properties of Matter and Thermal Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics - B.Sc. (Physics) Syllabus – 2022 – 23 onwards

Class	**: I year**	**Part**	**: III Core -2**
Semester	**: II**	**Hours**	**: 90**
Code	**: 22UPYC22**	**Credit**	**: 5**

ELECTRICITY & ELECTROMAGNETISM

(For Students admitted from the Academic Year 2022-2023 onwards)

Objective: To grasp the principles of laws of electricity and magnetism and to acquire experimental skills to construct & design technically useful devices.

Unit 1 Electricity: (18 hrs)

Coulomb's Law – Electric Field and Electric dipole (Basic Concepts) – Electrostatic Potential – Gauss law-Coulomb's law - Capacitors – Capacitance of a Parallel Plate Capacitor – Effect of Introducing Dielectric Slab between the Plates – Energy of a Charged Capacitor – Loss of Energy due to Sharing of Charges – Capacitors in Series and in Parallel – Carey Foster Bridge – Determination of temperature co-efficient of the resistance- Potentiometer – Calibration of Ammeter and Voltmeter.

Unit 2 Magnetic Effects of Electric Current: (18 hrs)

Lorentz force - Biot – Savart's Law - Magnetic induction at a point due to a straight conductor carrying current – Magnetic induction at any point on the axis of a solenoid - Ampere's circuital Law – Force on a current carrying conductor in a magnetic field – Force experienced by an electron moving in a magnetic field – Torque on a current loop in a uniform magnetic field – Moving coil Ballistic galvanometer – Current and voltage sensitiveness of a moving coil galvanometer - Measurement of charge sensitiveness (Figure of merit of BG) –Comparison of two capacitances using B.G.

Unit 3 Magnetic Properties of Materials & Electromagnetic Induction: (18 hrs)

Magnetic Properties of Materials: Magnetic Induction – Magnetisation – Relations between the three magnetic vectors B, H and M – Magnetic Susceptibility – Magnetic Permeabiity – Properties of Diamagnetic – Paramagnetic – Ferromagnetic materials.

Hysteresis – Experiment to draw M.H. curve (Horizontal method) – Energy dispersion in cycle – Importance of Hysteresis curve – Choice of magnetic material

Electromagnetic Induction: Laws of Electromagnetic Induction – Maxwell's Equation – Self Induction – Self Inductance (L) – L of a Long Solenoid – Mutual Induction – Mutual Inductance (M) – Experimental Determination of M – Coefficient of Coupling – Eddy Current – Uses

Unit 4 Transient & Alternating Currents: (18 hrs)

Transient Currents: DC Circuits– Growth and Decay of Current in a Circuit Containing L and R – Growth and Decay of Charge in a Circuit Containing C and R –growth of charge in a circuit inductance , capacitance and resistance.

Alternating Currents: Peak, Mean, and RMS Values of Alternating Current and Voltage– AC Circuits Containing R only, L only, C only –LCR Series Resonance Circuits – Power in AC Circuits – Power Factor – Watt Less Current – Choke – Principle and Construction– Transformer – Construction – Theory– No Load - on Load Conditions – Energy Losses– Uses.

Unit 5 AC Bridges & Maxwell's Equations: (18 hrs)

AC Bridges: General Principle – Maxwell's Bridge – Owen's Bridge – Anderson's Bridge

Maxwell's Equations: Introduction – Displacement Current – Maxwell's Equations in Material Media – Physical significance of Maxwell's Equations – Plane Electromagnetic Waves in Free Space – Determination of Velocity of Light – Poynting Vector.

TEXT BOOKS:

1. Murugeshan, R., Electricity and Magnetism - Chand & Co., New Delhi, 2017.
   Unit I 1.1 -1.4, 1.6, 2.2, 3.1, 4.1, 4.5 (4.5.1 & 4.5.2), 4.6, 4.9 & 4.11, 6.7 & 6.8.
   Unit II 10.1 – 10.3, 10.6, 10.7, 10.9-10.13, 10.15
   Unit III 11.1 – 11.4, 11.15– 11.19, 11.22, 14.1 – 14.8, 14.16, 14.18, 14.19.
   Unit IV 12.1 – 12.3 & 12.6., 13.1-- 13.3, 13.5 – 13.7.
   Unit V 13.18, 13.19, 11.6, 15.1-15.4, 15.7, 15.8.

REFERENCES:

1. Edward M. Purcell, David J. Morin, Electricity & Magnetism, Cambridge University Press, 3rd edition, 2013.
2. Sehgal Chopra, Sehgal M., Electricity and Magnetism, Sultan Chand & Sons, 2010.
3. Chattopadhyay D and Rakshit P.C., Electricity and Magnetism - New Central Book Agency; 9th ed 2011.
4. Tewari K.K., Electricity and Magnetism, S Chand & Company; 1995.
5. Sathya Prakash, Electricity and Magnetism- Pragati Prakashan-Meerut; 2016.
6. Tayal, D.C., Electricity and Magnetism, Himalaya Publishing Company, New Delhi, 2009.
7. Halliday, Resnick and Krane, Fundamentals of Physics; Electricity & Magnetism, John Wiley & Sons, 2011.

Course outcomes

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

CO 1: explain various phenomena of electrostatics and current electricity.
CO 2: Illustrate the basic concepts of electromagnetism and their applications.

CO 3: distinguish between self induction (L) and mutual induction (M) and also determine the values of L and M.

CO 4: construct AC and DC circuits and analyse their parameters.

CO 5: design various AC bridges and generate the physical significance of Maxwell's equations.

Mapping of COs with PSOs &POs:

SEMESTER II	**Subject Code: 22UPYC22**								**Title of Paper: Electricity & Electromagnetism**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		2	3	1			3	2	3	3	3	26
CO2	3	3		3	3	3			3	3	2	2	3	28
CO3	3	3		3	3	3			3	2	3	3	3	29
CO4	3	3		3	2	3	1		3	2	3	3	3	29
CO5	3	3		2	3	3			3	3	2	2	3	27
Grand total of COs with PSOs and POs														139
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{139}{51}\right)$														2.73

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.73
Observation	**COs of Mechanics and Properties of Matter Strongly related with PSOs and POs**		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS

Class	**: B.Sc. Mathematics**	**Part**	**: III Allied-2**
Semester	**: II**	**Total hours**	**: 45**
Subject Code	**: 22UPYB22**	**Credit**	**: 3**

ALLIED PHYSICS - II:
(For Mathematics students)
MODERN PHYSICS, ELECTRICITY & MAGNETISM AND ELECTRONICS
(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:
To provide knowledge on modern physics, electronics, electricity & magnetism for mathematics students.

Unit 1: Atomic Physics (9 hrs)
Atom model - vector atom model - various quantum numbers – coupling - Pauli's exclusion principle (def) –Magnetic dipole moment due to orbital motion of electron - spin - Stern and Gerlach experiment.

Unit 2: Nuclear Physics (9 hrs)
Nuclear model - liquid drop model, shell model - mass defect, binding energy (def) - Nuclear fission and fusion - chain reaction – atom bomb - nuclear reactor

Unit 3: Theory of Relativity (9 hrs)
Frame of reference - Galilean transformation equations - Postulates of special theory of relativity- Lorentz transformation equations- length contraction, time dilation - mass energy equivalence.

Unit 4: Electricity & Magnetism (9 hrs)
Capacitor - energy of a charged capacitor - loss of energy due to sharing of charges – Biot-Sarvart's law – magnetic induction at a point on the axis of a circular coil- electric circuit switches and its types - fuses, circuit breaker and relay.

Unit 5: Electronics (9 hrs)
Basic Electronics: PN junction - Zener diode – characteristics - LED - Common Emitter Transistor amplifier (Principle). Digital Electronics: AND, OR, NOT, NAND, NOR gates - NAND and NOR gates - universal building blocks - De Morgan's theorem.

Books for Study:
1. R. Murugesan (2016) Allied Physics, First Edition, S. Chand and Co., New Delhi-110005.

Books for Reference:
1. Brijlal and Subramanyan (2002), Properties of Matter, S Chand Publication, New Delhi.
2. NN Bhargava, DC Kulshreshtra, SC Gupta, (1984). Sixteenth Edition, Basic Electronics and Linear Circuits, Tata McGraw-Hill Publishing Co., New Delhi.
3. Malvino and Leach, 1986 Digital Principles and Applications, – 4thEdn. Tata McGraw - Hill,

Course Outcomes

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

CO 1: Understand the structure of atom and various quantum numbers
CO 2: Acquire knowledge on the nuclear model.
CO 3: Explain the concepts of relativity.
CO 4: Elucidate the ideas on electricity and magnetism.
CO 5: Illustrate working of semiconductor devices.

Mapping of COs with PSOs &POs:

SEMESTER II	**Subject Code: 22UCHB44**								**Title of Paper: Modern Physics, Electricity & Magnetism and Electronics**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PSO1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2		3	3	2		1	3	3	3	2	3	28
CO2	2	3		3	3	3			3	2	3	3	2	27
CO3	3	2		3	3	3		1	3	3	3	2	3	29
CO4	3	3		2	3	3			3	2	3	2	3	27
CO5	3	2		3	3	3			3	3	3	2	3	28
Grand total of COs with PSOs and POs														139
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{139}{52}\right)$														2.67

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.67
Observation	**COs of Allied Physics - IV: Modern Physics, Electricity & Magnetism and Electronics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Physics**	**Part**	**: III Core**
Semester	**: I & II**	**Total hours**	**: 90 (45 per sem.)**
Subject Code	**: 22UPYP12**	**Credit**	**: 3**

PHYSICS LAB – I

(For Students admitted from the Academic Year 2019-2020 onwards)

Course Objectives

- To determine the physical properties of matter such as mechanical, thermal, optical and electrical properties, calibration of electrical instruments

Any 14 of the following list of experiments:

1. Young's Modulus - Uniform bending – Pin & Microscope
2. Young's Modulus - Uniform bending – Optic lever & Telescope.
3. Young's Modulus - Non-Uniform bending – Pin & Microscope
4. Young's Modulus - Non-Uniform bending – Optic lever & Telescope.
5. Young's Modulus - Cantilever
6. Torsion Pendulum - Rigidity Modulus and M.I of the disc
7. Compound Pendulum – Acceleration due to gravity
8. Specific heat capacity of liquid - Method of Cooling
9. Thermal conductivity – Lee's disc method
10. Spectrometer -μ of solid prism
11. Spectrometer -μ of hollow prism
12. Spectrometer - Dispersive power of a prism
13. Sonometer - Frequency of the tuning fork
14. Potentiometer – Calibration of Low range voltmeter
15. Potentiometer – Calibration of Ammeter
16. Dipole Moment of a magnet - Tan C method
17. Comparison of dipole moments – Tan A, Tan B simultaneous method
18. Potentiometer – Resistance and Specific resistance
19. Moving coil Galvanometer – Current and voltage sensitiveness
20. Thermo emf - Moving Coil Galvanometer

Course Outcomes

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

CO1: Calculate the Young's Modulus and Rigidity Modulus of the materials using various methods

CO2: Determine acceleration due to gravity using compound pendulum

CO3: Perform optical experiments to determine the refractive index and dispersive power

CO4: Carryout the experiments to calculate Thermo emf, Thermal conductivity and Specific heat capacity

CO5: Construct the electrical circuit to measure current and voltage sensitiveness, resistance and specific resistance and to calibrate ammeter and voltmeter

Mapping of Cos with PSOs &Pos:

SEMESTER I & II	**Subject Code: 22UPYP12**								**Title of Paper: PHYSICS LAB – I**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		3	3	3			3	3	3	2	2	28
CO2	3	3		2	2	3			3	3	3	2	2	26
CO3	3	3		3	3	2			3	3	3	2	3	28
CO4	3	3		3	3	2			3	3	3	3	3	29
CO5	3	3		3	3	2			3	3	3	2	3	28
Grand total of COs with PSOs and POs														139
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{139}{50}\right)$														2.78

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.78
Observation	**COs of Physics Lab – I Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Maths**	**Part**	**: III Allied**
Semester	**: I & II**	**Hours**	**: 60 (30 per sem.)**
Subject Code	**: 22UPYR12**	**Credits:**	**2**

PHYSICS LAB

I Maths (Aided and SF)

(For Students admitted from the Academic Year 2019-2020 onwards)

Course Objectives:

- To study the characteristics of Zener diode, Transistor and single stage amplifier.
- To evaluate the properties of solid materials using young's modulus, compound pendulum and torsion pendulum.
- To construct Hartley oscillator, Bridge rectifier and study their parameters.
- To construct electronic logic gates using ICs, study their performance and verify theorems using logical gates.
- To study the experimental methods of spectrometer, Lee's disc, Air wedge and Ballistic galvanometer.

Any 14 of the following list of experiments:

1. Young's Modulus - Uniform bending – Pin & Microscope
2. Young's Modulus - Uniform bending – Optic lever & Telescope.
3. Young's Modulus - Non-Uniform bending – Pin & Microscope
4. Young's Modulus - Non-Uniform bending – Optic lever & Telescope.
5. Torsion Pendulum - Rigidity Modulus and M.I of the disc
6. Compound Pendulum – Acceleration due to gravity
7. Comparison of Viscosities of two Liquids – Burette method
9. Thermal conductivity – Lee's disc method
10. Air Wedge – Thickness of thin wire
11. Spectrometer – Grating – Normal Incidence method
12. Ballistic Galvanometer - Current & voltage sensitiveness
13. Series resonance circuit - Resonant frequency, Self-inductance (L), Q-factor & Band width
14. Bridge Rectifier with filter – Determination of voltage regulation factor
15. Zener diode – V-I Characteristics- Voltage regulation
16. Transistor Characteristics –CE mode
17. Single stage amplifier _ CE mode – construction & measurement of Voltage gain
18. Hartley Oscillator – frequency of Oscillations
19. Logic Gates _ AND, OR,NOT,NAND, NOR Gates using IC's
20. Demorgan's theorem – Verification using IC's

Course Outcomes

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

CO1: Study the characteristics of Zener diode, Transistor and single stage amplifier

CO2: Evaluate the properties of solid materials using young's modulus, compound pendulum and torsion pendulum.

CO3: Construct Hartley oscillator, Bridge rectifier and study their parameters.

CO4: Construct electronic logic gates using ICs, study their performance and verify theorems using logical gates.

CO5: Study the experimental methods of spectrometer, Lee's disc, Air wedge and Ballistic galvanometer

Mapping of Cos with PSOs &Pos:

SEMESTER I & II	**Subject Code: 22UPYR24**								**Title of Paper: Physics Lab (I Maths - Aided & SF)**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		2	3	3			2	3	3	3	2	27
CO2	3	3		3	3	2		1	3	3	3	3	3	30
CO3	2	3		2	3	3			3	3	3	3	3	28
CO4	3	3		2	3	3			3	3	2	3	3	28
CO5	3	3		3	3	3			3	3	3	3	3	30
Grand total of COs with PSOs and POs														143
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{185}{51}\right)$														2.80

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.80
Observation	**COs of Physics Lab - I: (Maths - Aided & SF) Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class	**: B.Sc. Physics**	**Part**	**: III Core-3**
Semester	**: III**	**Hours**	**: 90**
Subject Code	**: 22UPYC33**	**Credits**	**: 6**

BASIC ELECTRONICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To acquire the basic concepts of various network theorems, clipper/clamper and filter circuits, amplifier and oscillator circuits.
- To obtain the knowledge of BJT, FET, UJT, OP-Amp and optoelectronic devices.

Unit 1 Network Analysis (18 hrs)

Superposition Theorem - Voltage source and Current Source - Thevenin's Theorem - Norton's Theorem - Maximum Power Transfer Theorem - h parameters - h parameters of an ideal CE transistor

Unit 2 Solid State Devices - I (18 hrs)

Ideal diode - Clipping and Clamping Circuits - Positive and Negative clipping - Positive and Negative clamping - Zener Diode - Characteristics -Zener Diode as Voltage Regulator - Full-Wave Bridge Rectifier - Filter Circuits - Shunt Capacitor Filter - Voltage Multiplier - Doubler - Tripler

Unit 3 Solid State Devices - II (18 hrs)

DC Load Line - Quiescent Point - Stability factor - Methods of biasing -Emitter Feed Back Bias - Universal Divider Bias. FET - Working Principles of JFET - Output Characteristics of JFET - Working Principles of UJT -Application of UJT as an oscillator-SCR -Working Principles

Unit 4 Amplifiers and Oscillators (18 hrs)

Amplifiers - Common Base and Common Collector - Amplifiers (Basics only) Common Emitter Type - Voltage Gain - Frequency Response -Amplifier Classification based on biasing condition - Push Pull Amplifier.

Oscillators - Feedback Principle - Types of Feedback - Advantage of Negative Feed Back - Barkhausen Criterion - Hartley, Colpitt and Phase Shift Oscillators - Multivibrators - Astable - Monostable - Bi-stable Multivibrators

Unit 5 Optoelectronics and Operational Amplifiers (18 hrs)

Optoelectronics - LED - Photovoltaic Devices - Photo Diodes

OP-AMP - Characteristics - Non Inverting Amplifier - Inverting Amplifier -Expressions for Gain - Concept of Virtual Ground - Applications as Adder, Subtractor, Differentiator, Integrator and Comparator.

Text Book:

1. Theraja. B.L, 2012, Basic Electronics, S.Chand and Co., New Delhi.
   Unit I - Ch 4.2- 4.9, 21.14, 21.18.
   Unit II - Ch.14.4, 14.13-14.17, 15.1-15.2, 17.8, 17.9, 17.11, 17.24-17.27.
   Unit III - Ch.20.1, 20.2, 20.3, 20.5, 20.8, 20.10, 20.13, 26.1-26.6, 27.1-27.4.
   Unit IV - Ch.22.2, 22.4, 22.5, 22.6, 22.7 23.9.22.13, 22.24, 25.1-25.3, 28.1-28.14.28.21, 28.22, 29.6-29.10.
   Unit V – Ch.16.1- 16.3, 16.6 - 16.11, 31.18-31.3.

References:

1. Mehta, V.K & Rohit Mehta, 2020, Principles of Electronics, 12th ed., S.Chand and Co., New Delhi.
2. Millman and Halkias, 2017, Electronics Fundamentals and Applications, 2nd ed., McGraw Hill, New Delhi.
3. Albert Malvino& David J. Bates, 2017, Electronic Principles, 7th ed., McGraw Hill.
4. Grob & Schultz, 2003, Basic Electronics, 9th ed., Tata McGraw Hill.

Course outcomes

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

CO 1: Understand the complex circuits via various network theorems.

CO 2: Apply the basics of diode to describe the working of rectifier circuits such as Full and half wave rectifiers.

CO 3: Illustrate the principles and working of semiconductor devices.

CO 4: Classify the amplifier circuits and oscillator principles and its types.

CO 5: Discuss ideal operational amplifier (op amp) and design different application circuits using op amp.

Mapping of Cos with PSOs &Pos:

SEMESTER II	**Subject Code: 22UPYC33**								**Title of Paper: Basic Electronics**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		3	3	3			3	3	3	3	3	30
CO2	2	3		3	3	3			3	3	2	3	3	28
CO3	3	3		3	3	3			3	2	3	3	3	29
CO4	2	3		3	3	3			3	3	3	3	3	29
CO5	3	3		3	2	3	1		3	3	3	3	2	29
Grand total of COs with PSOs and POs														145
Mean value of COs with PSOs and POs=$\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{145}{51}\right)$														2.84

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.84
Observation	**COs of Basic Electronics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Chemistry**	**Part**	**: III Allied-3**
Semester	**: III**	**Hours**	**: 45**
Subject Code	**: 22UPYB33**	**Credits**	**: 3**

ALLIED PHYSICS – I (For Chemistry students)

MECHANICS, PROPERTIES OF MATTER, THERMAL PHYSICS and OPTICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To explain the wave nature & properties of elastic bodies with experiments.
- To understand basic concepts of thermodynamics and various properties of light.

Unit 1: Waves and Oscillations **(9 hrs)**

Simple harmonic motion - transverse vibrations of strings - Melde's string - transverse and longitudinal modes - ultrasonic's - production - application and uses - reverberation - factors for good acoustics of hall and auditorium.

Unit 2: Properties of Matter **(9 hrs)**

Elasticity - different moduli of elasticity - poisson's ratio - energy stored in a stretched wire - bending of beam -Young's modulus by uniform and non - uniform bending - torsion pendulum - determination of rigidity modulus by torsional pendulum. Viscosity: Streamline flow and turbulent flow - Coefficient of viscosity.

Unit 3: Thermal Physics **(9 hrs)**

Postulates of the kinetic theory of gases – Van der waals equation of states -Joule - Kelvin effect - porous plug experiment. Laws of thermodynamics - heat engine - entropy - change of entropy in reversible and irreversible processes.

Unit 4: Geometrical Optics **(9 hrs)**

Refraction- Refraction through a thin prism – dispersion through a prism- expression for the dispersive power of material of a thin prism - combination of two prisms to produce dispersion without deviation - direct vision spectroscope - defects of images-coma- - spherical aberration in lens – methods of minimizing spherical aberration - chromatic aberration in lens - removal of chromatic aberration.

Unit 5: Physical Optics **(9 hrs)**

Interference – Interference in thin films - air wedge - determination of diameter of a thin wire by air wedge - Diffraction - theory of transmission grating- Normal incidence - polarization- double refraction- Nicol prism.

Text Book:

1. R. Murugesan Allied Physics, First Edition (2016), S. Chand and Co., New Delhi-110005.
   - Unit I - Ch. 1.1,1.5-1.7,1.9,1.11-1.18.
   - Unit II - Ch. 2.1-2.8, 2.12-2.15.
   - Unit III - Ch. 3.1-3.2, 3.4-3.6, 3.15-3.22.
   - Unit IV - Ch. 5.1, 5.10-5.14, 5.16, 5.18-5.19, 5.22, 5.25.
   - Unit V - Ch. 6.2- 6.5, 6.8, 6.10 - 6.14, 6.16.

Books for Reference:

1. Brij Lal and N Subramanyan, 2002, Properties of Matter, First Edition, S Chand Publication, New Delhi.
2. D S Mathur, 2010, Elements of Properties of Matter, First Edition, S Chand & Company, New Delhi.

Course outcomes

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

CO 1: Describe the wave nature
CO 2: Explain the properties of elastic bodies with experiments.
CO 3: Characterize the basic concepts of thermodynamics.
CO 4: Interpret the change of entropy.
CO 5: Understand the dispersion of light through various medium.
CO 6: Analyze the interference and diffraction in various medium.

Mapping of COs with PSOs & POs:

SEMESTER I	**Subject Code: 22UPYB33**								**Title of Paper: Allied Physics – I MECHANICS, PROPERTIES OF MATTER, THERMAL PHYSICS and OPTICS**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	1		1	2	2	1	1	2	1	3	1	3	21
CO2	3	2		3	3	2			3	2	3	1	3	25
CO3	3	3		2	3	2			3	2	2	2	2	24
CO4	3	2		3	3	2			3	2	2	3	2	25
CO5	3	2		2	1	3		1	2	2	3	2	3	24
Grand total of COs with PSOs and POs														119
Mean value of COs with PSOs and POs=$\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{119}{52}\right)$														2.29

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.29
Observation	**COs of Allied Physics – I:MECHANICS, PROPERTIES OF MATTER, THERMAL PHYSICS and OPTICS Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class	**: B.A., (Arts)**	**Part**	**: IV NME-1**
Semester	**: III**	**Hours**	**: 45**
Subject Code	**: 22UPYN13**	**Credits**	**: 2**

POPULAR PHYSICS – (elective for arts students)
(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand the basics of light & sound, sources of energy and communication
- To gain knowledge on the idea about the universe and astrophysics
- To acquire knowledge on the medical instruments and its uses

Unit 1 Light and Sound (9 hrs)

Nature of light – Sources of light – Properties of light – Velocity of light – Naturally occurring phenomenon of light (introductory ideas) Rainbow, Blue of sky

Nature of sound waves – Characteristics of sounds – Reverberation – Echo - Velocity of sound - SONAR - Lightning and thunder

Unit 2 Energy Physics (9 hrs)

Different forms of energy – Conventional and non-conventional energy sources – Solar energy - Wind energy – Tidal energy – Nuclear energies– Applications

Unit 3 Communication Physics (9 hrs)

Communication system – Analog and digital communication system – Process in communication system - Communication satellites – Components of a satellite – RADAR – Fibre optic communication – Advantages

Unit 4 Astro-Physics (9 hrs)

The Universe - Solar system (Sun, Planets & Satellites) – Earth – Rotation & Revolution of earth - Seasons – Standard time - Lunar eclipse – Solar eclipse.

Unit 5 Medical Physics (9 hrs)

Parts of eye - Defects of eyes – Body temperature and Blood pressure – X-Rays and its uses in medicine - Ultrasounds and its uses in medicine – Lasers and its applications in medicines

Text Books:

1. Course material, Department of Physics, Arul Anandar College, Karumathur.

References:

1. R. Murugesan, 2016, Allied Physics, First Edition, S.Chand and Co., New Delhi-110005.
2. Rai, G.D., 2005, Non-conventional sources of Energy-4thEd., Khanna Publishers, New Delhi.
3. Jayant V. Narlikar, Fred Hoyle - Introduction to cosmology, 3rd Ed., (2002), Cambridge University Press.
4. Subir Kumar Sarkar, Optical Fibres and Fibre Optic Communication Systems, Fourth Edition (2014), S Chand & Company Pvt Ltd, New Delhi.
5. M. Arumugam, 2019 (3rd ed - Reprint), Biomedical instrumentation, Anuradha Publication.

Course Outcome

On completion of the course, students should be able to

CO 1: develop knowledge and an understanding of fundamentals of light.

CO 2: elucidate the basic principle and types of energy generation.

CO 3: understand the components of satellite and fibre optical communication.

CO 4: describe the objects in the solar system.

CO 5: identify the various instruments in medical Physics.

Mapping of Cos with PSOs &Pos:

SEMESTER I	**Subject Code: 22UPYN13**								**Title of Paper: POPULAR PHYSICS**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2		2	3	3			3	2	3	3	3	26
CO2	2	2		2	3	3			3	2	3	3	3	26
CO3	2	2		2	3	3			3	2	3	3	3	26
CO4	1	2		2	3	3			3	2	3	3	3	25
CO5	2	2		2	3	3			3	2	3	3	3	26
Grand total of COs with PSOs and POs														129
Mean value of COs with PSOs and Pos = $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{129}{50}\right)$														2.58

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.58
Observation	**COs of Popular Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class : B.Sc. Physics **Part : Self-Learning Course**

Semester : III **Credits : 3**

Subject Code : 22UPYSL3

SPACE PHYSICS

(Self-Learning Course - Offered by Department of Physics)

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To acquire the knowledge of solar system, stars, galaxies and space technology tools in astronomy.

UNIT 1 Universe

Origin of universe - Steady state theory – Big bang theory – Hubble's law – Red shift – models of the universe (idea only) -Milkyway galaxy – structure - Types of galaxies: Spiral – Elliptical – Irregular.

UNIT 2 Stars

Birth of stars – Nuclear fusion reaction - Evolution of stars – Binary stars – White dwaft - Neutron stars - Black holes.

UNIT 3 Solar system

Sun – Earth – Moon – other planets – Solar and lunar eclipses –comparison of stars and planets - constellations.

UNIT 4 Satellites

Satellites – Natural and artificial satellites – Types and uses – Escape speed – orbital speed.

UNIT 5 Space Technology

ISRO – Rockets - Satellite Launching vehicles – parts – types - SLV, ASLV, PSLV and GSLV.

Books for Reference

1. Mohan Sundar Rajan, Space Today, 2012, National Book Trust of India.
2. Baidyanath Basu, An Introduction to Astrophysics, 2003, PHI
3. Krishnaswamy, K.S. 1996, Astrophysics, New Age International.
4. George O.Abell, David Morrison, Sidney C. Wolf, 1995, Exploration of the universe, Harcourt College Publication.
5. Niclolas.A. Pananides and Thomas Arny, 1979, Introductory Astronomy, Addison Wesley Publ. Co.
6. Carrol and Ostlie, 2007, Introduction to Modern Astrophysics, 2nd ed., Pearson International.

