

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	CORE Mechanics & Properties of Matter	6	5
	22UPYP12	Physics Lab – I	3	--
	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	CORE Electricity & Electromagnetism	6	5
	22UPYP12	Physics Lab – I	3	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		
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		
IV	22UPYR24	Allied Physics Practical (For Chemistry)	2	2
	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	
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. Murugesan, 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{141}{52}\right)$													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
	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
Course Outcomes (CO'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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{119}{52}\right)$														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 Permeability – 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. Murugesan, 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{139}{51}\right)$														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
	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
Course Outcomes (CO'S)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{139}{52}\right)$													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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{139}{50}\right)$													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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{185}{51}\right)$														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
Semester : III
Subject Code : 22UPYC33

Part : III Core-3
Hours : 90
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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{145}{51}\right)$													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
	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
Course Outcomes (CO'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 $POs = \frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{119}{52}\right)$														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)
Semester : III
Subject Code : 22UPYN13

Part : IV NME-1
Hours : 45
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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{129}{50}\right)$													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		

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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} =$ $\left(\frac{133}{52}\right)$													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
Semester : IV
Subject Code : 22UPYC44

Part : III Core-4
Hours : 90
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 of energy - 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:

- 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:

- J.K.Sharma and K.K.Sarkar, 2018, Thermodynamics and Statistical Mechanics, 2ndEd., Himalaya Publishing House, New Delhi.
- R. Murugesan and Kiruthiga Sivaprasath, 2013, Thermal Physics - S.Chand& Co., New Delhi.
- Halliday, Resnick and Krane, 2002, Physics (Vol I), 5thed., John Wiley & sons.
- Mathur, D.S., Heat and Thermodynamics –5th Ed., S.Sulthan Chand & Sons, New Delhi 2004.
- 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
Semester : IV
Subject Code : 22UPYB44

Part : III Allied-4
Hours : 45
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, 12th edition (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
	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
Course Outcomes (CO'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 = $\frac{\text{GrandtotalofCOswithPSOsandPOs}}{\text{NumberofCOsrelatingwithPSOsandPOs}} = \left(\frac{139}{52}\right)$													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. Murugesan 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
Semester : III & IV
Subject Code : 22UPYP24

Part : III Lab-2
Hours : 90
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 to perform V-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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{126}{51}\right)$													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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{185}{51}\right)$													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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{125}{51}\right)$													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

B.Sc. Physics - CBCS (2019-2020 Onwards)

PART	SUB. CODE	PAPER	HRS	CR
V SEMESTER				
		CORE		
	19UPYC65	Modern Physics	5	5
	19UPYC75	Optics & Spectroscopy	5	5
	19UPYC85	Mathematical Physics	5	5
	19UPYC95	Digital Electronics	5	4
III	19UPYP36	Physics Lab – III	3	--
	19UPYP46	Physics Lab – IV	3	--
		CORE ELECTIVE		
	19UPYE15	Astrophysics / Information Technology	3	2
	19UINT15	Internship	-	1
IV	19USSI16	Soft Skill	1	--
Total			30	22
VI SEMESTER				
PART	SUB. CODE	PAPER	HRS	CR
		CORE		
	19UPYD06	Thermodynamics and Statistical Mechanics	5	5
	19UPYD16	Nuclear Physics	5	5
	19UPYD26	Solid state Physics	5	5
	19UPYD36	Nanophysics	5	4
III	19UPYP36	Physics Lab – III	3	3
	19UPYP46	Physics Lab – IV	3	3
		CORE ELECTIVE		
	19UPYE26	Basic Electric Principles & Applications/ Medical Physics	3	2
IV	19USSI16	Soft Skill	1	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	19UPYSL3	Space Physics	3
IV	19UPYSL4	Novel Materials	3
V	19UPYSL5	Thin film Science	3
VI	19UPYSL6	Optical Communication	3

**ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS**

PROGRAMME SPECIFIC OUTCOME (PSO)

- PSO1:** Apply the basic concepts of physics principles for the applications in scientific, industrial, communication, medical, energy and environmental fields.
- PSO2:** Acquire the problem solving skills and experimental skills keeping in mind the needs of the society and environment.
- PSO3:** The ability to formulate, conduct, analyze, interpret the theory and experiments in Physics effectively as an individual or a leader for a group.
- PSO4:** Develop the experimental tools with numerical techniques with an understanding of physics concepts.
- PSO5:** Demonstrate and communicate theoretical and experimental Physics ideas to the society.