Course Outcomes

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

CO 1: Acquire the knowledge of solar system, stars and space technology tools in astronomy.

CO 2: Describe the formation of stars and galaxies.

CO 3: Discuss the energy generation and properties of sun.

CO 4: Classify the different types of stars and galaxies.

CO 5: Analyse the characteristics of different satellites and tools.

Mapping of Cos with PSOs &Pos:

SEMESTER V	Subject Code: 15UPYSL3								Title of Paper: SPACE PHYSICS					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3		2	3	2			3	3	3	2	2	26
CO2	3	3		3	3	2			3	3	3	2	3	28
CO3	2	3		3	3	2			3	2	3	2	2	25
CO4	3	3		3	3	2	1		3	3	3	2	2	28
CO5	3	3		3	3	2	1		3	1	3	2	2	26
Grand total of COs with PSOs and POs														133
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{133}{52}\right)$														2.56

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.56
Observation	**COs of Space Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Physics**	**Part**	**: III Core-4**
Semester	**: IV**	**Hours**	**: 90**
Subject Code	**: 22UPYC44**	**Credits**	**: 6**

HEAT AND THERMODYNAMICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To provide students with a broad understanding of the behaviour of ideal and real gas
- To equip the learners with the conceptualization of transmission of heat, entropy and phase transition through demonstrations

Unit 1 Behaviour of Ideal and Real Gases (18 hrs)

Concept of Ideal gas – Expression for the pressure exerted by a gas – Derivation of gasequation – Derivation of gas laws – Degrees of freedom – Maxwell's law of Equipartition ofenergy - Van der Waals' Equation – Estimation of Critical Constants - Critical Coefficient – Joule-Thomson Porous Plug Experiment – Relation between Boyle Temperature, Temperature of Inversion and Critical Temperature

Unit 2 Transport Phenomena in Gases (18 hrs)

Molecular collisions - Mean free path – Sphere of Influence – Collision Cross-Section - Expression for mean free path – Variation of λ with Temperature and Pressure - Transport phenomena – Viscosity – Effect of Temperature on η – Effect of Pressure on η – Thermal Conductivity – Relation between η and K – Effect of temperature on K – Effect of Pressure on K – Self Diffusion – Effect of Temperature and Pressure on D – Relation between η and D

Unit 3 Radiation (18 hrs)

Thermal radiation – Black Body – Stefan-Boltzmann Law – Distribution of Energy in Black Body spectrum– Wien's Displacement Law- Rayleigh Jeans Law - Planck's Radiation Law – Derivation of Stefan's law-Derivation of Newton's Law of Cooling from Stephen's Law - Experimental verification of Stefan's Law-Solar Constant – Temperature of the sun - Solar Spectrum

Unit 4 Laws of Thermodynamics (18 hrs)

Thermodynamic system- Zeroth law of thermodynamics- Internal energy- First Law of Thermodynamics – The indicator diagram- Work done using an isothermal process-work done during an adiabatic process- Slopes of adiabatics and Isothermals- Carnot's ideal heat engine- Carnot's cycle-Second law of thermodynamics

Unit 5 Thermodynamical relationships II (18 hrs)

Concept of Entropy- Change in Entropy - Change in Entropy in adiabatic process- Change of Entropy in reversible Cycle – Principle of increase of Entropy -Change of Entropy in an Irreversible Processes–The T-S Diagram– Physical significance of Entropy -Entropy of a Perfect Gas- Third law of thermodynamics – Nernst's heat theorem- Maxwell's Thermodynamical Relations – Thermodynamic Potentials – Relation between C_p, C_v and μ - first order phase transitions-Second order phase transitions: Ehrenfest's equations.

TEXT BOOKS:

1. Brijlal, Subramaniam, & Hemne, 2014, Heat & Thermodynamics, S. Chand & Company Ltd
   Unit – I: 1.2, 1.4, 1.8, 1.9, 1.18, 1.19, 2.8, 2.10, 2.12, 2.21, 2.25
   Unit – II: 3.1 – 3.14, 3.16, 3.17, 3.18
   Unit – III: 8.1, 8.6, 8.12-8.15, 8.17, 8.20, 8.21, 8.22, 8.26, 8.27, 8.31
   Unit – IV: 4.1, 4.2, 4.6, 4.7, 4.11-4.14, 4.23, 4.24, 4.28
   Unit – V: 5.1- 5.9, 5.15, 6.3, 6.5, 6.8, 6.18, 6.19,

REFERENCES:

1. J.K.Sharma and K.K.Sarkar, 2018, Thermodynamics and Statistical Mechanics, 2nd Ed., Himalaya Publishing House, New Delhi.
2. R. Murugeshan and Kiruthiga Sivaprasath, 2013, Thermal Physics - S.Chand& Co., New Delhi.
3. Halliday, Resnick and Krane, 2002, Physics (Vol I), 5th ed., John Wiley & sons.
4. Mathur, D.S., Heat and Thermodynamics –5th Ed., S.Sulthan Chand & Sons, New Delhi 2004.
5. Sears W. Francis, 1986, Thermodynamics Kinetic Theory & Statistical Thermodynamics - Addison- Narosa Publishing House, New Delhi..

COURSE OUTCOMES

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

CO1: distinguish the behaviour of ideal gas and real gas.

CO2: comprehend the various transport phenomena like viscosity, thermal conductivity and self-diffusion.

CO3: explain the concept of mode of heat transmission and their significance

CO4: apply various laws of thermodynamics to various real systems

CO5: calculate entropy and phase changes in thermodynamical processes

SEMESTER III	Subject Code: 22UPYD06								Title of Paper: HEAT AND THERMODYNAMICS					Hours 90	Credits 6
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					Mean score of CO'S	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	3	2	1	2	1	2	3	2	3	3	3	2	3	2.31	
CO2	3	1	2	3	2	2	2	2	3	2	3	3	2	2.31	
CO3	2	2	3	2	2	3	1	1	3	2	3	3	3	2.31	
CO4	3	2	3	2	2	3	2	1	3	2	3	3	3	2.46	
CO5	3	2	3	2	2	3	2	1	3	2	3	3	3	2.46	

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Chemistry**	**Part**	**: III Allied-4**
Semester	**: IV**	**Hours**	**: 45**
Subject Code	**: 22UPYB44**	**Credits:**	**3**

ALLIED PHYSICS – II (For Chemistry students)

MODERN PHYSICS, ELECTRICITY & MAGNETISM AND ELECTRONICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To describe theories of an atom, properties of a nucleus and relativity.
- To understand the basics of electricity and magnetism and electronics.

Unit 1: Atomic Physics (9 hrs)

Atom model - vector atom model - various quantum numbers – coupling- Pauli's exclusion principle (definition) –Magnetic dipole moment due to orbital motion of electron - spin - Stern and Gerlach experiment.

Unit 2: Nuclear Physics (9 hrs)

Nuclear model - liquid drop model - mass defect, binding energy (definition) - shell model - Nuclear fission and fusion - chain reaction – atom bomb - nuclear reactor

Unit 3: Theory of Relativity (9 hrs)

Frame of reference - Galilean transformation equations - Postulates of special theory of relativity- Lorentz transformation equations- length contraction, time dilation - mass energy equivalence.

Unit 4: Electricity & Magnetism (9 hrs)

Capacitor - energy of a charged capacitor - loss of energy due to sharing of charges – Biot-Sarvart's law – magnetic induction at a point on the axis of a circular coil- electric circuit switches and its types - fuses, circuit breaker and relay.

Unit 5: Electronics (9 hrs)

Basic Electronics: PN junction - Zener diode – characteristics - LED - Common Emitter Transistor amplifier (Principle). Digital Electronics: AND, OR, NOT, NAND, NOR gates - NAND and NOR gates - universal building blocks - De Morgan's theorem.

Text Books:

2. R Murugesan, Allied Physics, First Edition, 2016, S. Chand and Co., New Delhi.
   - Unit I - Ch. 7.1-7.4, 7.6-7.8.
   - Unit II - Ch. 8.1-8.5, 8.8-8.9, 8.11-8.14.
   - Unit III - Ch. 9.1-9.4, 9.6-9.9.
   - Unit IV - Ch. 4.1-4.3, 4.5-4.6, 4.16-4.20.
   - Unit V - Ch. 10.1-10.3, 10.5, 10.11-10.18, 10.21.

Books for Reference:

4. Brij Lal & N Subramanian, Properties of Matter, First edition (2002), S Chand Publication, New Delhi.
5. V K Mehta, Rohit Mehta, Principles of Electronics, 12thedition (2020), S Chand Publication, New Delhi.
6. Malvino and Leach, Digital Principles and Applications, 8th edition (2014), Tata McGraw - Hill, New Delhi.

Course Outcomes

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

CO 1: Understand the structure of atom and various quantum numbers

CO 2: Acquire knowledge on the nuclear model.

CO 3: Explain the concepts of relativity.

CO 4: Elucidate the ideas on electricity and magnetism.

CO 5: Illustrate working of semiconductor devices.

Mapping of Cos with PSOs &Pos:

SEMESTER IV	**Subject Code: 22UPYB44**								**Title of Paper: ALLIED PHYSICS – II Modern Physics, Electricity& Magnetism and Electronics**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PSO1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	2		3	3	2		1	3	3	3	2	3	28
CO2	2	3		3	3	3			3	2	3	3	2	27
CO3	3	2		3	3	3		1	3	3	3	2	3	29
CO4	3	3		2	3	3			3	2	3	2	3	27
CO5	3	2		3	3	3			3	3	3	2	3	28
Grand total of COs with PSOs and POs														139
Mean value of COs with PSOs and POs=$\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{139}{52}\right)$														2.67

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.67
Observation	**COs of Allied Physics - II: Modern Physics, Electricity & Magnetism and Electronics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. (NME)**	**Part**	**: IV NME-2**
Semester	**: IV**	**Hours**	**: 45**
Subject Code	**: 22UPYN24**	**Credits**	**: 2**

BASICS OF APPLIED PHYSICS (For other science students)

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To integrate and relate scientific knowledge learned from the classroom with real-life situations.

Unit 1 *:* Heating Effects of electric current **(9 hrs)**

Joule's law of heating - Heating elements - Applications of heating effect of current: Incandescent lamps - electric iron - water heater- electric kettle – Electric Fuse

Unit 2 : Communication Physics **(9 hrs)**

Types of Communication – Satellite Communication – RADAR – Optical fiber communication.

Unit 3 *:* LASER Physics **(9 hrs)**

Characteristics of LASER – Principle of Spontaneous and Stimulated Emission – Population Inversion – Optical Pumping - Applications.

Unit 4 : Medical Physics **(9 hrs)**

Defects of vision in Eyes – Body temperature and Blood Pressure – Ultrasonography – X-Ray – MRI – ECG – Endoscope – Bloodless Surgery.

Unit 5 : Astrophysics **(9 hrs)**

Universe – Our Solar system: The Sun, Planets and Natural Satellites – Seasons: Meteorological Seasons and Astronomical Seasons – Eclipses: Lunar and Solar Eclipses

TEXT BOOKS:

1. Course Material prepared by PG & Research Department of Physics, Arul Anandar College (Autonomous), Karumathur.

REFERENCES:

1. Murugeshan and R. Kiruthiga Sivaprakash, 2014, Optics and Spectroscopy, S.Chand & Publ.
2. Alexis Leon and Mathews Leon, 1999, Fundamentals of Information Technology, Vikas Publishing house/UBS Publishers distributors Ltd.
3. Noakes GR, 2000, Fundamentals of Physics, 1st Ed., Macmillan Publishers.
4. John R. Cameron and James G.Skofronick, 2000, Medical Physics, John Wiley & Sons.
5. A. Shanmugaraju, Introduction to Astrophysics, 2010, Shanlax Publications, Madurai.

Course outcome

On completion of the course, students should be able to

CO 1: Apply the heating effects of current in real-time applications.

CO 2: Classify various types of communication and recognize their role in various fields.

CO 3: Understand the significance of LASER and its applications.

CO 4: Comprehend the functions of various diagnosing instruments in the medical field.

CO 5: Recognize and understand the knowledge of the physical universe, various celestial objects and astronomical phenomena.

SEMESTER IV	Subject Code: 22UPYN24								Title of Paper: BASICS OF APPLIED PHYSICS					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3		2	3	2			3	3	3	2	2	26
CO2	3	2		2	3	2			3	2	2	3	2	24
CO3	3	3		3	3	3			3	3	3	3	2	29
CO4	3	3		3	3	3			3	3	3	2	2	28
CO5	3	3		3	3	3			3	3	3	3	2	29
Grand total of COs with PSOs and POs														136
Mean value of COs with PSOs and POs=Grand total of COs with PSOs and Pos Number of COs relating with PSOs and POs=13650														2.72

Strong – 3, Medium – 2, & Low – 1

Mapping of Cos with PSOs & Pos:

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.72
Observation	**COs of Basics of Applied Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class	**: B.Sc. Physics**	**Part**	**: III Lab-2**
Semester	**: III & IV**	**Hours**	**: 90**
Subject Code	**: 22UPYP24**	**Credits**	**: 3**

PHYSICS LAB – II

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To determine the magnetic properties M and B_H using Tan A and Tan B positions.
- To calculate the optical properties like wavelength, refractive index and Cauchy's constant using spectrometer experiments.
- To carry out the electrical experiments toperformV-I characteristics, voltage regulation, single stage RC coupled amplifier, Hartley oscillator, Voltage doubler and tripler.

Any 14 of the following list of experiments:

1.Field along the axis of the coil – Vibration magnetometer
2. Determination of M and B_H – Tan A and Tan B
3. Potentiometer – Calibration of high range voltmeter
4. Ballistic Galvanometer – Current and voltage sensitiveness
5. Ballistic Galvanometer – Charge sensitiveness
6. Ballistic Galvanometer – Thermo emf
7. Spectrometer – i-d curve
8. Spectrometer – i-i' curve
9. Spectrometer – grating – normal incidence method
10. Spectrometer – grating – oblique incidence method
11. Spectrometer – Cauchy's constant
12. Newton's rings – radius of curvature
13. Bridge rectifier – with pi filter
14. Field along the axis of the coil – deflection magnetometer
15. Zener diode – V-I characteristics, Voltage regulation
16. Single stage RC coupled amplifier – CE mode
17. Hartley oscillator
18. Voltage doubler and tripler
19. Transistor static characteristics – CE mode

Course Outcomes

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

CO1: Find the M and B_H using Tan A and Tan B positions.

CO2: Measure the charge, current, voltage and thermo emf sensitiveness using B.G.

CO3: Determine the field along the axis of the coil using deflection magnetometer and vibration magnetometer

CO4: Measure the optical properties like wavelength, refractive index and Cauchy's constant using spectrometer experiments.

CO5: Carryout the electrical experiments toper form V-I characteristics, voltage regulation, single stage RC coupled amplifier, Hartley oscillator, Voltage doubler and tripler.

Mapping of Cos with PSOs & POS:

SEMESTER III & IV	**Subject Code: 22UPYP24**								**Title of Paper: PHYSICS LAB – II**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2		2	1	2	1		3	3	3	2	3	25
CO2	3	1		3	2	2			3	2	3	3	2	24
CO3	2	2		2	2	3			3	2	3	3	3	25
CO4	3	2		2	2	3			3	2	3	3	3	26
CO5	3	2		2	2	3			3	2	3	3	3	26
Grand total of COs with PSOs and POs														126
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{126}{51}\right)$														2.47

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.47
Observation	**COs of Physics Lab – II Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Chemistry**	**Part**	**: III Allied**
Semester	**: III & IV**	**Hours**	**: 60 (30 per sem.)**
Subject Code	**: 22UPYR24**	**Credits: 2**	

ALLIED PHYSICS LAB

II Chemistry

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To study the characteristics of Zener diode, Transistor and single stage amplifier.
- To evaluate the properties of solid materials using young's modulus, compound pendulum and torsion pendulum.
- To construct Hartley oscillator, Bridge rectifier and study their parameters.
- To construct electronic logic gates using ICs, study their performance and verify theorems using logical gates.
- To study the experimental methods of spectrometer, Lee's disc, Air wedge and Ballistic galvanometer.

Any 14 of the following list of experiments:

1. Young's Modulus - Uniform bending – Pin & Microscope
2. Young's Modulus - Uniform bending – Optic lever & Telescope.
3. Young's Modulus - Non-Uniform bending – Pin & Microscope
4. Young's Modulus - Non-Uniform bending – Optic lever & Telescope.
5. Torsion Pendulum - Rigidity Modulus and M.I of the disc
6. Compound Pendulum – Acceleration due to gravity
7. Comparison of Viscosities of two Liquids – Burette method
9. Thermal conductivity – Lee's disc method
10. Air Wedge – Thickness of thin wire
11. Spectrometer – Grating – Normal Incidence method
12. Ballistic Galvanometer - Current & voltage sensitiveness
13. Series resonance circuit - Resonant frequency, Self-inductance (L), Q-factor & Band width
14. Bridge Rectifier with filter – Determination of voltage regulation factor
15. Zener diode – V-I Characteristics- Voltage regulation
16. Transistor Characteristics –CE mode
17. Single stage amplifier _ CE mode – construction & measurement of Voltage gain
18. Hartley Oscillator – frequency of Oscillations
19. Logic Gates _ AND, OR, NOT, ssNAND, NOR Gates using IC's
20. Demorgan's theorem – Verification using IC's

Course Outcomes

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

CO1: Study the characteristics of Zener diode, Transistor and single stage amplifier

CO2: Evaluate the properties of solid materials using young's modulus, compound pendulum and torsion pendulum.

CO3: Construct Hartley oscillator, Bridge rectifier and study their parameters.

CO4: Construct electronic logic gates using ICs, study their performance and verify theorems using logical gates.

CO5: Study the experimental methods of spectrometer, Lee's disc, Air wedge and Ballistic galvanometer

Mapping of Cos with PSOs &Pos:

SEMESTER III & IV	**Subject Code: 22UPYR24**								**Title of Paper: Allied Physics Lab (II Chemistry)**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		2	3	3			2	3	3	3	2	27
CO2	3	3		3	3	2		1	3	3	3	3	3	30
CO3	2	3		2	3	3			3	3	3	3	3	28
CO4	3	3		2	3	3			3	3	2	3	3	28
CO5	3	3		3	3	3			3	3	3	3	3	30
Grand total of COs with PSOs and POs														143
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{185}{51}\right)$														2.80

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.80
Observation	**COs of Allied Physics Lab : (II Chemistry) Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Physics**	**Part**	**: SLC**
Semester	**: IV**	**Hours**	**: -**
Subject Code	**: 22UPYSL4**	**Credits**	**: 3**

Novel Materials– (Self learning course)

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To acquire knowledge of glass materials, composite ,metals and alloys and their properties.
- To describe the properties of novel materials for various industrial applications

Unit-1 Glass-Ceramics

Kinetic and thermodynamic criteria for glass formation, types of glasses and their chemical compositions, Physical properties of glasses, Nucleation and crystal growth in glasses, nucleation through micro miscibility, nucleating agents, properties and applications of glass-ceramics.

Unit-2 Metals & Alloys

Brief overview of commercial metals and alloys and their crystal structures. General properties of metals and alloys. Processing: Casting, solidification, powder metallurgy, hot workability, sheet metal forming, welding, elementary ideas of rolling, forging and extrusion. Carbon and alloy steels, Al, Ni, Zn, Ti, Mg based alloys.

Unit-3 Composite Materials

Composite Materials Types of composites and their advantages. Reinforcements: Glass, boron, carbon, organic and ceramic fibers, their structure, properties and processing.

Unit-4 Biomaterials

Introduction to biomaterials for biomedical applications, Chemical structure and property of biomaterials, Degradation of biomaterials, Polymeric biomaterials: Introduction, preparation, hydrogel biomaterials, Bio conjugation techniques, Biomaterials for drug delivery application

Unit-5 Chemical Sensors

Introduction to chemical sensing; Potentiometry: fundamental principles, membrane potentials, Applications of potentiometry: ion-selective electrodes, amperometry, glucose sensors in diabetes: more enzyme electrodes, immunosensors, ELISA, piezoelectric devices: quartz crystal microbalance, luminescent sensors and electrochemical luminescence.

References

1. Gladius Lewis, 1995, “Selection of Engineering Materials”, Prentice Hall Inc. New Jersey USA,.
2. Bahadur and Sastry, 2002, Principles of Polymer Science, Narosa Publishing House.

Course Outcomes

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

CO1: Describe the properties of glass material and its properties.

CO2: Acquire knowledge on metals and alloys.

CO3: Discuss on composite materials and its properties.

CO4: Illustrate the chemical structure and property of biomaterials,

CO5: Explain the properties of chemical sensors for various applications

Mapping of Cos with PSOs &Pos:

SEMESTER IV	**Subject Code: 22UPYSL4**								**Title of Paper: Novel Materials**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2		2	1	2	1		3	3	3	2	3	25
CO2	3	1		3	2	2			3	2	3	3	2	24
CO3	2	2		2	2	3			3	2	3	3	3	25
CO4	3	2		2	2	3			3	2	3	3	3	26
CO5	3	2		2	2	3			3	2	3	3	3	26
Grand total of COs with PSOs and POs														126
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{125}{51}\right)$														2.47

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.47
Observation	**COs of Novel Materials Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Physics**	**Part**	**: III Core-6**
Semester	**: V**	**Hours**	**: 75**
Subject Code	**: 22UPYC65**	**Credit**	**: 5**

MODERN PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To acquire the concepts of dual nature and quantum theory of light
- To enrich the knowledge on wave function, wave equations and operators.
- To analyse the physical importance of various atomic models.
- To understand the concepts of magnetic dipole moment, coupling schemes and selection rules.
- To study the magnetic and electric field effects by Zeeman and Stark effects

Unit I Dual Nature **(15 hours)**

Photoelectric Effect – Quantum Theory of Light – Work function –X-Rays-X-Ray diffraction-Compton Effect. De Broglie Waves-Waves-Phase and Group velocities-Particle Diffraction – Davisson –Germer experiment – Uncertainty Principle – I and II

Unit II Quantum Mechanics **(15 hours)**

Wave function-Normalization- Well-behaved Functions-The Wave Equation- Partial Derivatives-Schrodinger Equation time dependent form- Validity of Schrodinger Equation - Linearity and superposition-Expectation Values-Operators (Momentum and Energy)-Schrodinger's Equation: Steady state Form-Eigen values and Eigen functions-Operators and Eigen values-Particle in a Box (Wave functions, Momentum, Momentum eigen values and Momentum eigen functions for trapped particle) -Finite Potential Well-Tunnel Effect-Harmonic Oscillator (frequency of harmonic oscillator, Energy levels, Wave function).

Unit III Atomic models **(15 hours)**

Rutherford Alpha particle scattering theory – Bohr atom model–Somerfield's relativistic atom model– Fine structure of the H_α Line – The Vector Atom Model – Quantum numbers associated with the Vector atom model– Coupling schemes (L-S and J-J Coupling) – The Pauli Exclusion Principle – The Periodic Classification of elements– Electron Configuration with their modern symbolic representations.

Unit IV Magnetic Dipole Moment & Spectra **(15 hours)**

Magnetic Dipole Moment of an Electron due to Orbital and Spin Motion – Bohr Magnetron – The Stern and Gerlach Experiment – Optical Spectra- - Spectral terms –Spectral notation-The Selection Rules – Intensity Rules – Interval Rule – Fine Structure of the Sodium D Line - Fine structure of H_α line

Unit V Magnetic and Electric field effects (15 hours)

Zeeman Effect – Experimental Arrangement – Expression for the Zeeman shift-Larmor's Theorem – Quantum Mechanical Explanation of the Normal Zeeman Effect – Anamolous Zeeman Effect – Theoretical Explanation – Lande's Factor – Explanation of Splitting of D1, D2 Lines of Sodium – Paschen Back Effect – Stark Effect.

Text Books:

1. Arthur Beiser, Shobhit Mahajan, S.Rai Choudhury, 2017, Concepts of Modern Physics, 7th edition, McGraw Hill, New Delhi.
   Unit I – Ch: 2.3, 2.5, 2.6, 2.7, 3.1,3.2,3.3,3.4, 3.5 3.7, 3.8; Unit II – Ch: 5.1 to 5.7.1, 5.7.2, 5.8, 5.9, 5.10,5.11
2. Murugesan, R., Er. Kiruthiga Sivaprasath, 2022, Modern Physics, S. Chand Publications, New Delhi.
   Unit III – 4.1,4.2, 4.3, 4.11- 4.17; Unit IV – 4.18 to 4.22 ; Unit V – 4.23 to 4.28

References:

1. Halliday & Resnick, 2018, Fundamentals of Physics, 11th ed. John Wiley & Sons.
2. G. Aruldhas Quantum Mechanics, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2008)
3. N. Subrahmanyam, Brijlal, Jivan Seshan, 2017, Atomic & Nuclear Physics, S. Chand & Co.
4. J. B. Rajam, Modern Physics, S. Chand & Co.
5. Nk Sehgal Dl Sehgal, Kl Chopra, 2013, Modern Physics, Sultan Chand and Sons, New Delhi
6. Modern Physics, S. Ramamoorthy, National Publishing & Co.

Weblinks/E - Resources:

1. https://www.toppr.com/guides/physics/mechanics/modern-physics/
2. https://galileo.phys.virginia.edu/classes/252/home.html

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Understand the concepts of dual nature and quantum theory of light

CO2: Acquire knowledge on wave function, wave equations operators and Harmonic Oscillator.

CO3: Interpret the physical importance of various atomic models.

CO4: Analyze the magnetic dipole moment, coupling schemes and selection rules.

CO5: Illustrate the magnetic and electric field effects by Zeeman and Stark effects

Mapping of COs with PSOs & POs:

SEMESTER V	Subject Code:								Title of Paper: Modern Physics					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2		2	1	2	1	1	3	3	3	3	3	27
CO2	3	1		3	2	2			3	2	3	3	3	25
CO3	2	2		2	2	3	1	1	3	2	3	3	3	27
CO4	3	2		2	2	3		1	3	3	3	3	3	27
CO5	3	2		2	2	3		1	3	2	3	3	3	27
Grand total of COs with PSOs and POs														133
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{133}{56}\right)$														2.375

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.34
Observation	**COs of Modern Physics strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. PHYSICS**	**Part**	**: III Core -7**
Semester	**: V**	**Hours**	**: 75**
Subject Code	**: 22UPYC75**	**Credit**	**: 5**

OPTICS AND SPECTROSCOPY

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand the basics on interference.
- To enrich knowledge on diffraction.
- To clarify the effects of polarization.
- To understand the basics of spectroscopy.
- To compare the IR and Raman Spectra.

Unit I Interference **(15 hours)**

Light waves – Superposition of waves – Interference – Theory of interference (analytical method) – Intensity Distribution in the Fringe System –Superposition of incoherent waves- Superposition of many coherent waves – Young's double slit experiment – Conditions for interference – Techniques for obtaining interference – Fresnel biprism -Determination of Wave Length –Variable thickness (Wedge shaped) film –Newton's Rings – Condition for bright and dark rings – Circular fringes – Radii of dark fringes - Determination of wavelength of light.

Unit II Diffraction **(15 hours)**

Huygens – Fresnel theory – Fresnel's assumptions – Rectilinear propagation of light – Zone plate - Fresnel and Fraunhofer types of Diffraction –Theory of Plane Diffraction Grating – Resolving Power – Rayleigh's Criterion - Resolving Power of optical instruments – Criterion for resolution according to lord Rayleigh - Resolving Power of a Prism and Plane Transmission Grating.

Unit III Polarization **(15 hours)**

Polarization – Unpolarized and polarized light – Natural light (unpolarized) – Types of polarization – Production of plane polarized light - Polarization by Reflection – Polarizing Angle and Brewster's Law – Polarization by refraction-Pile of Plates – Polarization by scattering – Double Refraction – Polarizer and Analyzer – Malus law – Anisotropic Crystals – Double refraction in calcite crystal – Nicol Prism – Retarders (quarter and half wave plates) — Optical activity – Optical rotation – Specific rotation - Fresnel's explanation.

Unit IV Introduction to Spectroscopy **(15 hours)**

Characterization of Electromagnetic Radiation – The Quantization of Energy – Region of the Spectrum – Basic elements of practical spectroscopy – Signal to noise ratio and resolving

power - Width and Intensity of Spectral Lines – Microwave Spectroscopy – Rotation of Molecules – Rotational Spectra – Diatomic Molecules.

Unit V IR & Raman spectroscopy **(15 hours)**

Infra-Red Spectroscopy – Vibrating Diatomic Molecule – Diatomic Vibrating Rotator – Vibration – Rotation Spectrum of Carbon Mono Oxide – Breakdown of the Born – Oppenheimer Approximation. Raman Spectroscopy: –Quantum Theory of Raman effect – pure rotational Raman spectra, Raman Activity of Vibrations.

Text Books:

1. Brijlal and Subramanyam and Avadhanulu, 2006, 23rd Edn.,Textbook of Optics, S.Chand and Company, New Delhi.
   (Unit1)–Chapter14.1-14.4,14.4.1(a),14.4.2-14.4.4,14.5,14.7-14.9,15.5-15.6,15.6.1-15.6.3, 15.6.7;
   (Unit 2)– Chapter 17.2-17.5,17.7, 18.7, 19.1, 19.2, 19.5, 19.6, 19.11, 19.12.
   (Unit 3) – 20.1-20.6, 20.6.1-20.6.3, 20.6.5, 20.8-20.12, 20.19, 20.21, 20.27, 20.28-20.30
2. Banwell, C.N. &McCash,E.M., 2007, Fundamentals of molecular spectroscopy, Tata McGraw Hill, 4th ed.
   (Unit 4.4 – Chapter 1.1-1.3, 1.5-1.7, Chapter 2.1- 2.3.1; Unit 5 – Chapter 3.1-3.4, Chapter 4.1.1,4.2, 4.3.1)

References:

1. Jenkins and White, 1981, Fundamentals of Optics-McGraw Hill International
2. Pedrotti and Pedrotti, 1987, Introduction to Optics- Prentice Hall International.
3. Murugeshan, R.& Kiruthiga Sivarakash, 2006, Optics and Spectroscopy, S. Chand & Publ.

Weblinks/E - Resources:

1. https://www.ossila.com/pages/optical-spectroscopy
2. https://www.sciencedirect.com/topics/medicine-and-dentistry/optical-spectroscopy
3. https://www.avantes.com/support/theoretical-background/introduction-to-spectrometers/

Teaching Learning Methods:

- Lecture Method, Demonstration, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO 1: Acquire knowledge on the concepts of interference of light waves and their applications

CO 2: Understand the effect of diffraction in prism and grating

CO 3: Apply the concept of polarization in certain fields.

CO 4: Explain concepts of electromagnetic radiation and microwave spectroscopy

CO 5: Compare the principles of Infra-red and Raman Spectroscopy

Mapping of COs with PSOs & POs:

SEMESTER V	Subject Code:								Title of Paper: OPTICS AND SPECTROSCOPY					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2		2	3	3			3	3	3	2	3	27
CO2	2	3		1	2	3	1		3	3	3	2	3	26
CO3	3	3		2	3	3		1	3	3	2	3	3	29
CO4	3	2		3	3	2	1		3	2	3	3	2	27
CO5	3	3		2	3	2		1	3	3	2	3	3	28
Grand total of COs with PSOs and POs														137
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{137}{54}\right)$														2.54

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.54
Observation	**COs of Optics and Spectroscopy Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. PHYSICS**	**Part**	**: III Core-8**
Semester	**: V**	**Hours**	**: 75**
Subject Code	**: 22UPYC85**	**Credits:**	**5**

MATHEMATICAL PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To facilitate the learners to elaborate the fundamentals of Vector and Scalar fields.
- To provide the students a broad view of understanding in special type of matrices which are relevant to Physics.
- To train the students developing analytical skill in various Special functions.
- To make the students gaining knowledge on Laplace Transforms and its applications to solve Simple Harmonic equation.
- To equip the students to correlate measures of Central tendency and Dispersion.

Course Outline

Unit I: Vector Analysis (15 hrs)

Gradient of a scalar field – Line, Surface and Volume integrals – Divergence of a vector function – Expression for divergence in Cartesian Co-ordinates – Curl of a Vector function – Expression for Curl in Cartesian Co-ordinates – Gauss divergence theorem – Stoke's theorem – Green's theorem.

Unit II: Matrices (15 hrs)

Types of Matrices – Eigen values, Eigen vectors: Characteristic equation of a matrix – Cayley Hamilton theorem – Diagonalization of Matrices – Inverse of a matrix – Non-homogeneous Linear equations – Cramer's rule for solving non-homogenous linear equations.

Unit III: The Beta and Gamma Functions (15 hrs)

Beta function: Definition, Symmetry property, Evaluation and other forms – Gamma function: Definition, Evaluation and other forms – Relation between Beta and Gamma functions – Simple Problems.

Unit IV: Laplace Transforms (15 hrs)

Definition of the Laplace Transforms (Laplace Transform of functions like 1, t, t^n, e^{at}, e^{-at}, sin at, cos at, sinh at, cosh at, t sin at, t cos at, e^{at} sin ωt, e^{at} cos ωt)– Laplace Transform of Derivatives – Laplace Transform of Integrals – Laplace Transform of Gamma function – Applications of Laplace Transforms to solve simple harmonic equation

Unit V: Statistics (15 hrs)

Arithmetic Mean – Properties of the Arithmetic Mean – Median – Quartiles – Deciles – Percentiles – Mode – Empirical relation between Mean, Median and Mode – Geometric Mean – Harmonic Mean - Range – The Mean Deviation – Standard Deviation – Mean Square Deviation – Relation between Standard Deviation and Root Mean Square Deviation.

Text Book

1. Murugeshan.R (2016), Mechanics and Mathematical Physics, New Delhi: S.Chand & Company Pvt.Ltd.
   Unit I : 7.2 – 7.7, 7.10 – 7.12;
   Unit II : 8.1, 8.2, 8.4, 12.1 – 12.4
   Unit III : 9.1 – 9.8;
   Unit IV : 15.1, 15.8, 15.9, 15.14, 15.27
   Unit V : 17.1 – 17.10, 17.12 – 17.16

Reference Books

1. Gupta.B.D., (2010), Mathematical Physics, 4th Edition, Vikas Publishing House Private Ltd.
2. Arfen.G.B , Weber.H.J&Harris.F.E (2013), Mathematical Methods for Physicists 7th Edition, Noida Elsevier India Pvt. Ltd.
3. Sathya Prakash, Mathematical Physics, S.Chand, New Delhi, 2nd Edition, 2004.

WEBLINKS/E - Resources:

1. http://www.youtube.com/@buvanateacher159
2. https://youtube.com/playlist?list=PLtyD1JIkFn3Zdwo7bIXELWQUtw1uYKIdi&si=CqhBUXSYXVB__ki7
3. https://youtu.be/u4XYcPdpYb8?si=ojvYYHg0pOgMF7wi
4. https://youtube.com/playlist?list=PLU6SqdYcYsfJz9FAzbgocIjlkw4NXAar-&si=OVVqUtdXuzO2ZK_9
5. https://youtu.be/fZ231k3zsAA?si=VucB2vWS-ZY-Aa8h
6. https://youtu.be/vvzTEbp9lrc?si=MKJeRwQd7XdxQWwK
7. https://youtu.be/JMjbPh1Mjn8?si=JoNArSumVEvgoaeP
8. https://youtu.be/rowWM-MijXU?si=lIC-QiRGkXb-FJF6
9. https://youtube.com/playlist?list=PLhSp9OSVmeyIADP2WgrRNsoj3OdItMqSv&si=j9dMIB0DYgpAvizc
10. https://www.youtube.com/live/njcdN_-XPqc?si=7HMl5wLU6u5Nw85Y

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Video Making Quiz, Group Discussion

Course Outcomes:

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

CO1: Elaborate the fundamentals of Vector and Scalar fields.

CO2: Understand the special type of matrices which are relevant to Physics.

CO3: Analyse the Special functions like Beta and Gamma functions.

CO4: Acquire knowledge on Laplace Transforms and its applications to solve simple harmonic equation.

CO5: Correlate measures of Central tendency and Dispersion.

Mapping of COs with PSOs & POs:

SEMESTER V	Subject Code:								Title of Paper: Mathematical Physics					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2		1	3	2		1	3	3	2	2	1	23
CO2	3	3		2	3	2			3	3	2	2	1	24
CO3	3	2		1	3	2		1	3	3	2	2	1	23
CO4	3	2		1	3	2		1	3	2	2	2	1	22
CO5	3	3		2	3	3			3	3	2	2	2	26
Grand total of COs with PSOs and Pos														118
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{118}{53}\right)$														2.23

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.23
Observation	**COs of Mathematical Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. PHYSICS**	**Part**	**: III Core-9**
Semester	**: V**	**Hours**	**: 60**
Subject Code	**: 22UPYC95**	**Credit**	**: 4**

DIGITAL ELECTRONICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To understand and examine the structure of various number systems and their applications.
- To analyse various combinational and sequential circuits.
- To explain and compare the working of multivibrators using IC 555
- To identify basic requirements and memory operations for circuit design.
- To develop skill in writing simple program for 8085 and its applications

Unit I Number systems, codes & Arithmetic Circuits (12 hours)

Binary number system – Binary to decimal conversion – Decimal to binary conversion – Octal numbers – Hexadecimal numbers – The ASCII code– the gray code- Binary Addition – Binary Subtraction – complements (1's, 2's, 9's and 10's) – binary addition, binary subtraction using 1's & 2's complement methods Binary Multiplication and Division – Arithmetic Building Blocks (Half Adder & Full Adder)

Unit II Digital Principles &Combinational Logic Circuits (12 hours)

Basic logic gates -universal logic gates (NAND & NOR)-Boolean laws and theorems – De-Morgan's theorem –standard representation of logic functions (sum of products method(SOP) & Product of sums method(POS))-Truth table to Karnaugh map 2, 3, 4 variables –-Don't care condition – Multiplexers (4:1) and De-Multiplexers(1:4), – (Principles only) – encoder (8-line-to-3- line) and decoder (3-line-to-8-line) (Principles only), BCD to seven segment decoder.

Unit III Timing Circuits and Flip flops (12 hours)

555 Timer: Pin configuration –Block diagram-555 Timer application (Astable, Monostable) – Flip Flops: S-R Flip-flop , J-K Flip-flop, T and D type flip-flops, JK master-slave flip-flop, truth tables

Unit IV Registers, Counters & Memory (12 hours)

Registers: Types of Registers -Serial IN Serial OUT - Serial IN Parallel OUT - Parallel IN Parallel OUT - Parallel IN serial OUT - counters -asynchronous counter:-mod-8, mod-10, synchronous counter- 4-bit & ring counter – general memory operations, ROM, RAM (static and dynamic), PROM, EPROM, EEPROM, EAROM. IC

Unit V Microprocessor (12 hours)

Digital Computers – Pin configuration – Intel 8085 block diagram – Data and address bus– Intel 8085 instructions – Opcode and operands –Addressing modes -Assembly language programmes for addition (8-Bit & 16-Bit), subtraction (8-Bit & 16-Bit), multiplication (8- Bit), division (8- Bit) – largest and smallest number in an array – BCD to ASCII and ASCII to BCD.

Text Books:

1. Donald P Leach, Albert Paul Malvino, Goutam Saha, 2012, Digital Principles and Applications –– Seventh Edition,– Tata McGraw Hill Education Private Limited, New Delhi
   Unit I – Ch.5: 5.1 to 5.8; Ch.6: 6.1, 6.2, 6.5, 6.7, 6.11;
   Unit II – Ch. 2: 2.1, 2.2; Ch.3: 3.1 to 3.8; Ch.4: 4.1, 4.2, 4.3, 4.6;
   Unit III – Ch.7: 7.4, 7.5; Ch.8: 8.1, 8.2, 8.4, 8.5, 8.8;
   Unit IV - Ch.9: 9.1 to 9.5,9.7; Ch.10: 10.1, 10.3,10.6;
2. Ram, 2004, Microprocessor, Dhan Pat Rai Publications, New Delhi.
   (Unit V - Chap.3 related topics).

WEBLINKS/E - Resources:

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

References:

1. S. Salivahana & S. Arivazhagan, 2018, Digital circuits and design – Fifth Edition, Oxford University Press.
2. Malvino, 1988, Digital Principles and Applications, McGraw Hill, New Delhi.
3. Morris Mano, 2007, Computer Architecture, Pearson Education, New Delhi.
4. Aditya P.Mathur, 1984, Introduction to Microprocessor –Tata McCraw Hill, New Delhi.

Teaching Learning Methods:

- Lecture Method, Demonstration, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Understand and examine the structure of various number systems and their applications in digital design.

CO2: Analyse various combinational and sequential circuits.

CO3: Explain and compare the working of multivibrators using IC 555

CO4: Identify basic requirements for circuit design and propose a cost-effective solution.

CO5: Develop skill in writing simple program for 8085 and its applications

Mapping of COs with PSOs & POs:

SEMESTER V	Subject Code: 22UPYC95								Title of Paper: Digital Electronics					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	
CO1	3	3		3	3	3	1		3	2	3	3	3	30
CO2	3	2		3	3	3			3	3	3	2	3	28
CO3	3	3		2	3	2		1	3	3	2	3	2	27
CO4	3	2		3	3	2			3	3	3	2	2	26
CO5	3	3		2	3	3	1		3	3	2	3	2	28
Grand total of COs with PSOs and POs														139
Mean value of COs with PSOs and POs=$\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{139}{54}\right)$														2.57

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.57
Observation	**COs of Digital Electronics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. PHYSICS**	**Part**	**: III Core Elective-1**
Semester	**: V**	**Hours**	**: 45**
Subject Code	**: 22UPYE15 (A)**	**Credit**	**: 2**

ASTROPHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To acquire the knowledge of solar system objects, activities of sun, stars and their evolution
- To classify the galaxies and types of telescopes and its applications in astronomy
- To enlighten the knowledge on latest trends in astronomy

Unit I Solar System **9 Hours**

Solar System -Motion of the Earth -Seasons -Latitudes and Longitudes –Types of Planets - Solar Eclipse -Lunar Eclipse -Asteroids and Meteoroids -Comets – Origin of moon – Lunar craters - The Sun -Internal Layers of the Sun -Atmospheres of the Sun – photosphere – chromosphere – corona.

Unit II Solar Activities, Stars and their evolution **9 Hours**

-Solar Activities –sunspots – coronal holes – coronal mass ejections – solar flares – radio bursts – Sun-Earth relationship -Estimation of surface temperature of the Sun -Solar wind - Nuclear reactions in star -Properties of stars -Classification of stars -Birth of stars – Hertzprung-Russel diagram -Main sequence stars -Life time of main sequence stars -Stellar evolution - Binary Stars - Star Clusters

Unit IV Galaxies and Universe **9 Hours**

Milkyway Galaxy -Other galaxies -Types of galaxies -Galactic clusters -Cosmology -Origin of Universe -Expanding Universe -Cosmic Microwave Background -Density and Shape of Universe -White dwarf -Quasars and Neutron stars -Black hole

Unit V Tools of Astronomy **9 Hours**

Introduction-Optical Telescopes – Refracting and reflecting telescopes - Comparison of Galilean and Keplerian telescopes -Image – resolving power – magnification power - Aberrations -Spectroscope -Radio Telescopes -Astronomical scales -Multiwavelength Astronomy -Comparison of optical and radio astronomy -Some optical and radio observatories in India

Unit V Recent Developments in Astronomy **9 Hours**

Ground and space based telescopes - Chandrayan 3 – Aditya L1 – XPOSAT – Solar Probe – Solar Dynamic Observatory – Thirty meter telescope (TMT) – James Webb Telescope – LIGO experiment and black holes collision – Exoplanets and TESS satellite – Dark matter and Dark energy.

Text Books:

1. Shanmugaraju, A., 2019, Introduction to Astrophysics, Arul Anandar College, Karumathur, Madurai (Units I to IV)
2. Lecture notes (Unit V)

References:

1. Baidyanath Basu, 2010, An introduction to astrophysics, 2nd ed., PHI Publ.
2. Abell, Morrison and Wolf, 1995, Exploration of the Universe, &th ed., Harcourt College Publ.
3. Carrol and Ostlie, 2007, Introduction to Modern Astrophysics, 2nd ed., Pearson International.
4. Krishnaswamy, K.S. 1996, Astrophysics- A modern perspective, New Age International.

WEBLINKS/E - Resources:

1. https://www.space.com/26218-astrophysics.html
2. https://web.astro.princeton.edu/academic/undergraduate-program/introduction-astrophysics
3. https://www.secretsofuniverse.in/basics-of-astrophysics-sou/

Teaching Learning Methods:

- Lecture Method, Models, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO 1: Acquire the knowledge of solar system and occurrence of seasons on the earth.

CO 2: Describe the effects of solar activities on the Earth, properties and evolution of stars.

CO 3: Discuss the structure of milky way and various types of galaxies.

CO 4: Classify the tools of astronomy and the types of telescopes.

CO 5: Acquire the knowledge about recent developments in astronomy

Mapping of COs with PSOs & POs:

SEMESTER V	Subject Code:								Title of Paper: ASTROPHYSICS					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3		2	3	2			3	3	3	2	2	25
CO2	3	3		3	3	2			3	3	3	2	1	26
CO3	2	3		3	3	2			2	2	3	1	2	23
CO4	3	3		3	3	2		1	3	1	3	1	2	25
CO5	3	3		3	3	2			3	1	3	2	1	24
Grand total of COs with PSOs and POs														123

Mean value of COs with PSOs and POs=$\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{123}{51}\right)$	2.41

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.41
Observation	**COs of Astrophysics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Physics**	**Part**	**: III Core Elective - 1**
Semester	**: V**	**Hours**	**: 45**
Subject Code	**: 22UPYE15 (B)**	**Credit**	**: 2**

INFORMATION TECHNOLOGY

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To acquire the knowledge of Computer Networks, Internet and their applications.
- To understand the basics of World wide web, Mobile computing and Email.
- To enlighten the knowledge on latest trends in Information Technology.

UNIT – I: Introduction to Computer Networks (9 hours)

Introduction – Types of Computer Networks – Local Area Networks (LAN) – Wide Area Networks (WAN) – Gateways (Routers) – Repeaters – Bridges – Networking Topologies – Star Topology – Ring Topology – Bus Topology – Mesh Topology – Mesh Topology – Tree Topology.

UNIT – II: Internet & World Wide Web (9 hours)

Introduction – Client and Servers – Host and Terminals – TCP/IP – World Wide Web (WWW) – Hypertext – Uniform Resource Locator (URL) – Web Browsers – IP Address – Domain Name – Domain Name Service (DNS) – Internet Service Providers (ISP) – Internet Security.

UNIT – III: Mobile Computing (9 hours)

Introduction –Wireless Application Protocol (WAP) – Architecture – WAP Internal Structure – Wireless Session Layer – Wireless Transaction layer – Bearers – GSM – CDMA – Mobile Data Transmissions using 2G, 3G, 4G and 5G Technology.

UNIT – IV: Electronic Mail & IT Applications (9 hours)

Introduction – Email – History of Email – Impact of Email – Email Technologies – Email Securities – Cloud Storage – MS Office 365 & Google Suite – Web Conferencing – Online Chat – Online Training & Online Classes.

UNIT – V: Emerging Technologies in IT (9 hours)

Introduction – Human Computer Interface – Virtual Reality (VR) – Big Data – Artificial Intelligence (AI) – Natural Language Processing – Machine Learning – Deep Learning – Internet of Things (IOT) – Cyber Security – Hacking – Ethical Hacking – Career opportunities in Information Technology.

Book for Study

1. Deepak Bharihoke (2000), *Fundamentals of Information Technology* - 3rd Edition, Excel Books, New Delhi.
   Unit 1: Chapter 17 (Relevant topics)
   Unit 2: Chapter 18 (Relevant topics)
   Unit 3: Chapter 19 (Relevant topics)
   Unit 4: Chapter 20 (Relevant topics) & Lecture Notes
   Unit 5: Study Material & Lecture Notes

Books for Reference:

3. Alexis Leon and Mathews Leon (2009), *Fundamentals of Information Technology* – 2nd Edition, Leon Vikas Publishing House Pvt Ltd., Noida.
4. Shambhavi Roy, Clinton Daniel, and Manish Agrawal (2023), *Fundamentals of Information Technology* - Digital Commons @ University of South Florida, https://digitalcommons.usf.edu/dit_tb_eng/19.
5. Peter Norton (2011), *Introduction to Computers* – 7th Edition, Tata McGraw – Hill Education Pvt Ltd., New Delhi.

Weblinks/E - Resources:

1. http://www.mhhe.com/peternorton.
2. https://digitalcommons.usf.edu/dit_tb_eng/19.
3. https://www.telecomtrainer.com/mobile-network-2g-3g-4g-5g/
4. https://developer.ibm.com/articles/cc-beginner-guide-machine-learning-ai-cognitive/

Course outcomes

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

CO 1: Describe the computer networking basics.

CO 2: Explain the fundamentals of Internet & World Wide Web.

CO 3: Acquire knowledge on the mobile computing.

CO 4: Understand the concepts of email and applications of IT.

CO 5: Elucidate the future emerging technologies & career opportunities in IT.

Mapping of COs with PSOs & POs:

SEMESTER V	Subject Code: 22UPYE15 (B)								Title of Paper: INFORMATION TECHNOLOGY					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	1	1	2	2	1	1	2	1	3	1	3	22
CO2	3	2	1	3	3	2			3	2	3	1	3	26
CO3	3	3	1	2	3	2			3	2	2	2	2	25
CO4	3	2	2	3	3	2			3	2	2	3	2	27
CO5	3	2	2	2	1	3		1	2	2	3	2	3	26
Grand total of COs with PSOs and POs														126
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{126}{52}\right)$														2.42

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.42
Observation	**COs of INFORMATION TECHNOLOGY Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. PHYSICS**	**Part**	**: Self Learning Course**
Semester	**: V**	**Hours**	**:**
Subject Code	**: 22UPYSL5**	**Credit**	**: 3**

THIN FILM SCIENCE

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To understand the growth mechanism of thin films
- To study the preparation of various thin films by physical and chemical deposition methods
- To examine the structural, optical and electrical properties of thin films
- To examine the morphological, elemental and mechanical properties of thin films
- To discuss the use of thin films in different industrial applications.

Unit -I Introduction

Introduction-Advantages of thin film devices over their bulk counterparts-Thin film growth stages-Applications of thin films-Certain important properties of thin films-Thickness-Density-Structural properties-Optical properties-Electrical properties-Surface morphological properties-Compositional properties-Magnetic properties-Mechanical properties-Epitaxial films

Unit-II Thin Film Deposition Techniques

Introduction-Physical deposition methods-Vacuum evaporation technique- Thermal evaporation

Electron beam evaporation (EBE)-Pulsed laser deposition (PLD -Sputter deposition process-Chemical vapor deposition (CVD)- Chemical bath deposition (CBD)-Successive ionic layer adsorption and reaction (SILAR) - Spray pyrolysis technique Sol-gel spin coating technique

Unit-III Characterization Techniques-I

Characterization of thin films -Thickness of thin films-Weight gain method-Surface profilometry (or) Stylus technique-Optical interference method-Multiple beam interferometry method- Ellipsometry-Measurement of density-Structural properties-X-ray diffractometry (XRD)-Optical properties-UV–vis- NIR double beam spectrophotometry-Photoluminescence (PL) spectroscopy-Electrical properties-Four point probe technique-van der Pauw technique-Hall effect measurement

Unit-IV Characterization Techniques-II

Surface morphological properties-Scanning electron microscopy (SEM)- Atomic force microscopy (AFM)-Transmission electron microscopy (TEM)- Scanning tunnelling microscopy (STM)- Compositional properties- Energy dispersive analysis of X-ray (EDAX)- X-ray photo electron spectroscopy (XPS)- Auger electron spectroscopy (AES)- Rutherford back scattering spectroscopy (RBS)- Fourier transform infrared (FTIR) spectroscopy - Raman spectroscopy-

Magnetic properties- Vibrating sample magnetometer (VSM)- Superconducting quantum interference device- (SQUID) magnetometer- Mechanical properties-Hardness test

Unit-V Applications

Introduction-Thin films in photo-voltaic (PV) technologies-Dye sensitized solar cells-Thin film based gas sensors-films in disinfectant technologies-as antibacterial agents-as photocatalysts- Bio- medical uses- Magnetic films for data storage applications – Spintronics- Thin film resistors, thermistors and capacitors- film strain gauge elements- Functional / Decorative coatings- Transparent conducting oxide (TCO) thin films- Electrical and optical properties of TCOs- Quality factor (Figure of merit) of TCO films- Pre-requisites for good TCOs- Applications of TCOs- Emerging applications of TCOs

Reference books

1. Introduction to Thin films, K. Ravichandran, K. Swaminathan, B. Sakthivel, Research India publications, New Delhi, (2013).
2. Nanocoatings and Ultra-Thin Films: Technologies and Applications, 1st Edn., A.S.H. Makhlouf and I. Tiginyanu,Woodhead Publishing, (2011).
3. Thin Film Fundamentals: A. Goswami-New age International, 2007.
4. Thin Film Phenomena, K. L. Chopra, McGraw Hill Inc. (1969)

Weblinks/E - Resources:

1. https://www.sciencedirect.com/topics/materials-science/thin-films

Teaching Learning Methods:

- Self - learning, Discussion

Course Outcomes

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

CO1: Describe the growth mechanism of thin films

CO2: Illustrate the preparation of various thin films by chemical deposition methods

CO3: Explain the growth of various thin films by physical deposition methods

CO4: Analyze the properties of thin films using different instruments

CO5: Discuss the use of thin films in different industrial applications.

Mapping of COs with PSOs & POs:

SEMESTER V	Subject Code: 22UPYSL5								Title of Paper: THIN FILM SCIENCE					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2		2	1	2	1		3	3	3	2	3	25
CO2	3	1		3	2	2			3	2	3	3	2	24
CO3	2	2		2	2	3			3	2	3	3	3	25

CO4	3	2		2	2	3			3	2	3	3	3	26
CO5	3	2		2	2	3			3	2	3	3	3	26
Grand total of COs with PSOs and POs														126
Mean value of COs with PSOs and POs=$\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{126}{51}\right)$														2.47

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.47
Observation	**COs of Thin Film Science Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics - B.Sc. (Physics) Syllabus

Class	**: III year**	**Part**	**: III Core -10**
Semester	**: VI**	**Total hours**	**: 75**
Code	**: 22UPYD06**	**Credit**	**: 5**

CLASSICAL, STATISTICAL & RELATIVISTIC MECHANICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Objectives:

- To understand the mechanics of system of particles and to deduce the equations of motion of Lagrangian
- To analyse Hamilton equation by comparing it with Lagrangian and to use it in some applications
- To acquire knowledge in classical and quantum statistical mechanics and to compare all the three statistics
- To elaborate different frames and to interpret the ideas of special theory of relativity
- To study the concept of mass-energy equivalence and general theory of relativity

Unit 1 Mechanics of a System of Particles & Lagrangian Formulation (15 hours)

External and Internal force, Centre of Mass – Conservation of Linear momentum – Conservation of Angular momentum – Conservation of Energy (K.E., P.E.) - Constraints – Generalized Coordinates (Transformation Equations)

Principle of Virtual Work – D'Alembert's Principle - Lagrangian Equations from D'Alembert's Principle (Derivation) – Applications (Simple Pendulum, Atwood's Machine, Compound Pendulum), Lagrangian Equations in presence of Non-Conservative force.

Unit 2 Hamiltonian Formulation (15 hours)

Hamiltonian Function H and Conservation of energy (Jacobi's Integral) – Physical significance, Hamilton's Equations (Derivation) – Hamilton's equations in different coordinate system (Cartesian) - Applications (Harmonic oscillator, motion of a particle in central force field, Compound Pendulum).

Unit 3 Statistical Mechanics (15 hours)

Introduction - Phase space – Maxwell Boltzmann Distribution – Molecular Energies in an Ideal Gas Law – Maxwell Boltzmann Velocity Distribution Law – Quantum Statistics - Bose Einstein Distribution Law (Derivation only) – Fermi Dirac Distribution Law (Derivation only) – Comparison of the Three Distribution Laws.

Unit 4 Relativistic Mechanics I (15 hours)

Concept of Space, Time and Mass - Frame of Reference – Newtonian Relativity - Galilean Transformation – Ether Hypothesis – Michelson and Morley Experiment – Explanation of Negative Result - Postulates of Special Theory – Lorentz Transformation Equations – Length Contraction – Time Dilation – Meson Decay – Relativity of Simultaneity.

Unit 5 Relativistic Mechanics II (15 hours)

Addition of Velocities – Variation of Mass with Velocity – Mass Energy Equivalence – Minkowski's Four Dimensional Space - Time Continuum - The General Theory of Relativity – Postulates – Predictions of General Relativity – Deflection of Light in a

Gravitational Field – Advance of the Perihelion of Mercury's Orbit – Gravitational Red Shift.

Text Books:

1. J.C. Upadhyaya, July 2005, Classical Mechanics, Published by Himalaya Publishing House, Mumbai
   Unit1: 1.7.1, 1.7.2, 1.7.3, 1.7.5, 1.7.8- (a, b, c), 2.3 (2.3.1, 2.3.2), 2.4, 2.5, 2.6, 2.7, (Example 2, 3, 5), 2.9
   Unit2: 3.4, 3.5, 3.6 (1), 3.7 (1, 2, 4)
2. Murugeshan, R. & Kiruthiga Sivaprasath, 18e, 2019, Modern Physics, S. Chand and Co., New Delhi.
   Unit 3: 43.1, 43.2, 43.6, 43.7 (Derivation only), 43.8 (Derivation only), 43.9
   Unit 4: 1.1 -1.11
   Unit 5: 1.12 – 1.17

References:

1. Gupta,B.D., Satyaprakash, 1991, Classical Mechanics, 9th ed., Ka dernath Ramnath Publ., Meerut
2. Gupta, Kumar, Sharma, 2005, Classical Mechanics, Pragati Prakashan Publ., Meerut.
3. Murray R.Spiegal, 1981, Theoretical Mechanics, Schaum's outline series, Mc Graw Hill Publ. Co., New Delhi.
4. Goldstein, 2001, Classical Mechanics, II Edition, Narosa Publishing Co.
5. B.K. Agarwal and Melvin Eisner, 2023, Statistical Mechanics – New Age International Publ.
6. Brijlal, Subramaniam & Hemne, 2008, Heat & Thermodynamics, S. Chand & Company.
7. French, A.P., 1968, Special theory of relativity, Van Nostran Rainhold Company.

Weblinks/E - Resources:

1. https://epgp.inflibnet.ac.in/ - (Classical Mechanics)
2. https://web.mst.edu/~sparlin/phys107/lecture/chap09.pdf - (Statistical Mechanics)
3. https://www.shobhituniversity.ac.in/pdf/econtent/Relativistic-Mechanics-Dr-R-K-Jain.pdf - (Relativistic Mechanics)

Course Outcomes

On completion of the course, students should be able to

CO 1: Understand the concepts of forces, conservation theorems, constraints and to deduce the equations of motion in Lagrangian

CO 2: Deduce the equations of motion in Hamiltonian and solve some applications

CO 3: Derive the statistical distribution functions, compare the three statistics and analyse their applications

CO 4: Analyze the motion of different bodies in different frames of reference and interpret the ideas of special theory of relativity

CO 5: To acquire knowledge in general theory of relativity and understand gravitational red shift

Mapping of COs with PSOs & POs:

SEMESTER IV	Subject Code: 22UPYD06								Title of Paper: Classical, Statistical and Relativistic Mechanics					
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3		2	3	3			3	3	3	2	2	27
CO2	3	3		1	3	3			3	2	3	2	2	25
CO3	3	3		2	3	3			3	2	3	2	2	26
CO4	3	3		3	3	3			3	2	3	2	2	27
CO5	3	3		3	3	3			3	2	3	3	2	28
Grand total of COs with PSOs and POs														133
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{133}{50}\right)$														2.66

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.66
Observation	**COs of Classical, Statistical and Relativistic Mechanics Strongly related with PSOs and POs**		

Arul Anandar College (*Autonomous*), Karumathur

Department of Physics

Class	**: B. Sc. PHYSICS**	**Part**	**: III Core -11**
Semester	**: VI**	**Hours**	**: 75**
Subject Code	**: 22UPYD16**	**Credit**	**: 5**

NUCLEAR PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

To understand constituents, properties and models of nucleus.

To give reason for radioactivity and study their properties.

To learn about the principles of various particle detectors and accelerators.

To acquire knowledge on different types of nuclear reactions and their applications.

To know the reason for cosmic rays and their effect on the surface of earth and also understand the classification of elementary particles.

Course Outline:

Unit - I **(15 hours)**

Properties of Nucleus & Nuclear Models:

constituents of nucleus – classification of nuclei – general properties of nucleus – binding energy – nuclear stability – theories of nuclear composition –meson theory of nuclear forces.

liquid drop model – applications of semi-empirical mass formula – shell model.

Unit - II **(15 hours)**

Radio activity:

radio activity – properties of alpha, beta and gamma rays – range of α-particles - Gammow's theory of α-decay (qualitative) – β-ray spectrum – neutrino theory of beta decay – detection of neutrino - laws of radioactive disintegration, (only final formulae) **–** units of radioactivity - Law of successive disintegration.

Unit - III **(15 hours)**

Particle Detectors and Accelerators:

ionization chamber - solid state detectors – proportional counter - Geiger-Muller counter – Wilson cloud chamber - bubble chamber - scintillation counter.

linear accelerators – cyclotron – betatron – synchrotron – proton synchrotron (bevatron).

Unit - IV **(15 hours)**

Nuclear Reactions:

Q-value equation for a nuclear reaction – threshold energy - types of nuclear reactions – conservation laws in nuclear reaction – nuclear transmutations - nuclear fission – energy released in fission – chain reaction – critical mass – nuclear reactor – nuclear fusion – sources of stellar energy – thermonuclear reactions.

Unit - V **(15 hours)**

Cosmic Rays and Elementary Particles:

latitude effects - altitude effect - primary and secondary cosmic rays – cosmic ray showers - discovery of positron – Van-Allen belts.

particles and antiparticles – types of fundamental interactions – quantum numbers of elementary particles – conservation laws and symmetry – quarks and types – quark model (elementary ideas only).

Text Books:

R Murugeshan & Kiruthiga Sivaprasath, (2019) Modern Physics, S. Chand & Co. 18th ed, New Delhi.

Unit I	**:**	17.1, 17.2, 17.3, 17.4, 17.5, 17.6, 17.7.1, 17.10, 17.11, 17.12
Unit II	**:**	20.1, 20.4, 20.8, 20.10, 20.10.2, 20.10.3, 20.18, 20.19, 20.20
Unit III	**:**	18.3, 18.4, 18.5, 18.6, 18.7, 18.8, 18.10, 19.2, 19.3, 19.5, 19.6, 19.7
Unit IV	**:**	21.2, 21.2.3, 21.2.4, 21.3, 22.1, 22.1.1, 22.2, 22.3, 22.6, 22.6.1, 22.6.2
Unit V	**:**	23.1, 23.3, 23.4, 23.5, 23.7, 23.9, 24.2, 24.4, 24.5 24.6, 24.7

References:

1) Basic ideas and concepts in Nuclear Physics, K.Heyde, (2004), 3rd Edn., Institute of Physics Pub.
2) Nuclear Physics, Tayal, D.C., (1995) Himalaya Publishing House.
3) Introductory nuclear Physics, Kenneth S. Krane, (2008), Wiley India Pvt. Ltd.
4) Radiation detection and measurement, G.F. Knoll, (2000), John Wiley & Sons.
5) Theoretical Nuclear Physics, J.M. Blatt &V. F. Weisskopf (1991), Dover Pub. Inc.
6) Elements of Nuclear Physics, M.L. Pandya, R.P.S. Yadav, Amiya Dash, (2020), Kedar Nath Ram Nath,
7) Introduction to High Energy Physics, D.H. Perkins, (2000), Cambridge University Press; 4th edition
8) Introduction to Elementary Particles, D. Griffith, (2008), John Wiley & Son

Web Resources

1) http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
2) https://makingphysicsfun.files.wordpress.com/2015/01/photoelectric-effect.pptx
3) https://www.khanacademy.org/science/in-in-class-12th-physics-india/nuclei
4) http://hyperphysics.phy-astr.gsu.edu/hbase/nuccon.html
5) https://www.kent.edu/physics/nuclear-physics-links
6) https://www2.lbl.gov/abc/links.html

Teaching Learning Methods:

Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes:

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

CO1: Understand the basic nuclear properties and applications of NMR.

CO2: Enumerate the different nuclear models.

CO3: Acquire the knowledge of Particle accelerators & Detectors.

CO4: Explain various nuclear reactions and properties of neutron.

CO5: Gain the basic knowledge of nuclear energy and elementary particles

Mapping of COs with PSOs & POs:

SEMESTER VI	Subject Code:22UPYD16								Title of Paper: Nuclear Physics					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3		3	3	2			3	3	2	2	2	26
CO2	3	2		2	3	2			1	2	2	1	2	20
CO3	3	2		3	3	2			3	3	3	2	2	26
CO4	3	2		1	3	2			3	3	1	2	2	22
CO5	3	3		3	3	2		1	3	3	2	1	2	26
Grand total of COs with PSOs and POs														120
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{120}{51}\right)$														2.35

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.35
Observation	**COs of Nuclear Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. PHYSICS**	**Part**	**: III Core -12**
Semester	**: VI**	**Hours**	**: 75**
Subject Code	**: 22UPYD26**	**Credit**	**: 5**

SOLID STATE PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To understand the basics of crystal structure of various materials.
- To appreciate the correlation between bonding and the properties of solids and free electron in metals.
- To discuss the properties of dielectric materials
- To acquire knowledge on magnetism and magnetic materials.
- To classify the types of superconductors and their applications

Unit 1 Bonding in solids & Elements of Crystallography (15 hours)

Interatomic Forces and Cohesive Energy - Different Types of Bonds in Solids – Lattice Energy of Cohesive Energy of Ionic Crystals - Some Fundamental Definitions in Crystallography - Miller indices - Lattice Parameters of Unit Cell – Bravais lattices - Crystal Structures of Important Engineering Materials and Stacking Sequences - Other important structures (diamond, Zinc blende, NaCl, CsCl) - Polymorphism and Allotrophy.

Unit 2 Electron theory of metal &Thermal Properties of Solids (15 hours)

Classical free electron theory –Electrical conductivity of a metal (based on Drude-Lorentz theory) – derivation of Ohm's law –thermal conductivity – Weidemann-Franz' law -Dulong and Petit's Law – specific heat of solids - Einstein and Debye theories of specific heat of solids – T^3 law (qualitative only)

Unit 3 Dielectric Properties (15 hours)

Fundamental definitions in di electrics – Different types of electric polarisation: electronic polarisation– calculation of polarisability – ionic, orientational and space charge polarization – dielectic loss –frequency dependence of dielectric constant -local field– Clausius-Mosotti relation

Unit 4 Magnetic properties (15 hours)

Origin of Magnetic Moment in Magnetic Materials - Magnetic Quantities - Different Types of Magnetic Material - Langevin Theory of Paramagnetism - Weiss Theory of Paramagnetism - Weiss Theory or Molecular Field Theory of Ferro Magnetism.

Unit 5 Superconductivity (15 hours)

Explanations for the Occurrence for Superconductivity-General Properties of Superconductors -Other General Observations-Types of Superconductors-High Temperature Superconductors-Single Particle Tunneling-Josephson Effect (AC & DC)-Applications of Superconductors.

Text Books:

1. Arumugam, M, 2004, Solid State Physics, Anuratha Agencies, Kumbakonam.
   (Unit I – Chap.1 Secs.1.1 – 1.4, Chap 2- Secs 2.1 – 2.6.
   Unit II - Chap.6 Secs. 6.1 – 6.3, 6.9-6.11
   Unit III – Chap.7 Secs. 7.1 – 7.8
   Unit IV – Chap.8 Secs. 8.1 – 8.8 (8.7.1. excluded)

Unit V – Chap.10 Secs. 10.1 – 10.5.1, 10.10 – 10.12

2. Murugesan, R., 2003, Modern Physics, S. Chand and Company, New Delhi.
   Unit II– Chap.16 Secs.16.10 – 16.12

Weblinks/E - Resources:

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

References:

1. Solid state Physics, Rita John,1st edition, TataMcGraw Hill publishers (2014).
2. Solid State Physics , R L Singhal, Kedarnath Ram Nath& Co., Meerut (2003)
3. P.K.Palanisamy, 2003, Solid State Physics, SCITECH Publ.
4. S.O.Pillai, 2005, Solid State Physics, New Age International.
5. Charles Kittel, Solid State Physics, 2005, Wiley Publishers.

Teaching Learning Methods:

- Lecture Method, Models Display, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Understand the bonding with the properties of solids and crystal systems and structure of various materials.

CO2: Correlate the energy-level spacing of a free electrons in metals and Thermal Properties of Solids

CO3: Identify the dielectric materials and their properties

CO4: Acquire knowledge on magnetism and magnetic materials.

CO5: Analyze the types of superconductors and their applications.

Mapping of COs with PSOs & POs:

SEMESTER VI	Subject Code: 22UPYD26								Title of Paper: Solid State Physics					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	
CO1	3	3		3	3	2			3	3	3	2	2	27
CO2	3	2		3	3	3			3	3	3	2	1	26
CO3	3	3		1	3	3		1	3	3	2	3	2	27
CO4	3	2		3	3	3			3	3	3	3	2	28
CO5	3	3		2	3	2			3	3	3	3	2	27
Grand total of COs with PSOs and POs														135
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{135}{51}\right)$														2.65

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.65
Observation	**COs of Solid State Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. Physics**	**Part**	**: III Core-13**
Semester	**: VI**	**Hours**	**: 60**
Subject Code	**: 22UPYD36**	**Credit**	**: 4**

NANOPHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand the basics of Nanomaterials, Classification and its properties.
- To discuss the various types of quantum materials, Nanotubes and nanostructures.
- To explain different techniques of preparation of nano materials and their advantages.
- To illustrate nanomaterial characteristic tools and its basic concepts.
- To describe the applications of nanomaterials in various fields.

Unit 1: Introduction to Nanotechnology and Nanomaterials (12 Hours)

History of nanotechnology – Classification of Nanomaterials – Properties of Nanomaterials – Effects of surface area to volume ratio on the properties of materials – Applications of Nanomaterials – Challenges in nanotechnology- Nanomaterials-Quantum dots – Quantum wires – Quantum well – Fullerenes – Buckminster fullerene – Carbon nanotubes-Nanocomposites – Nanohybrids – Nanoclusters and Nanoparticles

Unit 2: Preparation of Nanomaterials (12 Hours)

Top down and bottom up approaches – Top down techniques: Ball Milling – Etching – Nanolithography – Photolithography – Combustion synthesis. Bottom up techniques: Vacuum evaporation technique – Sputter deposition process – Laser ablation – Co-precipitation process – Hydro-thermal method – Sol-gel synthesis.

Unit 3: Structural, morphological and compositional Characterization Techniques (12 Hours)

X-ray Diffraction: Principle – Instrumentation – Determination of structural parameters. Scanning electron microscope (SEM) – Atomic Force Microscope (AFM)- Scanning tunnelling Microscope (STEM)-Transmission electron microscope (TEM) –Energy Dispersive X-ray Analysis (EDAX) – X-Ray Photoelectron spectroscope (XPS)- -Raman Spectroscope

Unit 4: Optical and Magnetic Characterization Techniques (12 Hours)

Fourier Transform infrared (FTIR) spectroscope-UV-Vis spectroscopy: Some important optical parameters (Absorption coefficient, Optical band gap, Extinction coefficient – Photoluminescence (PL) spectroscopy-Magnetic characterization-introduction-Super conducting Quantum interface Device (SQUID) magnetometer-Vibrating sample magnetometer

Unit 5: Applications of Nanomaterials (12 Hours)

Nanoelectronics – Molecular electronics – Nanophotonics – Nanorobotics – Nano mechanics–Biomedical applications: Targeted drug delivery – Cancer therapy – Targeted chemotherapy – Radiation Therapy – Thermotherapy – Immunotherapy – Photodynamic therapy – Anti-angiogenic therapy – Gene therapy – Tissue engineering – Biosensing – Bioimaging.

Text Book:

1. Dr. K. Ravichandran, Dr.K. Swaminathan, Dr. P.K. Praseetha, Dr. P. Kavitha, Introduction of Nanotechnology, JAZYM Publications, Trichy, India, (2019)
   [Unit 1 - Chapter 1: 1.1 – 1.7, 2.1-2.7, 2.9-2.11
   Unit 2 - Chapter 3.1, 3.2, 3.3 (3.3.1, 3.3.2,3.3.3 (only relevant titles),3.3.4), 3.4(3.4.1-3.4.6)
   Unit 3 – Chapter 4: 4.1, 4.2 (4.2.1), 4.6, Chapter 5: 5.2, 5.3, 5.4, 5.5 Chapter 6: 6.2, 6.3, 6.5, 6.6
   Unit 4 - Chapter 7: 7.1, 7.2, 7.3, 7.4, Chapter 8.1, 8.2, 8.3
   Unit 5 -Chapter 9: 9.1-9.6, 9.12-9.12.1-9.12.6]

Books for reference:

1. Introduction to Nanotechnology, Charles P.Poole Jr., Frank J. Owens, Wiley – India (2008).
2. Introduction to Nanoscience and Nanotechnology, K.K. Chattopadhyay and A.N. Banerjee – PHI Learning Pvt. Ltd (2009)
3. Nano: The Essentials – T. Pradeep, McGraw-Hill Education.
4. Nanotechnology and Nanoelectronics, W.R.Fahrner (Ed.), Springer (2008)
5. Exploring Nanomaterials, R.Pazhani, Pooja publishers, Ethamozhy (2009).

Weblinks/E - Resources:

1. https://phys.org/nanotech-news/nano-physics/
2. https://serc.carleton.edu/msu_nanotech/nano_intro.html
3. https://www.technology.org/2019/08/03/introduction-to-nanotechnology-basic-concepts-explained/
4. https://education.nationalgeographic.org/resource/nanotechnology/

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes:

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

CO1: Acquire the knowledge of nanomaterials and their properties

CO2: Elucidate and compare various quantum confinements and nanotubes

CO3: Describe the preparation of nano materials using different techniques

CO4: Analyse different characteristics of nanomaterials.

CO5: Classify the various applications of nanomaterials.

Mapping of COs with POs and PSOs

SEMESTER VI	Subject Code: 22UPYD36								Title of Paper: NANOPHYSICS					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3		3	2	2			3	3	3	3	3	28
CO2	3	2		2	3	2			3	3	2	3	3	26
CO3	3	3		3	2	2		1	3	3	3	3	3	29
CO4	3	2		2	2	2			3	3	2	3	2	24
CO5	3	3		3	3	2			3	3	3	3	3	29
Grand total of COs with PSOs and POs														136
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{136}{51}\right)$														2.67

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.67
Observation	**COs of Nanophysics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. PHYSICS**	**Total hours**	**: 90**
Semester	**: V & VI**	**Credit**	**: 3**
Subject Code	**: 22UPYP36**	**Hours/Week**	**: 3**

PHYSICS LAB – III (General)

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To determine certain physical properties through optical experiments
- To carry out the electrical experiments to find and compare the inductance of coils, impedance, emf and capacitances.
- To construct electrical circuits to measure the thermo emf, temperature coefficient and to find the resonance frequency characteristics.
- To perform ballistic & tangent galvanometer experiments to study the electric and magnetic parameters
- To determine the dielectric constants of air, solid and liquid.

Any 15 of the following list of experiments:

1. Determination of thickness of a wire by Air wedge
2. Determination of wavelength of light using Hartmann's interpolation formula - spectrometer
3. Determination of refractive index of material using small angle prism - spectrometer
4. Determination of self-inductance of a coil by Owen's bridge
5. Determination of self-inductance of a coil by Anderson's bridge
6. Determination of emf of a thermocouple by Potentiometer
7. Determination of temperature coefficient of resistance Potentiometer
8. Determination of Impedance and power factor – LR circuit
9. Conversion of Galvanometer in to ammeter
10. Conversion of Galvanometer in to voltmeter
11. Comparison of emf of two cells by B.G.
12. Comparison of capacitances by B.G.
13. Determination of absolute capacitance by B.G.
14. Determination of mutual inductance by B.G.
15. Determination of Horizontal component of Earth's magnetic field – Tangent Galvanometer
16. Study of B-H Hysteresis Curve
17. Determination of resonance frequency of LCR – series resonance circuit
18. Determination of resonance frequency of LCR – Parallel resonance circuit
19. Determination of Dielectric constants of air, solid and liquid
20. Verification of Brewster's law – Polarization
21. Determination of Thickness of a thin film of Bi-prism
22. Determination of Refractive Index - Double refraction (μ_e and μ_o)

23. Determination of Rydberg's constant – Hydrogen Spectra.
24. Determination of Planck's constant using photo diode

Teaching Learning Methods:

- Lecture Method, Demonstration, ICT, Hands-on session.

Course Outcomes

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

CO 1: Perform optical experiments to determine the thickness of a thin wire and Biprism, optical parameters such as Refractive index, Planck's constant & Rydberg's Constant.

CO 2: Carry out the electrical experiments to calculate the self-inductance of coils, impedance and power factor.

CO 3: Construct electrical circuits to measure the thermo emf, temperature coefficient and resonance frequency.

CO 4: Illustrate the working of ballistic & tangent galvanometer and to study the electric and magnetic parameters

CO 5: Determine the dielectric constants of air, solid and liquid.

Mapping of COs with PSOs & POs:

SEMESTER V & VI	**Subject Code: 22UPYP36**								**Title of Paper: PHYSICS LAB – III (General)**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PSO1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	
CO1	3	3		2	3	2			3	2	3	2	3	26
CO2	3	3		3	3	3			3	3	3	2	3	29
CO3	3	3		2	3	1			3	3	3	1	2	24
CO4	3	3		3	3	2			3	2	3	2	3	27
CO5	3	3		3	3	2			3	3	3	2	3	28
Grand total of COs with PSOs and POs														134
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{134}{50}\right)$														2.68

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.68
Observation	**COs of Physics Lab – III (General) Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. PHYSICS**	**Hours**	**: 90**
Semester	**: V & VI**	**Credit**	**: 3**
Subject Code	**: 22UPYP46**	**Hours/Week**	**: 3**

PHYSICS LAB – IV (Electronics)

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To study the various characteristics& applications of operational amplifier IC 741.
- To construct and determine the bandwidth using single stage and two stage amplifiers.
- To construct multivibrators and compare the theoretical and experimental frequency.
- To execute the arithmetic operations of 4 bit and 8-bit microprocessor kit.
- To analyse and verify the various logic gates and theorems.

Any 14 of the following list of experiments:

a. Study of V-I characteristics of UJT
b. Study of Frequency response curve study of two stage amplifier with feedback
c. Study of Frequency response curve study of two stage amplifier without feedback
d. Construction of Clippers and clampers using diode and CRO
e. Construction of Colpitt's oscillator using transistor.
f. Construction of Monostable multivibrator using transistor
g. Construction of Schmitt trigger using IC 555
h. Construction of Astable multivibrator using transistor
i. Construction of 5V, IC Regulated power supply
j. Study of V-I characteristics of Opamp – IC 741
k. Construction of differentiator and integrator using Opamp – IC 741
l. Construction of adder and subtractor using Opamp – IC 741
m. Construction of Logic gates using discrete components
n. Construction of Logic gates using ICs
o. Construction of Logic gates – using IC universal gates
p. Verification of Demorgan's theorem using Logic gates
q. Verification of Boolean expressions Logic gates
r. Study of XOR and XNOR – Using ICs
s. Verification of NAND as universal building block.
t. Verification of NOR as universal building block.
u. Construction of Half adder and full adder
v. Construction of R-S, J-K and D flip-flops
w. Study of Mod 5 and Mod 10 counters
x. Construction of Ring counters
y. Construction of Shift registers

z. Write a program using Microprocessor – 8085 and verify for addition, subtraction

aa. Write a program to execute 1's and 2's complement subtraction using Microprocessor – 8085

bb. Write a program using Microprocessor – 8085 for multiplication and division

cc. Write a program to find the 8 bit -largest/smallest of numbers Microprocessor 8085

dd. Write a program to perform ascending/descending order using Microprocessor 8085

Teaching Learning Methods:

- Lecture Method, Demonstration, ICT, Hands-on session.

Course Outcomes

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

CO 1: Study the various characteristics of operational amplifier IC 741.

CO 2: Calculate the gain and bandwidth using ~~single stage and~~ two stage amplifiers.

CO 3: Construct Oscillators, multivibrators and compare the theoretical and experimental frequency

CO 4: Perform the arithmetic & Logical operations of 4 bit and 8-bit microprocessor kit.

CO 5: Analyze and verify the various logic gates and theorems.

Mapping of COs with PSOs & POs:

SEMESTER V & VI	**Subject Code:22UPYP46**								**Title of Paper: PHYSICS LAB IV (Electronics)**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2		2	3	2			2	3	3	2	3	25
CO2	3	3		3	3	2			3	2	3	3	3	28
CO3	3	3		3	2	3			3	2	3	3	3	28
CO4	3	2		3	2	2			2	3	2	3	3	25
CO5	3	3		2	2	2			3	2	3	3	3	26
Grand total of COs with PSOs and POs														132
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{132}{50}\right)$														2.64

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.64
Observation	**COs of Physics Lab – IV (Electronics) Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics - B.Sc. (Physics) Syllabus – 2020 - 21 onwards

Class	**: III Year**	**Part**	**: III (Core Elective-2)**
Semester	**: VI**	**Hours**	**: 45**
Code	**: 22UPYE26(A)**	**Credit**	**: 2**

BASIC ELECTRIC PRINCIPLES AND APPLICATIONS

COURSE OUTCOMES

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

CO 1: Acquire knowledge on the nature of electricity and fundamental laws.

CO 2: Apply the knowledge of the heating effects of electric current in various fields.

CO 3: Understand the concept of illumination.

CO 4: Study the basics of transformers, generation and transmission of electricity.

CO 5: Analyze the working of cells and batteries.

Unit I Nature of electricity and fundamental laws (9 hours)

Nature of electricity- electronic theory-flow of electric current –electron drift-electrical circuit- path of electric current –types of electric circuits –electrical terms (definition) –laws of resistance – variation in resistance with temperature-combination of resistances –ammeter- voltmeter. work, power, energy.

Unit II Chemical and Heating effects of electric current (9 hours)

Heating effects of electric current, Joule's law of heating- thermal efficiency- heating unit- materials for heating elements- applications of heating effect (incandescent lamp, arc welding, electric heaters, room heater, soldering iron, electric kettle, electric iron, water heater: immersion water heater, storage water heater). Fuse (classification, parts, types)-precautions for renewing a fuse.

Unit III Illumination (9 hours)

Definitions and units, laws of illumination, incandescent lamps. Different types of lamps- gas filled lamp, carbon arc lamp, gas discharge lamp, sodium vapour lamp, mercury vapour lamp, fluorescent tube; used of choke and starter,. Neon- light tubes and neon lamps- solar cells.

Unit IV Transformer, Generation and transmission of electricity (9 hours)

Introduction- principle- types of transformers-construction –- advantages of transformer- uses. Generation of Thermal power, hydro power, nuclear power and non – conventional power, transmission of power.

Unit V Cells and Batteries (9 hours)

Production of EMF, Classification of cells, Characteristics of a cell- Care and maintenance -Secondary cell-Construction of Lead Acid Battery – Charging of battery-Indications of fully charged cell-Capacity of battery- Precautions for battery charging-Maintenance of battery.

TEXT BOOKS:

1. P.S.Dhogal –, Basic electrical engineering ,Vol -I ,Tata McGraw-Hill Publishing Company limited.
   UNIT I – Ch.3, 4 (relevant sections)
   UNIT II – Ch.5 (relevant sections)
2. P.S.Dhogal – Basic electrical engineering ,Vol- II, Tata McGraw – Hill Publishing Company limited.
   UNIT III – Ch. 20(relevant sections)
   UNIT IV- Ch.14 (relevant sections)
   UNIT V- Ch 24 (relevant sections)
3. G.D RAI, Non- conventional energy sources.
   UNIT V- Ch 9 (relevant sections)

REFERENCES:

1. M.L Anwani , Basic electrical engineering-Dhamp at Rai& co (p)LTD.
2. B.L .THERAJA, A.K THERAJA, Electrical technology, S.Chand& Company Ltd, New Delhi.

WEBLINKS/E - Resources:

1) https://www.anixter.com/en_au/resources/literature/technical-references/the-basic-principles-of-electricity.html
2) https://energizer.com/science-center/the-principles-of-electricity/

Mapping of COs with PSOs & POs:

Semester: VI	**Subject Code: 22UPYE26A**								**Title of Paper: BASIC ELECTRIC PRINCIPLES AND APPLICATIONS**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**2**	**1**	**2**	**2**	**1**			**3**	**2**	**2**	**3**	**3**	24
CO2	**3**	**3**	**3**	**2**	**3**	**2**			**3**	**3**	**3**	**3**	**2**	30
CO3	**3**	**3**	**2**	**2**	**3**	**3**			**3**	**3**	**3**	**2**	**3**	30
CO4	**3**	**2**	**3**	**3**	**3**	**2**			**3**	**3**	**2**	**3**	**3**	30
CO5	**3**	**3**	**3**	**3**	**2**	**2**			**3**	**3**	**2**	**3**	**2**	29
Grand total of COs with PSOs and POs														143
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{143}{52}\right)$														2.75

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.75
Observation	**COs of Basic Electric Principles and Applications Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class	**: B.Sc. PHYSICS**	**Part**	**: III (Core Elective-2)**
Semester	**: VI**	**Hours**	**: 45**
Subject Code	**: 22UPYE26 (B)**	**Credit**	**: 2**

MEDICAL PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand basic human physiological system and simple medical instruments
- To explain the designing and working of bio signal amplifiers and recorders
- To elaborate the concepts behind physiological assist devices and understand its importance
- To interpret the working of specialized medical equipment
- To realize and cognize the basic ethics involved in medical physics practice

UNIT I: Biopotential Electrodes and Transducers (9 Hrs)

Cell and their structure - Transport of ions through cell membrane – Resting potential & action potential; Bio electric potential - Design of medical instruments - Electrodes – Micro, Depth & Surface - Transducers (active, passive, resistive transducers only) – Bio-sensors (definition only).

UNIT II: Bio-Signal Amplifiers and Recorders (9 Hrs)

Isolation amplifier - Medical pre amplifier design - Chopper amplifier (Mechanical and non-mechanical chopper)- Bio signal analysis (Analog and digital methods, signal to noise improvement (methods only)) - Characteristics of recording systems (writer and pen damping effects) - Electrocardiography (origin of cardiac action potential) – Electroencephalography (origin of EEG) - Electromyography (recording setup) –Recorders with high accuracy.

UNIT III: Physiological Assist Devices (9 Hrs)

Pace makers (energy requirements to excite heart muscle)- Artificial heart valves (requirements, different neutral heart valve, different types of artificial heart valve)– Defibrillators (internal and external) - Nerve and muscle stimulators (stimulation of nerves) - Heart lung machine (mechanical function of heart) - Kidney machine (renal function and dialysis).

UNIT IV: Medical Equipments & Modern Imaging Systems (9 Hrs)

Oximeters (in-vitro and in-vivo) - Blood cell counters - Electron microscope - Radiation detectors (Geiger Muller counter only) - Digital thermometers – X-ray tube - X-ray Machine (Block diagram of X-ray machine only) – Lasers in medicine (laser action only) - Endoscopes – Ultrasonic imaging system (principle) – Magnetic resonance imaging (principle) – positron emission tomography (principle)

UNIT V: Ethics In Medical Physics Practice (9 Hrs)

General workplace ethics – professional relationships – practice audits – code of conduct – maintenance of competence – resources – communicating medical errors – whistle blower protection – professional conflict of interest - research – integrity in dealing with healthcare

data and patients – need for human research ethics committee clearance – General medical ethics – interaction with patients and public.

Text Book

1. M. Arumugam, Bio-Medical Instrumentation, Third edition - Anuradha Publication - 2016.

   Unit – I Chapter –1: 1.2, 1.4, 1.5, 1.6; Chapter–2: 2.2, 2.4, 2.4.4, 2.4.5, 2.4.6, 2.4.7, 2.5, 2.5.1 – 2.5.7
   Unit – II Chapter –3: 3.3, 3.4, 3.8, 3.8.1, 3.8.2, 3.9, 3.9.1, 3.9.2
   Chapter –4: 4.2, 4.2.1, 4.3, 4.3.1, 4.4, 4.4.1, 4.5, 4.5.1, 4.7
   Unit – III Chapter –5: 5.2, 5.2.1, 5.4, 5.4.1, 5.4.2, 5.4.3, 5.5, 5.5.1, 5.6, 5.6.1, 5.7, 5.7.1, 5.8, 5.8.1, 5.8.2
   Unit – IV Chapter –6: 6.15; Chapter –7: 7.2, 7.4, 7.5, 7.5.1, 7.5.2, 7.6, 7.8, 7.9; Chapter –10: 10.3, 10.4, 10.9 (principle only), 10.10 (principle only), 10.11

2. IAEA, Guidelines on professional Ethics for medical physicists, International Atomic Energy Agency – Training Course Series (78) - 2023

   Unit – V: Section - 4: 4.1, 4.1.1 – 4.1.8; 4.3, 4.3.1-4.3.2, 4.4, 4.4.1-4.4.2

Books for Reference:

1. R. S. Khandpur - Handbook of Biomedical Instrumentation - Tata McGraw-Hill, New Delhi - 1999.
2. Leslie Cromwell, Fred J. Weibell& Erich A. Pfeiffer - Biomedical Instrumentation and Measurements, II edition - Prentice Hall of India Private Limited, New Delhi - 2003.

Teaching Learning Methods:

- Lecture Method, Demonstration, ICT, Assignment, Quiz, Group Discussion

Weblinks/E - Resources:

1. https://www-pub.iaea.org/MTCD/publications/PDF/TCS-78_web.pdf
2. https://ijarsct.co.in/Paper988.pdf
3. https://www-pub.iaea.org/MTCD/Publications/PDF/TCS-78_web.pdf

Course Outcomes

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

CO1: Understand the simple medical instruments
CO2: Explain the working of bio signal amplifiers and recorders
CO3: Discuss the basic concepts of physiological assist devices
CO4: Interpret the working of specialized medical equipment
CO5: Cognize the basic medical physics ethics

Mapping of COs with PSOs & POs:

Semester: VI	Subject Code: 22UPYE26B								Title of Paper: MEDICAL PHYSICS					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	0	3	2	3	0	1	3	2	3	2	3	27
CO2	2	3	0	3	3	3	0	0	3	1	3	2	3	26
CO3	2	3	0	3	2	3	0	0	3	2	3	2	3	26
CO4	3	3	0	3	2	3	0	1	3	3	3	2	3	29
CO5	3	2	0	2	2	3	0	0	3	3	2	2	3	25
Grand total of COs with PSOs and POs														133
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{133}{52}\right)$														2.56

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.56
Observation	**COs of Medical Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class	**: B.Sc. PHYSICS**	**Part**	**: III (Core Elective-2)**
Semester	**: VI**	**Hours**	**: 45**
Subject Code	**: 22UPYE26 (C)**	**Credit**	**: 2**

OPTOELECTRONICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand phenomena of light such as Polarisation, Birefringence, electro-optic, magneto-optic and acousto-optic effect and NLO.
- To explain the principle and working of Display devices
- To elaborate the concepts of Lasers, Laser Sources such as Semiconductor, Dye and Gas Lasers.
- To describe the principle and working of specialized optical instruments like Photodiode, Photoresistors, Phototransistors
- To elucidate the basic ideas of optical communication systems

Unit I Light (9 Hrs)

Nature of light- wave nature of light, light sources, polarisation, Birefringence, optical activity- electro-optic effect, Kerr Modulators, Scanning and switching, magneto-optic effect, acousto-optic effect, Non-linear optics.

Unit II Display Devices (9 Hrs)

Radiative and non-radiative transitions, direct and indirect band gap materials, light emitting electronic materials, SC quantum dots, photon absorption and emission in semiconductors, Electron-Hole pair generation. Luminescence, Photoluminescence, cathode luminescence, cathode ray tube, electroluminescence, Plasma displays, display brightness, liquid crystal displays- numeric displays.

Unit III Lasers (9 Hrs)

Emission and absorption of radiation- population inversion and threshold condition- properties of lasers, Types of lasers: Doped insulator lasers- semiconductor lasers- gas lasers- dye lasers; laser applications- measurement of distance- holography- industrial applications- medical applications- laser induced nuclear fusion.

Unit IV Optoelectronic Devices (9 Hrs)

Light emitting diode (LED) construction, working principle, generation of light and external quantum efficiency, hetrostructures, high frequency limit, effect of surface and indirect recombination current in LED. Photoconductive Cells, Photodiodes, Laser diodes, Super

luminescent diodes, Phototransitors, Light activated SCR (LASCR), opto-couplers, Solar cells- Open circuit voltage, short circuit current, Fill factor, Imaging detectors, Recent advances in optoelectronic materials, organic semiconductors.

Unit V Optical Communication (9 Hrs)

Free space communications, Total internal reflection, construction of Optical Fiber and its Properties, propagation of light, refractive index profile, Optical fiber Modes and configuration, Step Index fibers, Graded Index fibers. Single mode fibers- Cut off wavelength, Mode Field Diameter, data rate and bandwidth, attenuation, leaky modes, bending losses.

Text book:

1. "Optoelectronics an introduction", John Wilson & John Hawkes Third Edition, Prentice Hall, Europe, 1998.

2. Optical Electronics, Gathak & Thyagarajan, 1st Edition, Cambridge Univ. Press, 2017.

Books for Reference:

1. Introduction to Semiconductor Devices, M.S.Tyagi, Wiley, 2008.
2. Electrical Engineering Materials, R.K.Shukla, Archana Singh, McGraw Hill Publishers, 2017.
3. Semiductor Devices: Physics & Technology, 3rd Edition, S.M.Sze, Wiley, 2016.

Teaching Learning Methods:

- Lecture Method, Demonstration, ICT, Assignment, Quiz, Group Discussion

WEBLINKS/E - Resources:

1. https://www.geeksforgeeks.org/optoelectronic-devices/
2. https://www.allaboutcircuits.com/technical-articles/an-introduction-to-optoelectronics/
3. https://www.elprocus.com/optoelectronics-devices-with-their-applications/
4. https://www.techopedia.com/definition/2622/optoelectronics

Course Outcomes

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

CO1: Understand the phenomena of light such as polarisation, Birefringence, electro-optic, magneto-optic and acousto-optic effect and NLO

CO2: Explain the principle and working of Display devices

CO3: Elaborate the concepts of Lasers, Laser Sources such as Semiconductor, Dye and Gas Lasers.

CO4: Describe the principle and working of specialized optical instruments like Photodiode, Photoresistors, Phototransistors

CO5: Elucidate the basic ideas of optical communication systems

Mapping of COs with PSOs & POs:

Semester: VI	**Subject Code: 22UPYE26C**								**Title of Paper: OPTOELCTRONICS**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	0	3	2	3	0	3	3	2	3	3	3	30
CO2	2	3	0	3	3	3	0	1	3	1	3	2	3	27
CO3	2	3	0	3	2	3	0	2	3	2	3	3	3	29
CO4	3	3	0	3	2	3	0	1	3	3	3	2	3	29
CO5	3	2	0	2	2	3	0	3	3	3	2	2	3	25
Grand total of COs with PSOs and POs														140
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{133}{52}\right)$														2.56

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.56
Observation	**COs of Medical Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: B.Sc. PHYSICS**	**Part**	**: Self Learning Course**
Semester	**: VI**	**Hours**	**:**
Subject Code	**: 22UPYSL6**	**Credit**	**: 3**

Optical Communication

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To understand the basic concepts of Optical communications
- To study the optical fibre modes, classification of optical fibers
- To acquire the knowledge of optical phenomena such as attenuation, absorption, bending losses, dispersion, Intra & Inter modal dispersion.
- To examine the various optical sources and detectors
- To discuss the various optical networks, and their optical components .

UNIT – I Overview of Optical Communication

Introduction, Free space communications, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, Total internal reflection, Acceptance angle, Numerical Aperture construction of Optical Fiber and its Properties, propagation of light, refractive index profile.

Unit II Optical Fibers

Optical fiber waveguides, Ray theory, cylindrical fiber (no derivations) single mode fiber, cutoff wave length, mode filed diameter. Optical Fibers: fiber materials, photonic crystal, fiber optic cables specialty fibers.

UNIT - III Transmission Characteristics of Optical Fibers

Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion, Intra modal dispersion, Inter modal dispersion.

UNIT - IV Optical Sources and Detectors

Introduction, LED's, LASER diodes, Photo detectors, Photo detector noise, Response time, double hetero junction structure, Photo diodes, comparison of photo detectors. 7 Hours

UNIT - V Optical Networks

Introduction, fiber alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers, SONET / SDH, Optical Interfaces, SONET/SDH rings, High – speed light – waveguides.

Text Books:

1. Optical Fiber Communication – Gerd Keiser, 4th Ed., MGH, 2008.
2. Optical Fiber Communications– – John M. Senior, Pearson Education. 3 rd Impression, 2007.

Books for Reference:

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education,2005.
2. Text Book on Optical Fiber Communication and its Applications – S.C.Gupta, PHI, 2005.
3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004.
4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

Teaching Learning Methods:

- Lecture Method, Demonstration, ICT, Assignment, Quiz, Group Discussion

WEBLINKS/E - Resources:

1. https://www.geeksforgeeks.org/optoelectronic-devices/
2. https://www.allaboutcircuits.com/technical-articles/an-introduction-to-optoelectronics/
3. https://www.elprocus.com/optoelectronics-devices-with-their-applications/
4. https://www.techopedia.com/definition/2622/optoelectronics

Course Outcomes

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

CO1: Understand the phenomena of light such as Polarisation, Birefringence, electro-optic, magneto-optic and acousto-optic effect and NLO

CO2: Explain the principle and working of Display devices

CO3: Elaborate the concepts of Lasers, Laser Sources such as Semiconductor, Dye and Gas Lasers.

CO4: Describe the principle and working of specialized optical instruments like Photodiode, Photoresistors, Phototransistors

CO5: Elucidate the basic ideas of optical communication systems

Mapping of COs with PSOs & POs:

Semester: VI	**Subject Code:**								**Title of Paper: MEDICAL PHYSICS**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	0	3	2	3	0	1	3	2	3	2	3	27
CO2	2	3	0	3	3	3	0	0	3	1	3	2	3	26
CO3	2	3	0	3	2	3	0	0	3	2	3	2	3	26
CO4	3	3	0	3	2	3	0	1	3	3	3	2	3	29
CO5	3	2	0	2	2	3	0	0	3	3	2	2	3	25
Grand total of COs with PSOs and POs														133
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{133}{52}\right)$														2.56

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.56
Observation	**COs of Medical Physics Strongly related with PSOs and POs**		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
Department of Physics - M. Sc. (Physics)
OBE - CBCS (2022-2023 Onwards)

SEMESTER I		**Hours**	**Credit**
22PPYC11	Mathematical Physics-I	6	5
22PPYC21	Classical Mechanics	6	5
22PPYC31	Electromagnetic theory	6	5
22PPYE11	Elective – I	6	4
22PPYP12	Practical-I	3	-
22PPYP22	Practical-II	3	-
	Total	**30**	**19**
SEMESTER II			
22PPYC42	Mathematical Physics-II	6	5
22PPYC52	Quantum Mechanics –I	6	5
22PPYE22	Elective – II	6	4
22PPYN12	Non-Major Elective	4	4
20PLFS12	Life Skills	2+2*	2
22PPYP12	Practical-I	3	4
22PPYP22	Practical-II	3	4
	MOOC / SWAYAM		02**
	Total	**30+2**	**28**
SEMESTER III			
22PPYC63	Quantum Mechanics –II	6	5
22PPYC73	Solid State Physics- I	6	5
22PPYC83	Molecular Spectroscopy	6	5
22PPYE33	Elective – III	6	4
22PPYP34	Practical-III	3	-
	Project Work	3	-
	MOOC / SWAYAM		02**
	Total	**30**	**19**
SEMESTER IV			
22PPYC94	Solid State Physics- II	6	5
22PPYD04	Nuclear & Particle Physics	6	5
22PPYE44	Elective – IV	6	4
22PPYP34	Practical-III	3	4
22PPYD14	Project Work & Viva	9	8
	Total	**30**	**26**

Non-major elective for other students: Energy physics
Self-Learning - MOOC / SWAYAM Course: II & III Sem (2 Credits for each course)

Semester	I	II	III	IV	**Total**
Credit	19	28	19	26	**92**

*** represents practical outside the class hour**
**** Extra credit course**

List of Electives

1. Energy & Environmental Physics (1 A)	5. Astrophysics (1B)
2. Applied Electronics (2 A)	6. Microprocessor & Microcontroller (2 B)
3. Thermodynamics and Statistical Physics (3 A)	7. Nanophysics (3 B)
4. Applied Optics & Laser Physics (4 A)	8. Medical Physics (4 B)

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS

PROGRAMME SPECIFIC OUTCOMES (PSO)

On completion of M.Sc. Physics programme, the students will be able to,

PSO1: Comprehend the concepts of diverse fields in Physics.

PSO2: Exhibit proficiencies in applying various concepts of physics to fulfil the regional, national and global needs.

PSO3: Demonstrate experiments to analyse & interpret the concepts of physics that will enable them to shine in the field of education, research and development.

PSO4: Acquire the skills to perform collaborative inter-disciplinary activities and to undertake effective research.

PSO5: Work in the field of physics with the desire to make it as a lifelong learning process for their continued academic and professional development.

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: CORE-1**
Semester	**: I**	**Hours**	**: 90**
Sub.Code	**: 22PPYC11**	**Credit**	**: 5**

MATHEMATICAL PHYSICS – I

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

To understand various mathematical techniques, concepts and applicable in physics

UNIT 1 Vectors (18 hours)

Gradient of a scalar field –Line , Surface and Volume Integrals – Gauss Divergence theorem (statement &Analytical Proof) –Gauss law in differential form – Poisson's equation and Laplace equation –Stoke's theorem (statement & Analytical Proof) –Green's theorem – Green's theorem in Plane –Orthogonal Curvilinear coordinates – Spherical Polar coordinates (Gradient, Divergence, Laplacian& Curl) - Cylindrical Coordinates (Gradient, Divergence, Laplacian& Curl) – Applications of vectors: Hydrodynamics - Equation of continuity – Equation of Heat flow in solids

UNIT 2 Vector Spaces and Transformation (18 hours)

Partitioning of Matrices – Special type of Matrices – Transpose of Matrix – Symmetric & Anti Symmetric - Hermitian and skew Hermitian – Adjoint of Matrix - Orthogonal matrices, Unitary matrices -Rank of a Matrix - Solution for Linear equation: Homogeneous, Non-Homogeneous, Creamer's rule - Linear - Orthogonal and unitary and – similarity transformations - Eigen Values, Eigen vectors: Characteristics equation of Matrix–Cayley-Hamilton theorem – Some important theorems on Eigen Values, Eigen vectors – Diagonalization of Matrices

UNIT 3 Operational Methods (18 hours)

Fourier series and Integrals: Fourier series - Dirichlet's theorem and condition – Uses of Fourier Series – Full Wave rectifier, Square Wave, Saw tooth wave - Fourier Integral –Fourier Transform – Properties of Fourier transform – Laplace Transform - Properties of Laplace transform - Laplace transform of the Derivative of function – Laplace transform of Integral - Inverse Laplace transform: Fourier Mellin theorem – convolution or Faltung theorem - Evaluation of Inverse Laplace transformby convolution theorem **–** Laplace transform of ordinary differential equation with constant coefficients and variable coefficients.

UNIT 4 Special Function I (18 hours)

Definitions: Beta and Gamma function – Symmetry property of Beta functions - Transformation of Beta function (other forms)–Evaluation of Gamma Function - Transformation of Gammafunction (other forms) – Relation between Beta and Gamma Function – Graph of Gamma Function

Bessel's Differential Equation: Bessel's function of First and second kind –Limiting value of $J_n(x)$ &$Y_n(x)$ – Recurrence formula for $J_n(x)$ – Generating function of $J_n(x)$

UNIT 5 Special Function II (18 hours)

Legendre differential equations and Legendre functions: Legendre's equation (first & second kind) –Generating function of Legendre polynomial, (corollary 1, 2) –Rodrigue's formula for Legendre polynomials, Deductions – Orthogonal Properties of Legendre's polynomials – Hermite differential equation–Laguerre's differential equation

References

1. Sathya Prakash, Mathematical Physics, 7th Edition, 2021, Sultan Chand & Sons, New Delhi.

   Unit 1:

   Chapters : 1.2, 1.3, 1.7, 1.8(2), 1.8(3), 1.9, 1.11, 1.12, 1.15, 1.15(c), 1.15(d), 1.19, 1.19(1), 1.19(b)

   Unit 2 :

   Chapters : 2.4, 2.5, 2.6, 2.9, 2.10, 2.15, 2.17, 2.18, 2.23, 2.27, 2.8, 2.29, 2.30, 2.31, 2.32, 2.34, 2.35

   Unit 3 :

   Chapters : 8.1, 8.2, 8.8, 8.9 (2,3,4), 8.13, 10.2, 10.3, 10.9, 10.10, 10.11, 10.12, 10.15, 10.18, 10.19, 10.22(b)

   Unit 4 :

   Chapters : 4.1, 4.2, 4.4, 4.5, 4.6, 4.7, 4.10, 7.22, 7.23, 7.26, 7.27

   Unit 5 :

   Chapters : 7.12, 7.13, 7.14, 7.15, 7.35, 7.40

2. Pipes and Harvill, 1970, Applied Mathematics for Engineers and Physicists- III, Edition, McGraw Hill International Book Company.
3. Joshi, A.W., II Edition, 1995, Matrices and Tensors in Physics- Wiley Eastern Ltd., New Delhi (Unit II: Ch. 1.1 – 1.10).
4. B.D.Gupta, 2004, Mathematical Physics –Vikas Publishing house.
5. Arfkan and Weber, 2005, Mathematical Methods for Physists, I Ed.,–Prism Books Pvt.Ltd. Mathews Walker, 1970, Mathematical Methods of Physics –Pearson Education, New Delhi.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Describe the concepts of vector algebra and their applications.

CO2: Analyse various types of matrices and theorems.

CO3: Develop the Fourier series expansions, Fourier and Laplace transforms for certain applications.

CO4: Demonstrate the importance of various special functions and enumerate the Generating Function for these special functions.

CO5: Perform operations with Legendre differential equations along with the corresponding recurrence formulae of different functions.

Mapping of COs with PSOs & POs:

SEMESTER I	Subject Code: 22PPYC11								Title of Paper: Mathematical Physics – I					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3		2	1	2			3	3	2	2	3	24
CO2	3	3		3	2	3			3	3	3	2	2	27
CO3	2	3		2	1	3			3	2	3	3	3	25

CO4	3	2		1	2	2			3	3	3	2	3	24
CO5	3	3		2	3	1			2	3	3	2	3	25
Grand total of COs with PSOs and POs														125
Mean value of COs with PSOs and POs=$\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{125}{50}\right)$														2.50

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.50
Observation	**COs of Mathematical Physics – I Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: CORE-2**
Semester	**: I**	**Hours**	**: 90**
Sub.Code	**: 22PPYC21**	**Credit**	**: 5**

CLASSICAL MECHANICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand the classical formulation theories like Lagrangian & Hamiltonian dynamics, Canonical transformations and Oscillations and to apply them to solve problems.

UNIT 1 Lagrangian & Hamiltonian Dynamics (18 hours)

Basic concepts – Constraints – Lagrangian equation from D'Alembert's principle – Procedure for formulation of Lagrange's equation – Hamilton's Principle and Lagrange's equations - Hamiltonian equations of motion - Cyclic coordinates and Routh's procedure – Physical significance of the Hamiltonian – Hamilton's equations from variational principle – The principle of least action.

UNIT 2 Canonical Transformations, Brackets & Hamilton-Jacobi Theory (18 hours)

Canonical transformation – Generating Functions – Example of canonical transformation – Conditions for a transformation to be canonical – Lagrange and poison bracket – Equations of motion in Poison bracket notation – Hamiltonian Jacobi equation – Solution to SHM using HJ theory - Separation of variable – Action angle variable.

UNIT 3 Motion Under Central Force: Two Body Problem (18 hours)

Reduction of two body to one body problem – Central force & motion in a plane – Equations of motion – Differential equation for an orbit – Inverse square law of force – Kepler's laws of planetary motion & their deduction – Virial theorem – Scattering in a central force field – Rutherford scattering cross section.

UNIT 4 Rigid body Dynamics (18 hours)

The independent coordinates of a rigid body – Orthogonal transformation – Formal properties of the transformation – The Euler's angles – Euler's theorem on the motion of the rigid body – Finite rotation – Infinitesimal rotations – Angular momentum & Inertia tensor – Rotational kinetic energy of a rigid body – The Coriolis effect – Torque free motion of a rigid body – Motion of symmetrical top.

UNIT 5 Small Oscillations (18 hours)

Stable, unstable & neutral equilibrium – One dimensional Oscillator – Theory of small oscillations' formulation – The Eigenvalue equation - frequency of free vibration and small oscillations in normal coordinates –Vibrations of a linear triatomic molecule – Two coupled oscillators - Double pendulum.

References

1. Herbert Goldstein, Charles P Poole, John Safko, 2011, Classical Mechanics, 3rd Edition, Pearson Education.
2. J.C. Upadhyaya, 2014, Classical Mechanics, Himalaya Publishing House.

Unit I : 2.2, 2.3 [2.3.1 & 2.3.2 only], 2.4, 2.7, 2.8, 2.11, 3.2, 3.4, 3.5, 3.8, 5.5, 5.11

Unit II : 6.1, 6.2, 6.3, 6.4, 6.5 (Eg : 1-5), 6.6, 7.1, 7.2, 7.3, 7.4, 8.1, 8.2, 8.3, 8.4, 8.6, 8.7

Unit III : 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.9, 4.10

Unit IV : 10.1 - 10.4; 10.6, 10.8, 10.11 – 10.13

Unit V : 9.1 – 9.4; 9.5 (double pendulum only), 9.6

3. Gupta, Kumar and Sharma, 2010, Classical Mechanics –Pragati Prakasan Publications.

4. P.V.Panat, 2005, Classical Mechanics –Narosa Publishing House.

5. G. Aruldhas, 2008, Classical Mechanics, Prentice Hall India.

6. A.B. Gupta, 2018, Fundamentals of Classical Mechanics, Books & Allied Publications.

7. N.C. Rana, P.S. Joag, 2017, Classical Mechanics, McGraw Hill Education.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Apply Lagrangian & Hamiltonian formulation to solve problems in classical mechanics.

CO2: Acquire knowledge in Canonical transformation and Hamilton-Jacobi theory.

CO3: Understand the motion under the central force and to analyze the problems related to it.

CO4: Explain the concepts of rigid body dynamics.

CO5: Discuss the frequency of vibration and small oscillations.

Mapping of COs with PSOs & POs:

SEMESTER I	**Subject Code: 22PPYC21**								**Title of Paper: Classical Mechanics**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		2	3	2			3	3	3	2	3	27
CO2	3	3		1	2	2			3	2	3	2	2	23
CO3	3	3		2	3	1			3	3	2	2	3	25
CO4	3	3		3	2	2		1	3	3	3	1	3	27
CO5	3	3		2	1	1		1	3	3	3	1	3	24
Grand total of COs with PSOs and POs														126
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{126}{52}\right)$														2.42

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.42
Observation	**COs of Classical Mechanics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: CORE-3**
Semester	**: I**	**Hours**	**: 90**
Sub. Code	**: 22PPYC31**	**Credit**	**: 5**

ELECTROMAGNETIC THEORY

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To discuss the concepts of electrostatic and magnetostatic fields, electromotive force, propagation of electromagnetic wave in waveguides

UNIT 1 ELECTROSTATICS (18 hours)

Coulomb's law; the electric field – line, flux and Gauss's Law in differential form - Gauss's law - application of Gauss's law – curl of E - the electrostatic potential; conductors and insulators - Poisson's equation; Laplace's equation –Boundary conditions – work and energy in electrostatics – energy of a point charge distribution – energy of continuous charge distribution – induced charges – capacitors. Potentials: Laplace equation in one dimension and two dimensions – Dielectrics – induced dipoles – Gauss's Law in the presence of dielectrics.

UNIT 2 MAGNETOSTATICS (18 hours)

Lorentz force – magnetic fields – magnetic forces – currents – Biot-Savart Law – divergence and curl of B – Ampere's Law – Electromagnetic induction - comparison of magnetostatics and electrostatics – Magnetic vector potential. Magnetization: effect of magnetic field on atomic orbit – Ampere's Law in magnetized materials –Magnetostatic Boundary Conditions - ferromagnetism.

UNIT 3 ELECTROMOTIVE FORCE (18 hours)

Ohm's Law – electromotive force – motional emf – Faraday's Law – induced electric field – inductance – energy in magnetic field – Maxwell's equation in free space and linear isotropic media – continuity equation – Poynting theorem- Newton's Third Law in Electrodynamics. Electromagnetic Waves in one dimension – wave equation – sinusoidal waves – reflection and transmission – Polarization

UNIT 4 ELECTROMAGNETIC WAVES (18 hours)

The wave equation for E and B – Monochromatic Plan waves – energy and momentum in electromagnetic waves – electromagnetic waves in matters – Propagation in linear media - Reflection and transmission at normal and oblique incidence - EM waves in conductors - Absorption, dispersion and reflection at a conducting surface. Potentials: potentials and fields – scalar and vector potentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form - Retarded Potentials - Liénard-Wiechert Potentials.

UNIT 5 GUIDED WAVES AND RADIATION (18 hours)

Guided waves: TE waves in rectangular wave guides – the co-axial transmission line. Electric dipole radiation - Magnetic dipole radiation - Radiation from an arbitrary source -power radiated by a point charge - Radiation reaction - radiation damping of a charged particle - Physical basis of the radiation reaction

References:

1. Griffiths David, J., 2015, Introduction to Electrodynamics, 4th Ed., Pearson Publ.
[Unit – I : Chap (2) Secs. 2.1 – 2.3.3, 2.3.5, 2.4.1-2.4.3, 2.5,
Chap (3) 3.1.1 – 3.1.3, Chap (4) 4.1.1, 4.1.2,4.3.1

Unit – II : Chap (5) Secs. 5.1 – 5.4, Chap (6) Secs 6.1.1, 6.1.3, 6.3
Unit – III : Chap (7) Secs. 7.1 – 7.3, Chap (8) Secs 8.1, 8.2.1, Chap (9) Secs 9.1
Unit – IV : Chap (9) Secs. 9.1 – 9.4, Chap (10) Secs 10.1, 10.2.1, 10.3.1
Unit – V : Chap (9) Secs. 9.5, Chap(11) Sec 11.1 – 11.2]

2. Paul Lorrain & Dale R. Corson, 2005, Electromagnetic fields and waves, 2nd Ed., CBS Publ., New Delhi.
3. J.R. Reitz, F.J. Milford and R.W. Christy, 2010, Foundations of Electromagnetic Theory, 4th Ed., Pearson Publications.
4. John D Kraus & Daniel Fleisch, 2017, Electromagnetics, 5th Ed., McCraw Hill Education Publn.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Discuss the concepts of electrostatic fields.
CO2: Solve the Laplace's equation in Cartesian and spherical coordinates.
CO3: Acquire knowledge on magnetostatics and vector potentials.
CO4: Analyze the propagation of EM waves in non-conductors and good conductors.
CO5: Describe the propagation of EM waves in waveguides.

Mapping of COs with PSOs & POs:

SEMESTER I	Subject Code: 22PPYC31								Title of Paper: Electromagnetic Theory					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3		2	1	2			3	3	3	2	3	25
CO2	3	3		1	1	2			3	2	3	1	3	22
CO3	3	3		2	1	2		1	3	3	3	2	3	26
CO4	3	3		2	2	2			3	3	3	2	3	26
CO5	3	3		3	2	3			3	3	2	3	3	28
Grand total of COs with PSOs and POs														127
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{127}{51}\right)$														2.49

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.49
Observation	**COs of Electromagnetic Theory Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core Elective-1**
Semester	**: I**	**Hours**	**: 90**
Sub.Code	**: 22PPYE11 (A)**	**Credit**	**: 4**

ENERGY AND ENVIRONMENTAL PHYSICS (ELECTIVE)

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To study the necessary non-conventional energy sources and the need of environmental protection.

UNIT 1 Various Energy Sources and Power Production (18 hours)

World and Indian energy future – Conventional sources of energy – Coal, Oil and gas – Renewable energy sources – Wind energy – Bio-gas, OTEC – Hydro, thermal and nuclear power productions.

UNIT 2 Solar Radiation and Solar Collectors: (18 hours)

Solar energy Indian research and perspectives – Solar radiation analysis and measurement pyrheliometer and pyranometers – heat transfer in solar thermal – radiation and convection.

Principles of flat plate solar collectors – Conversion of solar radiation into heat – Transmittance & absorbance – Collector thermal losses – Energy balance equation – Overall loss coefficient – Derivation for useful energy gain and efficiency.

UNIT 3 Applications of Solar Energy (18 hours)

Solar energy storage systems – solar pond – Applications of solar pond – Solar water heating – Space heating – Solar thermal electricity conversion – Solar electricity power generation: Solar Photovoltaics – Solar distillation – Solar cooking.

UNIT 4 Fuel Cells & Super Capacitors (18 hours)

Introduction to fuel cells – Types of fuel cells – Polymer electrolyte fuel cell – micro fuel cell – Solid oxide fuel cell – Hydrogen fuel - Super Capacitors.

UNIT 5 Air and Water Pollution (18 hours)

Water and air pollution – Sources of water and air pollution – Classification of water and air pollution – Effects of water and air pollution – Purification and control devices of water and air pollution. (Design and working of settling chambers, cycline separators and gaseous pollution control methods) – Global air pollution problems.

References

1. Rai, G.D., 2011, Non-conventional sources of Energy-4th Ed., Khanna Publishers, New Delhi. (Unit I: Chap 1, Unit II : Chap 2, Unit III : Chap 3,4 & 5, Unit IV : Chap 4 & 5).
2. Suddhasatwa Basu, 2007, Recent Trends in Fuel Cell Science and Technology, Springer publishers, New Delhi. (Unit IV related topics in this book), Super Capacitors (Lecture Notes).
3. M Rao, H.V.N. Rao, 1989, Air Pollution, 1st ed., Tata McGraw Hill Pub. Co. New Delhi. (Unit V related topics in this book)
4. H P Garg; J Prakash, 2017, Solar Energy: Fundamentals and Applications, 1st ed., Tata McGraw Hill, Pub. Co. New Delhi.
5. B. H. Khan, 2017, Non-Conventional Energy Resources, 3rd ed., McGraw Hill Education India Private Limited.
6. Suresh K. Dhameja, 2010, Environmental Engineering and Management, SK Kataria & Sons Publishers, New Delhi.

7. B.S.N.Raju, 2018, Fundamentals of Air Pollution, CBS Publishers and Distributors PVT LTD

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Distinguish between conventional and non-conventional energy sources, enumerate the various methods of power production.

CO2: Explain the methods of measurement of solar radiation and operation of solar collectors.

CO3: Describe the various applications of solar energy.

CO4: Classify the different types of fuel cells and its applications.

CO5: Analyse the causes of air pollution and water pollution.

Mapping of COs with PSOs & POs:

SEMESTER I	**Subject Code: 22PPYE11A**								**Title of Paper: Energy And Environmental Physics**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		3	3	2	1	1	3	3	3	2	3	30
CO2	3	3		3	3	2		1	3	3	3	2	3	29
CO3	3	3		3	3	3		1	3	3	3	3	3	31
CO4	3	3		3	3	2	1	1	3	3	3	3	3	31
CO5	3	2		3	3	2	1	1	3	3	2	3	3	29
Grand total of COs with PSOs and POs														150
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{150}{58}\right)$														2.59

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.59
Observation	**COs of Energy and Environmental Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics - M.Sc. (Physics) Syllabus – 2015 - 16 onwards

Class	**: I**	**Part**	**: Core Elective - 1**
Semester	**: I**	**Credits**	**: 4**
Code	**: 22PPYE11 (B)**	**Hours**	**: 90**

ASTROPHYSICS

Course Objectives:

- To study the properties of stars and their evolution and to understand the origin and structure of the universe.

UNIT 1 Astronomical Instruments And Space Astronomy (18 hrs)

Introduction – Optical telescopes – Optical photometric instruments and techniques – Optical spectroscopy – Radio telescopes – Miscellaneous remarks – Infrared astronomy – Ultraviolet astronomy – X-ray astronomy – Gamma ray astronomy – The Hubble space telescope.

UNIT 2 Properties of Stars - I (18 hrs)

Apparent luminosities of stars – Magnitude scale – measurement of apparent luminosity – various magnitude systems – Corrections for observed magnitudes – Stellar distances and absolute luminosity – Measurement of distances within the solar system – Trigonometric parallaxes of stars – The method of luminosity distance.

UNIT 3 Properties of Stars - II (18 hrs)

Surface temperature of stars – Introduction – Laws for radiation in thermodynamic equilibrium – Application of radiation laws to stellar photospheres – Defining temperature of stars by matter laws – Spectral classification of stars – Masses and radii of stars – Kepler's third law – Binary stars – Measurement of stellar radii – Important relation between stellar parameters – Stellar energy sources (only qualitatively).

UNIT 4 Stellar Evolution (18 hrs)

Evolution near the main sequence – Star formation – Pre-main sequence contraction – post-main sequence evolution – Nucleosynthesis – Super dense remnants – Evolution of close binary systems

UNIT 5 External Galaxies and Cosmology (18 hrs)

Building blocks of the universe – Radio galaxies and quasars – Clusters and multiple galaxies – Cosmology – Introduction – Some specific cosmological models – Past and future of the universe.

REFERENCES:

1. K.D.Abyankar, 2001, Astrophysics : Stars and Galaxies, Universities Press,. [relevant titles from Chs.3,4, 5, 6, 10, 17, 18, 19, 20].
2. Bradley W.Carrol and Dale A.Ostlie, 2007, An Introduction to Modern Astrophysics, 2nd ed., Pearson International Edition.

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core-4**
Semester	**: II**	**Hours**	**: 90**
Sub.Code	**: 22PPYC42**	**Credit**	**: 5**

MATHEMATICAL PHYSICS-II

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To understand the concepts of complex variables and complex functions.
- To apply these techniques and concepts to solve Physics problems

UNIT 1 Complex Variables (18 hours)

Complex numbers - Functions of a complex variable – Limit, continuity& differentiability – Definition: Analytic function - Cauchy – Riemann differential Equations - Line integrals of complex functions–Rectifiable curve – Basic Properties of the complex Line integrals – A Few preliminary concepts – Cauchy Integral theorem – Extension to multiple connected region - Cauchy's integral formula – Taylor's series - Maclaurin series - Laurents series

UNIT 2 Complex Analysis (18 hours)

Singularities of an Analytic function: Isolated and Types of Singularities–Residues and their evaluation: Residues – Evaluation of residues: Residues at a simple pole – Residues of a pole m>1 – The residue at infinity - Cauchy's Residue theorem–Define integrals of Trigonometric functions of $\cos\theta$ and $\sin\theta$ (integration around unit circle) – Evaluation of certain improper real integrals

UNIT 3 Tensor Analysis (18 hours)

Introduction – n-dimensional space – super scripts and sub scripts - coordinate transformations – Indicial and summation conventions – Dummy and real indices – Kronecker delta symbol – some properties – generalised Kronecker delta – scalars, , contravarient and covariant vectors – Tensors of Higher rank – contravarient, covariant and mixed tensors of second rank –Tensors of higher rank –Algebric operations of tensors: Addition, subtraction, equality of tensors, outer product – contraction of tensors – inner product – Quotient Law (Example) – symmetric and anti-symmetric tensors - Lorentz transformation equations - Lorentz transformation of space and time in four vector form

UNIT 4 Group Theory (18 hours)

Molecular symmetry – symmetry operations – Rotation about symmetry axis – Reflection at a plane of symmetry – Rotation reflection – Inversion and Identity operations –symmetry elements – Algebra of Symmetry operations – Multiplication table – Reducible and Irreducible representations – The Great Orthogonality theorem – Character table for $C_{2V}$and C_{3V} point groups

UNIT 5 Numerical Methods (18 hours)

Interpolation with unequal intervals: Divided differences – Newton's Divided difference formula - Lagrange's Interpolation formula for unequal intervals – Numerical integration – Trapezoidal rule – Simpson's 1/3 rule –Numerical solution of ordinary differential equation: Taylor's series method –Euler's method – Modified Euler's method – Runge – kutta methods: second order and fourth order Runge – kutta method

References:

1. Sathya Prakash, Mathematical Physics, 7th Edition, 2021, Sultan Chand & Sons, New Delhi.
2. G. Aruldhas, Molecular structure and spectroscopy, IV Edition.2004, Prentice – Hall of India, Private limited, New Delhi

Unit IV: Chap: 5 – 5.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.2, 5.3, 5.4, 5.7, 5.8, 5.9
3. A.Singaravelu, Numerical methods, New edition, Meenakshi Agency (1 January 2020), Medavakkam, Chennai.
Unit V: Chap: 4 – 4.1, 4.4, 4.9, 4.29, 4.31Chap: 5 – 5.2, 5.12, 5.14, 5.19
4. Arfkan and Weber, 2005, Mathematical Methods for Physists –I ed., Prism Books Pvt. Ltd.
5. Dr.B.S.Grewal, 2003, Numerical methods in engineering and science- Khanna Publishers.
6. A Pipes & Harvill, R., 1970,Applied Mathematics for engineers and physicists - III Edition,McGraw Hill international book company, New Delhi.
7. F.Albert Cotton, 1971, Chemical Applications of Group Theory –Wiley Eastern Publ., New Delhi.
8. V.Rajaraman, 1993, Computer oriented Numerical Methods –III ed., Prentice Hall of India., New Delhi.
9. S.S.Sastry, 2000, Numerical methods –Prentice Hall of Publications, New Delhi.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Describe the concept of complex functions and analyse their properties.

CO2: Discuss the singularities and residues of an analytic function and to find the integrals.

CO3: Compare various types of tensors and perform their algebraic operations.

CO4: Classify different groups and deduce the various symmetric operations in group theory.

CO5: Apply various numerical methods for scientific research-oriented problems.

Mapping of COs with PSOs & POs:

SEMESTER II	**Subject Code: 22PPYC42**								**Title of Paper: Mathematical Physics-II**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		2	1	1			3	3	3	1	2	22
CO2	3	3		2	1	1			3	3	2	2	3	23
CO3	3	3		1	2	2			3	3	3	2	3	25
CO4	3	3		2	2	3			3	3	3	2	3	27
CO5	3	3		2	1	2			3	3	2	2	3	24
Grand total of COs with PSOs and POs														121
Mean value of COs with PSOs and POs=$\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{121}{50}\right)$														2.42

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.42
Observation	**COs of Mathematical Physics-II Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: CORE-5**
Semester	**: II**	**Hours**	**: 90**
Sub.Code	**: 22PPYC52**	**Credit**	**: 5**

QUANTUM MECHANICS – I

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To get an idea about the quantum mechanical nature and understand the behaviour of particles in microscopic concepts.

UNIT 1 Wave Mechanical Concepts (18 hours)

Inadequacy of classical physics – old quantum theory – uncertainty and complementarity – The Schrodinger wave equation – one dimensional wave equation – extension to three dimensional wave equation – extension to three dimension – interpretation of the wave function – Normalization of ψ - probability current density – Particle in a box– expectation value – Ehrenfest theorem – Separation of wave equation – Continuity and bound conditions – discrete and continuous energy eigenvalues – one dimensional square well.

UNIT 2 Eigen functions and Eigen values of Some Systems (18 hours)

Energy eigenfunction – Orthonormality – Reality of energy eigenvalues – Momentum eigenfunction – box normalization – Discrete eigenvalues – LHO – spherically symmetric potential – square well-hydrogen atom – Degeneracy – Spherical polar coordinate only.

UNIT 3 Matrix Formulations (18 hours)

Concept of Hilbert space – Dirac's notation – projection operators – physical meaning of matrix element – Equations of motion – Schrodinger picture – Heisenberg picture – Interaction – Energy representation – Poisson and commutation brackets – Evaluation of commutators – Virial theorem – Matrix theory of harmonic oscillator – coordinate representation.

UNIT 4 Angular Momentum (18 hours)

The angular momentum operators– Commutation relations – Eigenvalues & Eigenfunctions of L^2&L_z–Eigenvalus of J^2&J_z - Angular momentum matrices – spin angular momentum – spin vectors for spin (-1/2) system – addition of angular momenta – Clebsch-Gordan coefficients – Recursion relations.

UNIT 5 Perturbation Theories (18 hours)

Time independent perturbation – basic concepts – non-degenerate energy levels- 1^{st} order correction- 2^{nd} order correction – Anharmonic oscillator: 1^{st} order correction - Ground state of Helium - Stark effect – Degenerate energy levels – 1^{st} order correction - The WKB method – Connection formulas – Validity of WKB Method.

References:

1. Schiff, Leonard .I. & Jayendra Bandhyopadhyay, 2017, Quantum Mechanics, IV ed., - McGraw Hill Publication, New Delhi. [Unit – I : Chap.1 : 1,2,3 & Chap.2 : 6,7,8,9 (relevant titles) Unit – II : Chap.3 : 10,11 & Chap. 4:13, 14, 15 & 16 (relevant titles) Unit – III: Chap.6: 23, 24 & 25 (relevant titles)]
2. G. Aruldhas, 2008, Quantum Mechanics, 2^{nd} ed., Prentice Hall India Learning Private Limited. [Unit – IV: Chap.8.1 – 8.9; Unit – V: Chap.9.1- 9.6, Chap. 11.1 – 11.3]
3. J. J. Sakurai, Jim Napolitano, 2020, Modern Quantum Mechanics, 3^{rd} edition, Cambridge University Press.

4. P. J. E. Peebles, 2010, Quantum Mechanics, Princeton University Press.
5. Richard L. Liboff, 2009, Introductory Quantum Mechanics, 4th ed., Pearson Education.
6. S. Devanarayanan, 2016, Quantum Mechanics: Principles & Applications, Createspace Independent Publishing Platform, The Book Depository Ltd.UK.
7. S.K. Anand & Gurdeep R. Chatwal, 2019, Quantum Mechanics, Himalaya Publishing House P L Nagpur, Mumbai.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Interpret the physical importance of wave function and wave equation.

CO2: Describe the Eigen function and Eigen value of various systems.

CO3: Discuss the matrix formulations of quantum mechanics.

CO4: Analyse angular momentum of quantum mechanical systems.

CO5: Deduce solutions of systems subjected to perturbations.

Mapping of COs with PSOs & POs:

SEMESTER II	**Subject Code: 22PPYC52**								**Title of Paper: Quantum Mechanics – I**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		2	1	2			3	3	3	2	3	25
CO2	3	3		2	2	2			3	3	3	1	3	25
CO3	3	3		1	1	2			3	3	3	2	2	23
CO4	3	3		2	2	3			3	3	3	2	3	27
CO5	3	3		1	2	2			3	3	3	1	2	23
Grand total of COs with PSOs and POs														123
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{123}{50}\right)$														2.46

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.46
Observation	**COs of Quantum Mechanics – I Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

CLASS	**: M.Sc. Physics**	**PART**	**: CORE ELECTIVE-2**
SEMESTER	**: II**	**HOURS:**	**90**
SUB.CODE	**: 22PPYE22 (A)**	**CREDIT:**	**4**

APPLIED ELECTRONICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To study the characteristics of Field Effect Transistor (FET), operation of Flip- Flops and their applications, architecture of operational amplifier, microprocessor & microcontroller, develop some programs for its operation and various signal conversion techniques

UNIT I Semiconductor Devices (18 hours)

Field effect transistor: The Ideal Voltage Controlled Current Source - The Junction Field Effect Transistor – The JFET Volt – Ampere Characteristics – JFET Transfer Characteristics – The MOSFET – The enhancement MOSFET Volt – Ampere Characteristics – The Depletion MOSFET – MOSFET Circuit Symbols – The DC Analysis of FETs – The MOSFET as a Resistance – Switch – Amplifier – CMOS Devices.

UNIT II Digital Electronics (18 hours)

Binary Systems – Boolean Algebra- Simplification of Boolean Functions – the Exclusive -OR, NAND, and NOR Gates – A1 bit memory – the Circuit Properties of a Bistable Latch – Flip-Flops – R-S Flip-Flop – the Clocked SR Flip- Flop – J-K Flip-Flop – the Master - Slave J-K Flip-Flop - D- Type Flip-Flop – Shift Registers – Ripple (Asynchronous) counters – Synchronous Counters – Applications of Counters. K-map (Four Variable)

UNIT III Operational-Amplifier (18 hours)

Op. Amp – Architectures – The Gain Stage with Active Load – the Differential Stage – DC level Shifting – Output Stages – Offset Voltages and Currents – Measurements of Op- Amp Parameters – Frequency Response and Compensation – Slew Rate – BIFET and BIMOS Circuits – Three Stage Op. Amp – MOS Op. Amp.

UNIT IV Signal and Data Conversion (18 hours)

Signals and Signal Processing - Sample – and Hold Systems – Analog Multiplexer - Analog Demultiplexer – Digital- to- Analog (D/A) Converters – A Ladder type D/A Converter – Multiplying D/A Converter - Analog- to- Digital (A/D) Converters –The Counting, Successive-Approximation, Parallel Comparator, and Dual-Slope A/D converters - Integrator and Differentiator Circuits – Electronic Analog Computation.

UNIT V Microprocessor and Microcontroller (18 hours)

8085 and its Architecture – Introduction to 8085 Instructions – Data Transfer Operations – Arithmetic Operations – Logic Operations – Branch Operations – Writing Assembly Language Program – Debugging a Program – Introduction to Intel 8051 microcontroller – pins of 8051 – Instruction set – Memory organizations of 8051 – Addressing Modes – Classification of Instructions – Data Transfer Instructions – Assembly Language Programs.

References

1. Millman. J & Grabel. A, 2017, Micro Electronics (2nd Ed.): Tata McGraw Hill International Editions.
   Unit: I Chapter – 4; Unit: II Chapter 6.1 – 6.3 and 8; Unit: III Chapter 14
   Unit: IV Chapter 16.1 – 16.7

2. B. Ram, 2013, Fundamentals of Microprocessors and Microcontrollers (8th Ed.), Dhanpat Rai Publications, New Delhi.
   Unit: V Chapter – 3.1.1-3.1.7, 4.3 - 4.6, 5.10, 10.1.1,10.1.2, 10.1.7, 10.1.13 – 10.1.15, 10.1.17
3. Malvino A.P. & Leech D., Goutam Saha, 2010, Digital Principles and Application (7th Ed.): Tata McGraw Hill, New Delhi
4. Ramesh Gaonkar, 2013, Microprocessor Architecture, Programming and applications with the 8085 (6th Ed.,): Penram International Publishing.
5. Morris Mano, 2016, Digital Logic and Computer Design (1st Ed.,): Pearson Education India.
6. J. Millman & C. Halkias, 2017, Integrated Electronics (2nd Ed.,): Tata McGraw Hill, New Delhi
7. Roy Choudhery D & Shail B Jain, 2018, Linear Integrated Circuits (4th Ed.,): New Age International Publishers.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

- **CO1:** Explain the characteristics of Field Effect Transistor (FET) and derive its parameters.
- **CO2:** Express the operation of Flip- Flops and their applications in digital logic circuits.
- **CO3:** Analyse the architecture of operational amplifier and its parameters.
- **CO4:** Identify and explain various signal conversion techniques.
- **CO5:** Describe the architecture of microprocessor and microcontroller, develop some programs for its operation.

Mapping of COs with PSOs & POs:

SEMESTER II	Subject Code: 20PPYE22								Title of Paper: Applied Electronics					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3		2	1	1			3	3	2	2	3	23
CO2	3	2		3	2	2			3	3	3	2	3	26
CO3	3	3		2	2	3			3	3	3	1	2	25
CO4	3	3		3	2	1			3	3	3	2	3	26
CO5	3	3		3	1	2			3	2	3	2	3	25
Grand total of COs with PSOs and POs														125
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{125}{50}\right)$														2.50

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.50
Observation	**COs of Applied Electronics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Elective-2**
Semester	**: II**	**Hours**	**: 90**
Code	**: 22PPYE22 (B)**	**Credits**	**: 4**

MICROPROCESSORS & MICROCONTROLLER

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To understand the concepts of microprocessors & Microcontrollers, programming and interfacing.
- To understand organizations of 8051, addressing modes, assembly language program examples using 8051 microcontrollers

UNIT 1: 8085 Microprocessor (18 hrs)

8085 and its architecture – ALU – registers – Data and Address bus- Pin Configuration - Opcode and Operands - Instruction Cycles – Fetch operation – Execute operation – Machine cycle and state – Instruction and Data flow – Timing Diagram – Timing Diagram for opcode fetch cycle – memory read/write – I/O read/write

UNIT 2 : Programming Techniques (18 hrs)

Introduction – Instruction and data formats –Ad dressing modes: Direct Addressing – register addressing – register indirect addressing – immediate addressing – implicit addressing – Introduction to 8085 instructions groups: Data transfer groups – arithmetic groups – logic groups – branch groups –stack, I/O and machine Control groups – subroutines.

UNIT 3 : Assembly Language Programs (18 hrs)

Introduction: Simple examples – addition/subtraction of two 8/16 bit numbers – decimal addition/subtraction of two 8 bit numbers – find one's/two's compliment of 8/16 bit numbers – to find the largest/smallest number in a data array – multiplication/divisions of two 8 bit numbers – 7 segment LED display – microprocessor based traffic control program.

UNIT 4 : 8051 Micro Controller (18 hrs)

Introduction – 8051 microcontroller – architecture – registers – Pins of Intel 8051 – I/O lines – 8051 Interrupts – Timer/counter 0 and Timer/Counter 1 – Boolean Processor - Instruction set –Serial Port.

UNIT 5: 8051 Micro Controller Programming Techniques & Programs (18 hrs)

Memory organizations of 8051 – Addressing modes – classifications of Instructions – Descriptions of 8051 Instructions – Data transfer, Arithmetic, logic and branching instructions - assembly language program examples: Addition/subtraction of two 8 bit numbers, to find largest/smallest numbers from a set of numbers, multiplication/division of two 8 bit numbers.

References:

1. Fundamentals of Microprocessors and Micro Computers – Ram, B., 2016, Dhanpat Rai Publications. (8^{th} Edition)
   Unit – I: Sec.3.0 – 3.3.,
   Unit – II : Sec.4.1 – 4.6,
   Unit – III : Sec.6.1 – 6.12, 6.29-6.30, 9.3, 9.8,
   Unit – IV : Sec.10.1 – 10.1.9,
   Unit – V: Sec.10.1.13 – 10.1.17

2. Microprocessor Architecture, Programming and application with 8085 – Ramesh Gaonkar, 2013, Penram International Publishing (6th edition).
3. Introduction to Microprocessor – Aditya P. Mathur,2018, Tata McCraw Hill (3rd Edition).
4. Microcontroller Theory & Applications - Ajay V.Deshmukh, 2017, McGraw Hill Edu.
5. Microprocessors and Interfacing, Programming and Hardware -Douglas V Hall, SSSP Rao,2017, McGraw Hill Education (3rd edition).

Teaching Learning Methods:

- Lecture Method, ICT, Demonstration, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO 1: learn about 8085 microprocessor architecture and its basic principles.
CO 2: Classify the data transfer, arithmetic and logical operations.
CO 3: Write the assembly language program using different operations/instructions.
CO 4: Understand the 8051-microcontroller hardware and its functions.
CO 5: understand organizations of 8051, addressing modes, assembly language program examples using 8051 microcontrollers.

Mapping of COs with PSOs & POs:

SEMESTER III	**Subject Code: 22PPYE33**								**Title of Paper: Microprocessors & Microcontroller**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		2	2	1			3	3	2	2	2	23
CO2	3	2		2	2	2			3	2	3	2	2	23
CO3	3	2		3	1	3			3	2	3	1	2	23
CO4	3	2		2	1	1			3	2	3	2	1	20
CO5	3	2		1	3	1			2	3	3	2	2	22
Grand total of COs with PSOs and POs														111
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{111}{50}\right)$														2.22

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.22
Observation	**COs of Microprocessors Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: NON MAJOR ELECTIVE-1**
Semester	**: II**	**Hours**	**: 60**
Sub.Code	**: 22PPYN12**	**Credit**	**: 4**

ENERGY PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To get an idea about the necessary non-conventional energy sources to manage the energy crisis.

UNIT 1 An Introduction to Energy Sources (12 hours)

An Introduction – Energy consumption as a measure of prosperity – conventional sources (coal, oil and gas) and energy production – availability and problems associated.

UNIT 2 Radiation Measurements (12 hours)

Solar constant – solar radiation at the earth's surface- solar radiation measurement [Pyrheliometer (Angstrom, Abbot silver disk, Eppley) – Pyranometer].

UNIT 3 Solar Energy Collectors (12 hours)

Introduction – physical principle of the conversion of solar radiation into heat – flat plate collectors (water and air heaters only) - concentrating collectors [Focusing type (parabolic trough reflector, mirror – strip reflector)

UNIT 4 Some Other Applications of Solar Energy (12 hours)

Solar water heating (pressurized natural circulation) - Introduction to solar photo-voltaic – Solar distillation – Solar cooking (design principle and constructional detail of a box type solar cooker).

UNIT 5 Other Forms of Energy (12 hours)

Wind energy (formation, character and production) – Basics principles of - biomass and biogas - hydro power production – thermo electric power generation – nuclear power generation.

References

1. 1. Rai, G.D., 2011, Non-conventional sources of Energy-4th Ed., Khanna Publishers, New Delhi. (Unit I: Chap 1, Unit II : Chap 2, Unit III : Chap 3,4 & 5, Unit IV : Chap 4 & 5).
2. Suddhasatwa Basu, 2007, Recent Trends in Fuel Cell Science and Technology, Springer publishers, New Delhi. (Unit IV related topics in this book).
3. M Rao, H.V.N. Rao, 1989, Air Pollution, 1st ed., Tata McGraw Hill Pub. Co. New Delhi. (Unit V (related topics in this book)
4. H P Garg; J Prakash, 2017, Solar Energy: Fundamentals and Applications, 1st ed., Tata McGraw Hill, Pub. Co. New Delhi.
5. B. H. Khan, 2017, Non-Conventional Energy Resources, 3rd ed., McGraw Hill Education India Private Limited.
6. Suresh K. Dhameja, 2010, Environmental Engineering and Management, SK Kataria & Sons Publishers, New Delhi.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Describe the energy consumption of the world in day today life.

CO2: Illustrate the methods of solar radiation measurements.

CO3: Explain the working of solar energy collectors.

CO4: Discuss the use of solar energy in real life applications.

CO5: Analyse the production of energy through other non-conventional energy sources

Mapping of COs with PSOs & POs:

SEMESTER II	**Subject Code: 22PPYN12**								**Title of Paper: Energy Physics**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3		3	3	2		1	3	3	3	3	3	29
CO2	3	3		2	3	2	1	1	3	3	2	3	3	29
CO3	3	3		3	3	2	1	1	3	3	3	2	3	30
CO4	3	3		2	3	2		1	3	3	2	3	3	28
CO5	3	2		3	2	2		1	3	3	3	2	3	27
Grand total of COs with PSOs and POs														143
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{143}{57}\right)$														2.51

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.51
Observation	**COs of Energy Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: CORE LAB - 1**
Semester	**: I & II**	**Hours**	**: 90**
Sub.Code	**: 22PPYP12**	**Credit**	**: 4**

PRACTICAL – I (General Physics)

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To perform experiments in order to calculate physical properties such as magnetic, electric, optical and also to find the physical constants such as Cauchy's, Hartmann's, Stephen's and elastic constants.

Any 14 of the following practical

1. Determination of Cauchy's constant using Spectrometer
2. Measuring conductivity of Germanium (Ge) Crystal by applying Four Probe Method
3. Calculate the velocity and compressibility of ultrasonic waves in liquids by employing Ultrasonic Interferometer
4. Determination of unknown wavelengths using comparator
5. Determination of Planck's constant (h) by using photo cell/LED's
6. Measurement of magnetic susceptibility (χ**)** by using Quincke's method
7. Determination of elastic constants in hyperbolic fringes
8. Determination of bandwidth and wavelength of light using bi-prism – optic Bench
9. Determination Energy Gap of semiconducting material like Germanium(Ge)
10. Determination of thickness of thin mica sheet, resolution of D1, D2 lines of Sodium using Michelson Interferometer
11. Determination of Elastic constants by forming elliptic fringes
12. Study the Hall effect in semiconductors
13. Determine the wavelength of prominent lines in the band spectrum by applying Hartmann's formula
14. Determination of Stefan's constant
15. Determination of numerical aperture and bending loss using LASER
16. Détermination of wave length of prominent lines of Arc spectra of metals like Al, Cu and Fe using Constant deviation spectrograph.
17. Determine the specific charge of an electron (e/m) by Magnetron method
18. Determine the dielectric constant of a given liquid using wavemeter
19. Experiments using Solar photo-voltaic system

References:

1. C. C. Ouseph, U. J. Rao and V. Vijayendran, Practical Physics and Electronics, 2011, S.Viswanathan (Printers and Publishers) Pvt.Ltd.
2. Department of Physics, St.Joseph's College (Autonomous), Advanced Physics Experiments For M.Sc., Physics Programme, 2005

Teaching Learning Methods:

Lecture Method, ICT, Demonstration, Hands-on session

Course Outcomes

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

CO1: Find the magnetic properties of the liquid by Quincke's method.

CO2: Perform optical experiments to determine the wave length of source, Cauchy's constant, Hartmann's constant and elastic constant

CO3: Carryout the experiments to calculate physical properties of known materials.

CO4: Measure the electrical properties like energy gap, conductivity, carrier concentration

CO5: Determine the physical constants by performing advanced experiments.

Mapping of COs with PSOs & POs:

SEMESTER II	**Subject Code:22PPYP12**								**Title of Paper: PG Laboratory – I**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		3	2	2			3	3	3	1	2	25
CO2	3	3		2	2	1			3	2	3	1	2	22
CO3	3	3		3	2	2			3	3	3	2	3	27
CO4	3	3		3	2	2			3	3	3	3	3	28
CO5	3	3		2	2	2			3	3	3	2	3	26
Grand total of COs with PSOs and POs														128
Mean value of COs with PSOs and POs=$\frac{Grand\ total\ \ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{128}{50}\right)$														2.56

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.56
Observation	**COs of Practical – I (General Physics) Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core Lab - 2**
Semester	**: I & II**	**Hours**	**: 90**
Sub.Code	**: 22PPYP22**	**Credit**	**: 4**

PRACTICAL – II (ELECTRONICS)

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To facilitate the learners in designing and constructing electronic circuits and study their performance.

Course Outline:

Any 14 of the following practical

1. Study the FET Characteristics
2. Design an amplifier circuit using FET
3. Construct a two stage RC- coupled transistor amplifier without feed back and study its frequency response
4. Construct the basic circuit of differentiator, integrator, adder, subtractor using OP-AMP
5. Design and study an Astable Multivibrator using IC 555 Timer.
6. Construction of filter circuits using OP-AMP
7. Study the characteristics ofSCR and discuss its applications
8. Construct a Wien's bridge oscillator using OP-AMP
9. Design a Dual Power supply using IC's
10. Study the characteristics and basic parameters ofOP-AMP
11. Demonstrate the characteristics and applications ofUJT
12. Construct a two stage RC- coupled transistor amplifier with feedback and study its frequency response
13. Construct a regulated power supply using IC's
14. Design and construct a Schmidt trigger using IC 555
15. Design a D/A converter (4 – bit binary weighted register)
16. Construct a wave generatorusing OP-AMP
17. Solvesimultaneous equations anddifferential equationsusing OP-AMP
18. Design and circuit constructionof PCB

References:

1. C. C. Ouseph, U. J. Rao and V. Vijayendran, Practical Physics and Electronics, 2011, S.Viswanathan (Printers and Publishers) Pvt.Ltd.
2. Department of Physics, St.Joseph's College (Autonomous), Advanced Physics Experiments For M.Sc., Physics Programme, 2005

Teaching Learning Methods:

Lecture Method, ICT, Demonstration, Hands-on session

Course Outcomes:

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

CO1: Study the characteristics of FET, UJT and SCR and their applications

CO2: Design circuits using OP-AMP and determine their parameters.

CO3: Construct two stage amplifier using transistors and study the parameters.

CO4: Construct electronic circuits using ICs and study their performance

CO5: Design a PCB for an electronic circuit

Mapping of COs with PSOs & POs:

SEMESTER II	Subject Code: 22PPYP22								Title of Paper: Practical – II (Electronics)					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3		3	2	2			3	3	2	2	3	26
CO2	3	3		3	2	3			2	3	3	1	3	26
CO3	3	3		2	3	2			3	2	3	2	3	26
CO4	3	3		3	2	3			3	3	2	3	3	28
CO5	3	3		2	3	2			3	3	3	2	3	27
Grand total of COs with PSOs and POs														133
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{133}{50}\right)$														2.66

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.66
Observation	**COs of Practical – II (Electronics) Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core-6**
Semester	**: III**	**Hours**	**: 90**
Code	**: 22PPYC63**	**Credits**	**: 5**

QUANTUM MECHANICS – II

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To study the principle theories of quantum mechanical systems
- To understand scattering theory, relativistic & quantum field equations

UNIT 1 Variation Method & Perturbation Theory (18 hrs)

The Variational Principle-Rayleigh-Ritz Method-variation method of excited states-the Hellmann-Feynman Theorem-Ground state of Helium-Ground state of Deuteron-Time-dependent perturbation theory – I order perturbation – Harmonic perturbation – Transition to continum states- Fermi's Golden Rule-Absorption and Emission of Radiation-Electromagnetic Field-Electric dipole Approximation –Transion probability-Einstein's A and B coefficients-Forbidden transitions.

UNIT 2 Many Electron atoms (18 hrs)

Indistinguishable particles – Pauli principle – inclusion of Spin- Spin functions for two and three electrons – Helium atom – Thomas-Fermi model of the atom – Hartree Equation – Hartree-Fock Equation.

UNIT 3 Scattering (18 hours)

Scattering cross section- scattering amplitude – partial waves –partial waves analysis – significant number of partial waves – scattering by an attractive square –well potential – Breit-Wigner formula – scattering length – expression for phase shifts – Integral equation – The Born approximation – scattering by screened coulomb potential – validity of Born approximation.

UNIT 4 Relativistic Wave Equations (18 hrs)

Klein Gordon equation–Interpretation– Particle in a Coulomb field – Dirac's equation for free particle- Dirac's Matrixes- Probability Density-Plane Wave equation – Negative energy state- Spin of the Dirac particle- Magnetic moment of the electron- Spin orbit interaction - Radial Equation for an electron in a central potential -Hydrogen atom- Lamb shift

UNIT 5 Quantum Field Equation (18 hrs)

Classical Field equation- Lagrangian Form- Hamiltonian Form- Quantisation of the Field – Schrödinger equation – Classical theory of Electromagnetic field -Quantisation of Electromagnetic field.

References:

1. G. Aruldhas, Quantum Mechanics 2nd ed., Prentice Hall India Learning Pvt. Ltd (2008).
   Unit I - Chapter : 10.1 – 10.6 & 12.1 – 12.7
   Unit II - Chapter : 13.1 – 13.6, 13.8 – 13.10
   Unit III - Chapter : 14.1 – 14.13
   Unit IV - Chapter : 15.1 – 15.5, 15.7 – 15.15
   Unit V - Chapter : 16.1 – 16.5, 16.9 & 16.10
2. Leonard I. Schiff, Jayendra Bandhyopadhyay, Quantum Mechanics, 3rd ed., McGraw Hill Education (2017).
3. Satya Prakash & Swati Saluja, Quantum Mechanics, Kedar Nath Ram Nath (2012).

4. P M Mathews, K Venkatesan, A Textbook of Quantum Mechanics, 2nd ed., McGraw Hill Education (2017).
5. Eugen Merzbacher, Quantum Mechanics, 3rd ed., John Wiley & Sons (1998).
6. J. J. Sakurai, Jim Napolitano, Modern Quantum Mechanics, 3rd ed., Cambridge University Press (2020).
7. Richard, L. Liboff, Introductory Quantum Mechanics, 4th ed., Pearson education (2002).
8. S. Devanarayanan, Quantum Mechanics: Principles & Applications, 2nd ed., Createspace Independent Publication (2016).
9. Chatwal and Anand, Quantum Mechanics, Himalaya Publishing House (2012).

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

On completion of the course, students should be able to

CO1: Apply the variational principle and various Perturbation theories to quantum mechanical systems

CO2: Understand the structure, properties of molecules, and effects of symmetry and asymmetry wave functions.

CO3: Develop the required solutions for various scattering phenomena.

CO4: Apply Klein Gordon and Dirac equations to study the relativistic particles.

CO5: Compare the classical and quantum field equations

Mapping of COs with PSOs & POS:

SEMESTER III	**Subject Code: 22PPYC63**								**Title of Paper: Quantum Mechanics – II**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		2	2	2			3	3	2	2	3	25
CO2	3	3		3	2	3			3	3	3	2	2	27
CO3	2	3		2	1	3			3	2	3	3	3	25
CO4	3	2		3	2	2			3	3	3	2	3	26
CO5	3	3		2	3	2			2	3	3	2	3	26
Grand total of COs with PSOs and POs														129
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{129}{50}\right)$														2.58

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.58
Observation	**COs of Quantum Mechanics – II Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core-7**
Semester	**: III**	**Hours**	**: 90**
Code	**: 22PPYC73**	**Credits:**	**5**

SOLID STATE PHYSICS – I

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To understand the concepts of crystals defects and dislocations.
- To acquire knowledge of electronic conduction in solids

UNIT 1 Crystal Physics (18 hrs)

Periodic arrangement of atoms – concepts of a lattice – lattice translation vectors – primitive lattice cell – two-and three dimensional lattice types – Miller indices of crystal planes – Simple crystal structures like sodium chloride type – cesium chloride type – hexagonal and face centered close packed structures – diamond structure and cubic zinc sulphide structure. Diffraction of waves by crystals :Bragg's law – Reciprocal lattice vectors – Laue equations – Brillouin zones – Reciprocal lattices to sc, bcc and fcc lattices – Fourier analysis of the basis and structure factors of bcc and fcc lattices.

UNIT 2 Defects and Dislocations (18 hrs)

Lattice vacancies – Diffusion – Metals – Colorcenters – F centers – Other centers in alkali halides – Frenkel defects – Schottky defects. Shear strength of single crystals – Slip – Dislocation – Burgers vectors – Stress fields of dislocations – Strength of alloys – Dislocations and crystal growth – Whiskers.

UNIT 3 Phonons (18 hrs)

Vibrations of linear monoatomic and diatomic chains – quantization of elastic waves – phonon momentum – Plank distribution for a system of identical harmonic oscillators – Periodic boundary condition and density of states in one and two dimensions – Einstein and Debye's theories of specific heat – Anharmonicity of lattice vibrations – thermal expansion – Thermal conductivity and umklapp processes.

UNIT 4 Free Electron in Crystals and Band Theory (18 hrs)

Energy levels in one dimensions – Fermi-Dirac distribution for a free electron gas – periodic boundary condition and free electron gas in three dimensions – Heat capacity of the electron gas – Ohm's law – Matthiessen's rule and Umklapp process – Hall effect – Wiedemann – Franz law – Nearly free electron model and the origin and magnitude of the energy gap – Bloch functions – Motion of an electron in a periodic potential – Kronig-Penny model – Bloch theorem – Approximate solution near a zone boundary

UNIT 5 Electronic Conduction in Solids (18 hrs)

Semiconductor crystals, fermi surfaces and metals Band gap in semiconductors – Equations of motion – holes and effective mass – Intrinsic mobility – Donor and acceptor states and thermal ionization of donors and acceptor – Reduced and periodic zone schemes – Construction of Fermi surfaces – Electron orbits – Tight-Binding method for energy bands – Wigner-Seitz method and cohesive energy – Quantization of orbits in a magnetic field – De Hass-Van Alphen effect.

References:

1. Charles Kittel, 2017, Introduction to Solid State Physics, VIII Edition
   [Unit I – Ch.1 and 2 (relevant titles)
   Unit II – Ch.20 and 21 (relevant titles)

Unit III – Ch.4 and 5 (relevant titles)
Unit IV – Ch.6 and 7 (relevant titles)
Unit V – Ch.8 and 9 (relevant titles)]

2. S.O.Pillai, 2005, Solid State Physics, New Age International.
3. M.Ali Omar, 2001, Elementary Solid State Physics, Addison Wesley Pub.
4. Ashcroft and Mermin, 1996, Solid State Physics –Harcourt College Publ.
5. J.P.Srivastava, 2001, Elements of Solid State Physics –Prentice Hall of India.
6. P.K.Palanisamy, 2003, SolidState Physics –SCITECH.
7. B.S.Saxena, R.C.Gupta& P.N Saxena, 2000,Fundamentals of Solid State Physics, Pragati Prakashan Publications.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Describe the concepts of crystals and lattices.
CO2: Discuss the theory of defects and dislocations.
CO3: Acquire knowledge of phonons and their thermal properties
CO4: Explain the concepts of free electron in crystals and band theory
CO5: Analyse the electronic conduction in solids by various methods.

Mapping of COs with PSOs & POs:

SEMESTER III	**Subject Code: 22PPYC73**								**Title of Paper: SOLID STATE PHYSICS – I**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2		2	1	2			3	3	3	2	3	23
CO2	3	1		2	2	2			3	2	3	3	2	23
CO3	2	2		2	2	3			3	2	3	2	3	24
CO4	3	2		2	2	3			3	2	3	3	3	26
CO5	3	2		2	2	3			3	2	3	3	3	26
Grand total of COs with PSOs and POs														122
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{122}{50}\right)$														2.44

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.44
Observation	**COs of Solid State Physics – I Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core-8**
Semester	**: III**	**Hours**	**: 90**
Code	**: 22PPYC83**	**Credits:**	**5**

MOLECULAR SPECTROSCOPY

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand the concept of rotational, vibrational and electronic spectra of the molecules.
- To acquire the knowledge of the Raman effect, NMR, ESR spectroscopies and its applications.

UNIT –I Microwave Spectroscopy (18 hrs)

Classification of molecules – Interaction of Radiation with rotating molecule – Rotational Spectra of rigid diatomic molecule – Isotopic effect in rotational spectra – Intensity of rotational lines – Non-rigid rotator – vibrational excitation effect – linear polyatomic molecule – symmetric top molecule – Asymmectric top molecules – Microwave spectrometer – Information derived from rotational spectra.

UNIT – II Infrared Spectroscopy (18 hrs)

Vibrational energy of a diatomicmolecule – Infrared Spectra – preliminaries – Infrared selection rule – vibrating diatomic molecule – diatomic vibrating rotator – Asymmetry of rotation – Vibration band – vibrations of polyatomic molecules – more about anharmonicity – fermi resonance –IR spectrophotometer – Instrumentation – Sample handling techniques – Fourier transform infrared spectroscopy – Applications: Identification of molecular constituents - characterisation of the transistion phase of ceramics

UNIT – III Raman Spectroscopy (18 hrs)

Introduction – Theory of Raman scattering – Rotation Raman spectra – Vibrational Raman spectra – Mutual Exclusion principle – Raman spectrometer – Sample handling techniques – Polarization of Raman scattered light –Structure determination using IR and Raman spectroscopy.

Nonlinear Raman phenomena – Preliminaries – Hyper Raman Effect – Simulated Raman scattering – Inverse Raman effect.

UNIT – IV Electronic Spectroscopy (18 hrs)

Introduction – Vibrational coarsestructure – Vibrational analysis of band systems – Deslandres Table – Progressions and sequences – Information derived from vibrational analysis – Franck-Condon principle – Intensity of vibrational electronic spectra – Rotational fine structure of electronic-vibration spectra – The FortratParabolae – Dissociation – Predissociation.

UNIT – V Resonance Spectroscopy (18 hrs)

Nuclear Magnetic resonance – NMR instrumentation – Relaxation process – Bloch equation – Dipolar interaction – Chemical shift – Indirect spin-spin interaction – NMR imaging – Electron spin resonance – Principle – ESR spectrometer –Mossbauer Spectroscopy – Recoilless emission and absorption – Experimental techniques – Isomer shift.

References:

1. Aruldhas, G., 2004, Molecular Structure and Spectroscopy, Prentice Hall of India, Edition - II.
   Unit I – Ch.6 – excluding 6.11 and 6.12;
   Unit II – Ch.7 –7.1-7.9, 7.16-7.19 (7.19.1,7.19.3);
   Unit III – Ch.8 – 8.1-8.8, 8.10, Ch.15 (15.1-15.4) ;
   Unit IV – Ch.9 – 9.1-9.10 ;
   Unit V – Ch.10 – 10.1-10.8, 10.19, Ch.11(11.1-11.3), Ch.13 (13.1-13.3).
2. Banwell and McCash, 2007, Fundamentals of Molecular Spectroscopy –Tata McGraw Hill
3. Jack D.Graybel, 1993, Molecular Spectroscopy –McGraw Hill.
4. G.M.Barrow, 2021, Introduction to Molecular Spectroscopy –Hassell Street Press.
5. Staughan and Walker, 1976, Spectroscopy –Chapman and Hall Publ.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

On completion of the course, students should be able to

CO1: Illustrate the concept of the rotational spectra of molecules.

CO2: Get an insight into the vibrational spectroscopy.

CO3: Appreciate Raman effect and its applications.

CO4: Analyse the intensity of vibrational electronic spectra.

CO5: Explain the NMR and ESR spectroscopy.

Mapping of COs with PSOs & POs:

SEMESTER III	**Subject Code: 22PPYC83**								**Title of Paper: MOLECULAR SPECTROSCOPY**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2		3	2	3			3	3	3	3	2	27
CO2	3	3		3	3	3			3	3	2	3	3	29
CO3	3	2		3	2	3			3	3	3	2	3	27
CO4	3	3		3	3	1			3	3	2	3	3	27
CO5	3	3		2	3	3			3	3	2	3	3	28
Grand total of COs with PSOs and POs														138
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{138}{50}\right)$														2.76

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.76
Observation	**COs of Molecular Spectroscopy Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Elective-3**
Semester	**: III**	**Hours**	**: 90**
Code	**: 22PPYE33 (A)**	**Credits**	**: 4**

THERMODYNAMICS AND STATISTICAL PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To conceptualize the state of system at equilibrium and comprehend the statistical thermodynamic parameters.
- To understand the statistical distribution function and apply for various systems.

UNIT: I Thermodynamic (18 hrs)

The laws of thermodynamics– Combined first and second law of thermodynamics (T & V independent, T & P independent, P & V independent and Tds equations) – Properties of Van-der Walls Gas - The Helmholtz function and the Gibbs function – Thermodynamic potentials – Maxwell's relations – Stable and unstable equilibrium – Phase transition – The Clausius-Clapeyron equation – The third law of thermodynamics (Nernst Heat theorem).

UNIT: II Applications of Thermodynamics (18 hrs)

Chemical potential – Phase equilibrium and phase rule – The Gibbs-Duhem Equation – Dependence of vapour pressure on total pressure – Surface tension – Vapour pressure of a liquid drop – The reversible voltaic cell – Thermodynamics of Blackbody radiation – Thermodynamics of magnetism.

UNIT: III Statistical Thermodynamics (18 hrs)

The Statistical basis of thermodynamics –Energy states and energy levels – Microstates and macrostates – Thermodynamic probability – Ensemble: Ensemble – Canonical ensemble – Ideal gas in the canonical ensemble – Entropy and other thermodynamic functions – The Grand Canonical ensemble – The Micro canonical ensemble-Analytical nature

UNIT: IV Statistical Distribution Functions (18 hrs)

Statistics: Bose-Einstein statistics - Fermi-Dirac statistics - Maxwell-Boltzmann statistics – The statistical interpretation of entropy.

Distribution function: Bose - Einstein distribution function - Fermi-Dirac distribution function - Comparison of distribution functions for indistinguishable particles - Maxwell-Boltzmann distribution function - The partition function of a system – Thermodynamic properties of a system.

UNIT: V Applications of Statistical Physics (18 hrs)

Applications – The monatomic ideal gas – The Sackur Tetrode equation for the monoatomic ideal gas – The distribution of molecular velocities – The Principle of equipartition of energy –The quantized linear oscillator – The Einstein theory of the Specific heat capacity of a solid – The Debye theory of the specific heat capacity of solid – Black body radiation.

REFERENCE BOOKS:

1. Thermodynamics, Kinetic theory and Statistical Thermodynamics - F W Sears and G L Salinger, 3rd edition, Narosa Publishing House, 2013.
   - UNIT: I : Chapter 6 : 6.1 – 6.5 & 6.8&Chapter 7 : 7.1 – 7.7
   - UNIT: II : Chapter 8 : 8.1 – 8.9
   - UNIT: III : Chapter 11: 11.1 – 11.4 and Ensembles* - Reference book (2)
   - UNIT: IV : Chapter 11: 11.9 – 11.15

UNIT: V : Chapter 12: 12.1 - 12.2, 12.5, and 12.6& Chapter 13:13.1 - 13.3

2. Heat Thermodynamics and Statistical Physics – S L Kakani, 2nd Edition, Sultan Chand Publishers, 2009
   Unit IV : Chapter 13 : 13.6
3. Statistical Thermodynamics - M C Gupta, 3rd edition, New Age International Private Limited, 2021.
4. Thermodynamics and Statistical Physics - Satya Prakash, S S Singhal, J P Agarwal, Pragati Prakashan, 2020.
5. Introduction to statistical mechanics – S K Sinha, Narosa Publications, 2009.
6. Statistical Physics - F Reif, Tata McGraw Hill Education India, 2008.
7. Statistical Physics Thermodynamics and Kinetic Theory – V S Bhatia, Vishal Publishing Company, 2006.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes:

CO1: To understand the laws and concepts of thermodynamics
CO2: To analyse the thermodynamic behaviour in various systems.
CO3: To describe the thermodynamics probabilities of micro state and macro state
CO4: To understand the various statistical distribution function
CO5: To apply the concepts of statistical distribution function to various system

Mapping of COs with POs and PSOs

SEMESTER III	**Subject Code: 22PPYE33**								**Title of Paper: NANOPHYSICS**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		3	2	2			3	3	3	3	3	28
CO2	3	2		2	3	2			3	3	2	3	3	26
CO3	3	3		3	2	2			3	3	3	3	3	28
CO4	3	2		2	2	2			3	3	2	3	2	24
CO5	3	3		3	3	2			3	3	3	3	3	29
Grand total of COs with PSOs and POs														135
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{135}{50}\right)$														2.70

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.70
Observation	**COs of Nanophysics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core Elective-3**
Semester	**: III**	**Total hours**	**: 90**
Code	**: 22PPYE33 (B)**	**Credit**	**: 4**

NANOPHYSICS (ELECTIVE)

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To enrich the students with the foundational knowledge of size dependant properties of Nanostructures and their various applications.

Course Outline:

UNIT 1: Introduction to Physics of the Solid State and Methods of Measuring Properties (18 hrs)

Size dependence of properties – Crystal structures – FCC nanoparticles – Tetrahedrally Bonded semiconductor structures – Lattice vibrations –Crystallography – Particle size determination – Surface structure – Transmission Electron Microscopy – Field Ion Microscopy – Scanning Microscopy – IR and Raman spectroscopy Photoemission and X-ray spectroscopy – Magnetic resonance.

UNIT 2: Properties of Individual Nanoparticles (18 hrs)

Metal nanoclusters: Magic numbers – Theoretical modelling of nanoparticles – geometric structure – Electronic Structure – Reactivity – Fluctuations – Magnetic clusters – Semiconducting nanoparticles: optical properties – Photofragmentation – Coulombic explosion – Rare gas and molecular clusters: Inert gas clusters – superfluid clusters – molecular clusters – Methods of synthesis: RF Plasma – Chemical methods – Thermolysis – Pulsed Laser Methods

UNIT 3: Carbon Nanoclusters (18 hrs)

Carbon molecules: nature of the carbon bond – New carbon structures – Carbon clusters: Small carbon clusters – Structure of C_{60} and its crystal – Alkali Doped C_{60} – Superconductivity in C_{60} – Carbon nanotubes: Fabrication – Structure – Electrical properties – Vibrational properties – Mechanical properties – Applications of carbon nanotubes: Field emission and shielding – computers – fuel cells – mechanical reinforcement.

UNIT 4: Quantum Wells, Wires and Dots: (18 hrs)

Preparation of quantum nanostructures – Size and dimensionality effects: (Size effects – conduction electrons and dimensionality) – Fermi gas and density of states – potential wells – partial confinement – properties dependent on density of states – Excitons – Single-electron tunnelling – Applications: IR detectors – quantum dot lasers.

UNIT 5: Nanomachines and Nanodevices: (18 hrs)

Microelectromechanical systems (MEMSs) – Nanoelectromechanical Systems (NEMSs): Fabrication – Nanodevices and nanomachines – Molecular and supramolecular switches (Any three switches).

References:

1 Charles P.Poole, Jr., Frank J.Owens, 2019, Introduction to Nanotechnology, Wiley Print India Press, Sahibabad.

Unit I : Sections 2.1.1 - 2.1.5, 3.2.2 - 3.4.3

Unit II: Sections 4.2 – 4.2.7, 4.3 – 4.5.4

Unit III: Sections 5.2 – 5.3.1, 5.3.3 - 5.3.5, 5.4 - 5.5

Unit IV: Sections 9.2 - 9.6

Unit V: Sections 13.1 - 13.3]

2. John H.Davis, 2007, The Physics of low dimensional semiconductors – An Introduction, Cambridge University Press.
3. Woggon, U., Optical properties of semiconductor quantum dots, Springer-Verlag.
4. Cuozhong Cao, University of Washington, USA, Nanostructures &Nanomaterials, 2004, Imperial College Press.
5. T.Pradeep, 2018, Nano: The Essentials, McGraw Hill Education (India) Private Limited, Chennai.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussions and Group Activities.

Course Outcomes:

CO1: Gain the foundational knowledge of size dependant properties of Nanostructures and various microscopic and spectroscopic techniques.
Construct a model for Cuboctahedron

CO2: Elucidate and compare the properties of nanoclusters and enumerate various methods of synthesis of nanoparticles.

CO3: Describe Carbon nanoclusters and various properties of carbon nanotubes.

CO4: Associate the low-dimensionality effects with the change in properties.

CO5: Compare MEMSs and NEMSs and analyse the working of molecular switches.

Mapping of COs with POs and PSOs

SEMESTER I	**Subject Code: 22PPYE11B**								**Title of Paper: NANOPHYSICS**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		3	2	2			3	3	3	3	3	28
CO2	3	2		2	3	2			3	3	2	3	3	26
CO3	3	3		3	2	2			3	3	3	3	3	28
CO4	3	2		2	2	2			3	3	2	3	2	24
CO5	3	3		3	3	2			3	3	3	3	3	29
Grand total of COs with PSOs and POs														135
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{135}{50}\right)$														2.70

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.70
Observation	**COs of Nanophysics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Lab - 3**
Semester	**: III & IV**	**Hours**	**: 90**
Subject Code	**: 22PPYP34**	**Credits**	**: 4**

PRACTICAL – III

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To construct and apply the physics principles of digital electronics, microprocessor, microcontroller and Arduino in the following experiments and their applications

Any 12 of the following list of experiments:

1. R-S,J-K and D-flip flops
2. Shift registers
3. Different mod counters (Scalar using IC 7490)
4. Asynchronous counters
5. Encoder / Decoder
6. Multiplexer and Demultiplexer
7. Arithmetic and logic unit
8. Karnaugh Map
9. Microprocessor – I (1 bit and 2-bit numbers shift by left and right, largest and smallest, block data transfer)
10. Microprocessor – II (1's and 2's complement subtraction, sum of series binary and decimal)
11. Microprocessor – III (seven segment display and interfacing with seven segment display).
12. Microprocessor – IV (interfacing with traffic controller and stepper motor)
13. Microprocessor – V (interfacing with DAC)
14. Microcontroller – AD & DA Converter
15. Microcontroller – Seven Segment Display
16. Microcontroller – Matrix Keyboard
17. Microcontroller – LCD & RTC
18. Arduino using Stepper motor
19. Arduino using relay control

Teaching Learning Methods:

- Lecture Method, Demonstration, Hands-on session

Course Outcomes

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

CO 1: Construct the registers and counters using flip flops

CO 2: Construct a decimal to BCD encoder and decoder

CO 3: Analyse the Arithmetic and logic units.

CO 4: Study the various operations and interfacing using microprocessor

CO 5: Use the microcontroller programming for various applications.

Mapping of COs with PSOs & POs:

SEMESTER III & IV	Subject Code:22PPYP24								Title of Paper: PRACTICAL – III					Sum of COs with PSOs and POs
Course Outcomes (CO'S)	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2		2	3	2			2	3	3	2	3	25
CO2	3	3		3	3	2		1	3	2	3	3	3	29
CO3	3	3		3	2	3			3	2	3	3	3	28
CO4	3	2		3	2	2		1	2	3	2	3	3	26
CO5	3	3		2	2	2			3	2	3	3	3	26
Grand total of COs with PSOs and POs														134
Mean value of COs with PSOs and POs = $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{134}{52}\right)$														2.58

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.58
Observation	**COs of Practical – III Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core-9**
Semester	**: IV**	**Hours**	**: 90**
Code	**: 22PPYC94**	**Credits**	**: 5**

SOLID STATE PHYSICS – II

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To understand the physical significance of super conductivity and magnetism
- To study the concepts of dielectrics and the phenomenon of surface and interface physics.

UNIT I Plasmons, Polaritons and Polarons and Optical processes and Excitons (18 hrs)

Dielectric function of the electron gas – longitudinal plasma oscillation – plasmons – Electrostatic screening – Screened coulomb potential – Mott transition – Screening and phonons in metals – Polaritons and LST relation – Electron – Electron interaction – phonon interaction and polarons – Peierls instability – Kramers – Kronig dispersion relations – Frenkel and Mott – Wannier excitons – Exciton condensation – Raman effect in crystals.

UNIT II Super Conductivity (18 hrs)

Its occurrence and its destruction by magnetic fields – Miessner effect – Heat capacity – Energy gap – microwave and infrared properties and isotope effect – Stabilization energy of a superconductor – London theory of Meissner effect – coherence length – Basic ideas of BCS – flux quantization – Type II superconductors and vortex state – Single particle tunnelling DC and AC Josephson effects – Macroscopic quantum interference – High temperature super conducting (HTC) materials.

UNIT III Magnetism in Solids (18 hrs)

Langevin diamagnetism equation and quantum theory of dia-magnetism – Quantum theory of para magnetism – Hund's rules – Crystal field splitting and quenching of orbital angular momentum – Spectroscopic splitting factor – Van vleck temperature independent paramagnetism – Ferro magnetism : Curie point – Weiss molecular field theory – Saturation magnetization – Quantization of spin waves (magnons) and thermal excitation of magnons – Ferromagnetism and antiferromagnetism – Neel temperature – Ferromagnetic domain walls and origin of domains – Coercivity and hysteresis.

UNIT IV Dielectrics (18 hrs)

Maxwell equations- Polarization- Macroscopic electric field- Depolarization field-Local electric field at an atom- Lorentz field-Field of dipoles in cavity-Dielectric constant and polarizability- Electronic plolarizability- classical theory of electronic plolarizability- Structure phase transitions

UNIT V Surface and Interface Physics, Alloys, Ferroelectrics (18 hrs)

IQHE and FQHE – PN junction – Rectification – Solar cells – Photovoltaic detectors. Substitutional solid solutions – Hume Rothery rules – Elementary theory of order – Kondo effect. Ferro electric crystals – Classification – Displacive transition – Soft optical phonon – Landau theory of phase transition – first order and second order transition.

References:

1. Charles Kittel, 2017, Introduction to Solid State Physics, VIII Edition
   [Unit I – Ch.14 and 15 (relevant titles)
   Unit II – Ch.10 (relevant titles)

Unit III – Ch.11 and 12 (relevant titles)
Unit IV – Ch. 16 (relevant titles)
Unit V – Ch. 16, 17and 22 (relevant titles)]

2. S.O.Pillai, 2005, Solid State Physics, New Age International.
3. M.Ali Omar, 2001, Elementary Solid State Physics: Principles and Applications, Addison Wesley Pub.
4. Ashcroft and Mermin, 1996, Solid State Physics –Harcourt Asia Publ.
5. J.P.Srivastava, 2001, Elements of Solid State Physics –Prentice Hall of India.
6. P.K.Palanisamy, 2003, Solid State Physics –SCITECH.
   B.S.Saxena, R.C.Gupta& P.N Saxena, 2000, PragatiPrakashan - Fundamentals of Solid State Physics

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Interpret the physical importance of excitation and optical processes in solids.
CO2: Describe the concepts of super conductivity by different theories.
CO3: Analyse the different types of magnetism and its effects in solids .
CO4: Investigate the concepts of dielectrics and its related theories.
CO5: Illustrate the phenomenon of surface and interface physics.

Mapping of COs with PSOs & POs:

SEMESTER IV	**Subject Code: 22PPYC94**								**Title of Paper: SOLID STATE PHYSICS – II**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2		2	1	2			3	3	3	2	3	24
CO2	3	1		3	2	2			3	2	3	3	2	24
CO3	2	2		2	2	3			3	2	3	3	3	25
CO4	3	2		2	2	3			3	2	3	3	3	26
CO5	3	2		2	2	3			3	2	3	3	3	26
Grand total of COs with PSOs and POs														125
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{125}{50}\right)$														2.50

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.50
Observation	**COs of Solid State Physics – II Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core-10**
Semester	**: IV**	**Hours**	**: 90**
Code	**: 22PPYD04**	**Credits**	**: 5**

NUCLEAR AND PARTICLE PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand the basics of nuclear properties, and to compare different forces, models, reactions, radio activity and sub-nuclear particles.

UNIT I Nuclear Properties and Nuclear Forces (18 hrs)

Charge – mass – radius – angular momentum (spin) – Magnetic dipole moment – Electric quadrapole moment – Parity – Isobaric spin (isospin) – The nuclear level – Nuclear forces : Introduction – Deuteron (properties of Nuclear force, no excited S-states, range and depth of potential – Excited states of the Deuteron) – Neutron – Proton scattering at low energies (Scattering length, Phase shift, Spin-dependence) – Proton – Proton scattering at low energies – Similarity between nn and pp forces – Non-central forces (Experimental evidence for the non-central forces, General form of this force, its properties - Meson theory of nuclear forces.

UNIT II Radio Activity (18 hrs)

Laws of radioactivity – radioactive equilibrium – radioactive series – isotopes - α-decay - α-particle spectra – Gamow's theory of α-decay –β-decay - β-spectroscopy (no instrumentation) – neutrino –direct method – Fermi theory – Gamma radiation – measurement of γ-ray energies (wavelength measurement by crystal diffraction)– Internal conversion (idea only) - Internal pair creation – nuclear isomerism.

UNIT III Nuclear Models (18 hrs)

Introduction – Fermi gas model – Liquid drop model – Shell model (Magic numbers , Extreme single particle model, (Square well of infinite depth, Harmonic Oscillator Potential, Spin-Orbit Potential), Predictions of Shell Model- Basic Concepts of Collective Nuclear Model, Unified Model, Superconductivity model.

UNIT IV Nuclear Reactions, Fission And Fusion (18 hrs)

Kinds of Nuclear reactions – Conservation Laws – Nuclear reaction kinematics –– Nuclear cross section – Compound nucleus – Nuclear transmutations – By alpha particles - by protons – by neutrons – by deuterons -Direct reactions (Stripping reactions, Pickup reactions), Stripping reactions and the shell model. Nuclear Fission (Types of Fission, Distribution of fission products, Neutron Emission in Fission, Fissile and Fertile materials, Spontaneous fission, Deformation of liquid drop, Bohr and Wheeler's Theory – Quantum effects) - Nuclear Fusion and Thermo nuclear reactions – Controlled thermonuclear reactions (hydrogen bomb, Different methods for the production of fusion reactions)

UNIT V Sub-Nuclear Physics (18 hrs)

Inroduction – Classifiation of Elementary particles – Fundamental interactions – Conservation laws – Conservation of isospin, strangeness, hypercharge, conjugation, parity, combined inversion, time reversal, CPT – Elementary particle symmetry – SU(2) group – SU(3) group – Quark.

References:

1. Tayal, D.C., 2021, Nuclear Physics, 5th Ed., Himalaya Publishing House.
   Unit – I: Chapter 8,

Unit- II: Sections 2.1-2.3,2.11,2.12,5.5-5.6, 6.1-6.3, 6.5, 7.1-7.2, 7.4 -7.6,
Unit – III: Chapter 9
Unit - IV: Chapters 10, Sections 10.1-10.4, 10.7, 10.16, 10.24, 10.25, Chapter 13, Sections 13.1- 13.3
Unit V: Chapter 18, Sections 18.1- 18.4, 18.18, 18.19

2. Irving Kaplan, 2002, Nuclear Physics, Revised Ed., Addison Wesley, New York.
3. Roy and Nigam, 2014, Nuclear Physics. 2nd Ed., New Age Intl., New Delhi.
4. Fujia Yang and Joseph Hamilton, 2010, Modern atomic and Nuclear Physics, Revised Ed., McGraw Hill.
5. V. K. Mittal,2018, Introduction to Nuclear and Particle Physics, 4th Ed., PHI Learning.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Understand the basic structure, properties of nucleus and the concept of nuclear forces.

CO2: Acquire the knowledge of nuclear decays and radioactivity.

CO3: Discuss the different types of nuclear models.

CO4: Apply the knowledge of nuclear reactions for producing fission and fusion energy.

CO5: Explain the symmetry properties & Quark model of elementary particles.

Mapping of COs with PSOs & POs:

SEMESTER IV	**Subject Code: 22PPYD14**								**Title of Paper: Nuclear And Particle Physics**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2		2	3	2			3	2	3	2	3	25
CO2	2	3		3	3	3			3	3	2	2	3	27
CO3	3	3		3	2	3			3	2	3	3	3	28
CO4	2	3		3	3	2			3	3	3	3	2	27
CO5	3	2		3	3	2			3	3	2	3	3	27
Grand total of COs with PSOs and POs														134
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{134}{50}\right)$														2.68

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.68
Observation	**COs of Nuclear and Particle Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core Elective-4**
Semester	**: IV**	**Hours**	**: 90**
Code	**: 22PPYE44 (A)**	**Credits**	**: 4**

APPLIED OPTICS AND LASER PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives

- To study the applications of optics such as LASERs and fiber optics and the corresponding theory
- To describe the electro optic effects, non-linear optical effects and their applications in various crystals.

UNIT I Laser- I (18 hrs)

Einstein coefficients – Light amplification – threshold condition – Laser rate equations – variation of Laser power around threshold- Optimum output coupling – Line broadening mechanisms

UNIT II Laser-II (18 hrs)

Modes of a rectangular cavity and the open planar resonator- Quality factor – The ultimate line width of the Laser – Mode Selection – Q- Switching – Mode locking in Lasers – General spherical resonator – High order modes

UNIT III Laser Systems & Spatial frequency filtering (18 hrs)

Laser System- Ruby Laser - Neodymium based Lasers – He-Ne Laser – Argon ion Laser – CO_2 Laser – Dye Laser – Excimer Lasers

Spatial frequency filtering: Introduction - Fourier Transform and some of its important properties – F.T property of a thin lens – some elementary examples of the Fourier transforming property of a lens

UNIT IV Electro-Optic Effect (18 hrs)

Electro-optic effect in KDP crystals: longitudinal mode & transverse mode – electro-optic effect in lithium niobate and lithium tantalate crystals- general considerations on modulator design- The index ellipsoid in the presence of an external electric field.

UNIT V Optical Fiber& Non- Linear Optics (18 hrs)

Optical fiber – Numerical aperture (NA) – Pulse dispersion in step index fibers.

Non-linear optics: Introduction – Self Focusing phenomenon- Second Harmonic Generation- Calculation of nonlinear polarization - Effect of deviation from the phase matching angle- Coupled equation and their solution - Generation of sum and difference frequencies.

References:

1. Ajoy Ghatak & K. Thyagarajan, 2017 (Reprint), Optical Electronics, First Edition, Cambridge University Press.
   [UNIT-I: Chapters 8.1 -8.8 Pages 201- 243
   UNIT –II Chapters : 9.1-9.7.1, 9.9, Pages 245-280,287 – 293.
   UNIT- III Chapters: 10.1-10.8 & 6.1 – 6.4 Pages 294-308, 167-169
   UNIT-IV Chapters : 15.1-15.5.3, 15.6 – 15.6.2, Pages 461-484,492 – 498.
   UNIT-V: Chapters – 13.1-13.4, 20.1-20.3, Pages 364-368 & 564-569]
2. B.B.Laud, 2011, Lasers& Non – Linear Optics, New Age International Pvt. Ltd.

3. Senior John, M., 2014, Optical Fiber communication: Principles and Practice, 3rd ed., Pearson Education, New Delhi.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes

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

CO1: Enhance the knowledge of comprehensive principles of Laser and its mechanisms.

CO2: Evaluate the knowledge of Q-switching and mode locked lasing phenomenon.

CO3: Understand and explain the various laser systems and Fourier transform properties of lens systems.

CO4: Discuss the electro optic effects and their applications in various crystals.

CO5: Acquire the knowledge of optical Fiber and Interpret the concepts of non-linear optics.

Mapping of COs with PSOs & POs:

SEMESTER IV	**Subject Code: 22PPYE44**								**Title of Paper: Applied Optics and Laser Physics**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		3	2	2			3	3	2	2	3	26
CO2	3	3		3	2	3			2	3	3	1	3	26
CO3	3	3		2	3	2			3	2	3	2	3	26
CO4	3	3		3	2	3			3	3	2	3	3	28
CO5	3	3		2	3	2			3	3	3	2	3	27
Grand total of COs with PSOs and POs														133
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{133}{50}\right)$														2.66

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.66
Observation	**COs of Applied Optics and Laser Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class	**: M.Sc. Physics**	**Part**	**: Core – Elective - 4**
Semester	**: IV**	**Hours**	**: 90**
Code	**: 22PPYE44 (B)**	**Credits**	**: 4**

MEDICAL PHYSICS

(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To understand the interaction of radiation with matter and its effects.
- To study radiation therapy, radiological imaging and scanning techniques.

UNIT –I: Radiation, Radiation Dosimetry and Definitions (18 hrs)

Radiation – classification of radiation - definitions of Dosimetry Quantities (DQ) - Units and relationship between DQ – relative biological effectiveness – radiation weighting factor, equivalent dose and sievert - linear energy transfer - tissue weighting factor - charged particle equilibrium - biological effects of radiation.

UNIT – II: Interaction of gamma rays and X-rays with matter (18 hrs)

Introduction - Types of interaction with matter – Photo electric absorption – Compton scattering – Pair production - Over all interaction of photons with matter – Linear attenuation co-efficient – Half-value thickness – Mean free path

UNIT –III: Treatment planning in radiation therapy (18 hrs)

Photon beam treatment planning – Therapeutic response - Radiation Therapy Process - Patient Positioning and Immobilization – Pre-treatment Simulation – Conventional Simulator – Computed Tomography Simulator – Positron Emission Tomography - Electron beam treatment planning - Dosimetric Data for Clinical Electron Beams. – Depth dose profiles – Variation with beam energy – Variation with field size – off-axis dose profile – Electron beam energy specification – Isodose curves

UNIT –IV: Introduction to Radiological Images (18 hrs)

X-ray Generator – Attenuation – Major Types of Interactions – Half-value layer and tenth-value layer – Collimator – Anti-scatter grids – screens – Photo -stimulable phosphor (PSP) – image quality measures – signal-to-noise ratio (SNR)

UNIT –V: Magnetic Resonance Imaging (MRI) and Computerized Tomography (CT) (18 hrs)

MRI –contrasts in MRI –Physiological and functional MRI –MRI safety –future MRI applications. CT and MRI Radiotherapy: CT based treatment simulation and planning –MRI in Radiotherapy

REFERENCES:

1. Introduction to Medical Physics – Muhammad Maqbool –Springer International Publishing (2017).

Unit – I: Chapter - 1: Sections: 1.1
Chapter - 2: Sections: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.11, 2.14.
Unit – II: Chapter - 3: Sections: 3.1, 3.2.1, 3.2.2, 3.2.3, 3.3, 3.3.1, 3.3.2, 3.3.3.
Unit – III: Chapter - 4: Sections: 4.1, 4.1.2, 4.1.3, 4.1.5, 4.1.6, 4.1.6.1, 4.1.6.2, 4.1.6.4, 4.2, 4.2.2, 4.2.2.1, 4.2.2.2, 4.2.2.3, 4.2.2.4, 4.2.2.5, 4.2.2.6.
Unit – IV: Chapter - 6: Sections: 6.1, 6.2, 6.3, 6.3.1, 6.3.2, 6.4, 6.5, 6.6, 6.7, 6.8, 6.8.1.
Unit – V: Chapter - 9: Sections: 9.1, 9.3, 9.4, 9.5

Chapter - 10: Sections: 10.1, 10.2, 10.3.

2. R. S. Khandpur,1999, Handbook of Biomedical Instrumentation - Tata McGraw-Hill, New Delhi.
3. Glenn. F. Knoll, 2010, Radiation Detection and Measurements - John Wiley & Sons, Inc. New York.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, Quiz, Group Discussion

Course Outcomes:

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

CO1: Acquire the knowledge of quantities used to define radiation and its effects.
CO2: Analyse the characteristics of interaction of gamma rays and x-rays with matter.
CO3: Construe the protocols used in radiation therapy.
CO4: Interpret the radiological imaging techniques.
CO5: Describe the different scanning techniques like MRI and CT.

Mapping of COs with PSOs & POs:

Semester: IV	**Subject Code:**								**Title of Paper: MEDICAL PHYSICS**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3		1	2				3	3	3	2	3	22
CO2	2	3		1	2	3			3	3	3	2	3	25
CO3	2	3		1	0	3			3	3	3	2	3	23
CO4	3	3		1	2	3			3	3	3	2	3	26
CO5	3	3		1	2				3	3	3	2	3	23
Grand total of COs with PSOs and POs														119
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{119}{47}\right)$														2.53

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.53
Observation	**COs of Medical Physics Strongly related with PSOs and POs**		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class : M.Sc. Physics **Part : Core**
Semester : III & IV **Hours : 180**
Code : 22PPYD14 **Credits: 8**

PROJECT WORK
(For Students admitted from the Academic Year 2022-2023 onwards)

Course Objectives:

- To acquire the basic knowledge in the respective field of research.
- To identify a suitable theoretical or experimental model in the field of interest.
- To analyze and interpret the observations for getting suitable solution to the research problem.

Each candidate has to submit a dissertation on any topic in physics after collecting materials and working out the details during the IV semester. It may be a theoretical work or an experimental work or even a compilation of material of current interest from literature.
The dissertation is evaluated by internal and external examiners with viva on the project work

Course Outcomes

On completion of the course, students should be able to
CO1: Acquire the knowledge in the respective field of research.
CO2: Collect the related literature from the available online and offline sources.
CO3: Design a theoretical or experimental model in their field of interest.
CO4: Analyse the observations for getting suitable solution to the research problem.
CO5: Write a dissertation in the approved format in view of writing research articles.

Mapping of COs with PSOs & POs:

SEMESTER III&IV	**Subject Code:22PPYD14**								**Title of Paper: Project Work**					**Sum of COs with PSOs and POs**
Course Outcomes (CO'S)	**Programme Outcomes (PO'S)**								**Programme Specific Outcomes (PSO'S)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3		3	3	3			2	3	3	2	3	28
CO2	3	3		1	3	2			3	2	3	3	3	26
CO3	3	3		3	3	1			3	2	3	3	3	27
CO4	3	3		3	3	2			3	3	3	3	3	29
CO5	3	3		1	2	3			3	3	3	3	3	27
Grand total of COs with PSOs and POs														137
Mean value of COs with PSOs and POs= $\frac{Grand\ total\ of\ COs\ with\ PSOs\ and\ POs}{Number\ of\ COs\ relating\ with\ PSOs\ and\ POs} = \left(\frac{137}{50}\right)$														2.74

Strong – 3, Medium – 2, & Low – 1

Mapping Scale	1	2	3
Relation	0.01 to 1.0	1.01 to 2.0	2.01 to 3.0
Quality	Low	Medium	Strong
Mean value of COs with PSOs and POs			2.74
Observation	**COs of Project Work Strongly related with PSOs and POs**		

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS - M.Sc. (PHYSICS) SYLLABUS
(2022 – 23 ONWARDS)

QUESTIONS PAPER PATTERN (External exam)

Section A:		
Answer all the questions (MCQ) (Each unit carry 2 questions)		10 x 1=10
Section B:		
Either or Choice – Short answer question **(2/3 problems may be asked)** (One question from each unit)	(5)	5 x 6 =30
Section C:		
Either or Choice – Long answer question (One question from each unit)	(5)	5 x 12 =60
	Total =	**100**

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS - M.Sc. (PHYSICS)
SYLLABUS
(2023 – 23 ONWARDS)

MARK ALLOTMENT FOR PROJECT WORK

Internal	
Literature survey &Seminar presentations	20
Theory or Experiment	20
Preparation of dissertation	10
External	
Viva-voce	50
	_____
	Total = 100

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS - M.Sc. (PHYSICS) SYLLABUS
(2022 – 23 ONWARDS)

QUESTIONS PAPER PATTERN (Internal exam)

Section A:
Answer all the questions (MCQ) 8 x 1=8

Section B:
Either or Choice – Short answer question 2x 6 =12
(One problem may be asked)

Section C:
Either or Choice – Long answer question 2x 10=20

Total = 40

ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS - M.Sc. (PHYSICS) SYLLABUS
(2022 – 23 ONWARDS)

SCHEME OF EVALUATION (Internal Marks)

Continuous Internal Assessment

Marks	
Test-1	40
Test -2	40
Assignment / Seminar	20

Total = 100
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2. Semester Examination 100 Marks
3. Total Marks = 50% C.I.A + 50% Semester Examinations

A candidate must score a minimum of 25 marks out of 50 in the semester examination and an overall aggregate minimum of 50 marks out of 100 for a pass.