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class : B.Sc. Physics
Semester : V
Subject Code : 19UPYC65

Part : III Core-6
Hours : 75
Credit : 5

MODERN PHYSICS
(For Students admitted from the Academic Year 2019-2020 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 -Compton Effect. De Broglie Waves Particle Diffraction – Davisson - Germer experiment – Uncertainty Principle – I and II

UNIT II Quantum Mechanics (15 hours)

Wave function-Normalization- Well-behaved Functions-Wave Equations- Partial Derivatives-Schrodinger time dependent Equations- Validity-Linearity and superposition-Expectation Values-Operators (Momentum and Energy)-Schrodinger's Equation: Steady state-Eigen values and Eigen functions.

UNIT III Atomic models (15 hours)

Rutherford Alpha Particle Scattering Theory – Bohr Model (No Theory) – Origin of Hydrogen Spectra – Somerfield's Model with Theory – Fine Structure of H-Alpha Line – Vector Atom Model – Quantum Numbers – L-S and j-j Coupling – Pauli Exclusion Principle– Periodic Classification – Electronic Configuration of Elements.

UNIT IV Magnetic Dipole Moment & Spectra (15 hours)

Magnetic Dipole Moment of An Electron due to Orbital and Spin Motion – Bohr Magnetron – Stern and Gerlach Experiment – Spin Orbit Coupling. Spectral Terms and Notation – Selection Rule – Intensity Rule – Interval Rule – Fine Structure of Sodium D Line – Hyperfine Structure

UNIT V Magnetic and Electric field effects (15 hours)

Zeeman Effect – Experimental Arrangement – 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 (Basic Principles Only).

TEXT BOOKS:

1. Arthur Beiser, Shobhit Mahajan, S.Rai Choudhury, 2017, Concepts of Modern Physics, 7th edition, McGraw Hill, New Delhi.
Unit I – Ch: 2.3,2.7, 3.1, 3.5 ; Unit II – Ch: 5.1 to 5.7.1
2. Murugesan, R., Er. KiruthigaSivaprasath 2014, Modern Physics, S. Chand Publications, New Delhi.
Unit III –6.2 to 6.4, 6.11 to 6.17 ; Unit IV –6.18 to 6.22 ; Unit V – 6.23 to 6.28

REFERENCES:

- Halliday & Resnick, 2018, Fundamentals of Physics, 11th ed. John Wiley & Sons.

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 and operators.

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	2	3	26
CO2	3	1		3	2	2			3	2	3	3	2	24
CO3	2	2		2	2	3	1	1	3	2	3	3	3	27
CO4	3	2		2	2	3		1	3	2	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													131	
Mean value of COs with PSOs and POs = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{131}{56}\right)$													2.34	

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
Semester : V
Subject Code : 19UPYC75

Part : III Core -7
Hours : 75
Credit : 5

OPTICS AND SPECTROSCOPY

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

Huygen's Principle – Coherent Sources – Young's Experiment – Interference Fringes – Intensity Distribution in the Fringe System – Fresnel's Biprism – Determination of Wave Length – Michelson's Interferometer – Air Wedge – Experiment – Newton's Rings – Determination of λ and μ – Fabry Perot Interferometer.

UNIT II Diffraction

(15 hours)

Fresnel and Fraunhofer Diffraction – Diffraction at a Straight Edge – Plane Transmission Diffraction Grating – Theory and Experiment – Normal and Oblique Incidence – Absent Spectra – Overlapping of Spectral Lines – Dispersive Power of Grating – Resolving Power of a Prism and Plane Transmission Grating – Comparison of Prism and Grating Spectra.

UNIT III Polarization

(15 hours)

Polarization by Reflection – Polarizing Angle and Brewster's Law – Polarization by a Pile of Plates – Law of Malus – Polarization by Dichroic Crystals – Double Refraction – Optic Axis – Principal Section and Planes – Polarization by Double Refraction – Nicol Prism – Parallel and Crossed Polarizers – Refraction by Calcite Prisms.

UNIT IV Introduction to Spectroscopy

(15 hours)

Characterization of Electromagnetic Radiation – The Quantization of Energy – Region of the Spectrum – Frequency, Wave Number and Wavelength – Types Energy Possessed by Molecules – 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 – Discovery – Experimental Study – Characteristics of Raman Line – Quantum Theory – Raman Activity of Vibrations.

Text Books:

1. Brijlal and Subramanyam and Avadhanulu, 2006, 23rd Edn., Textbook of Optics, S.Chand and Company, New Delhi.
(Unit 1– Chapter 14.5 -14.9, 15.5-15.8, 15.11.4, 15.12 ; Unit 2– Chapter 17.7, 17.10, 18.7
Unit 3 - 20.5.1, 20.5.1.1, 20.5.2, 20.8.1, 20.8.2, 20.8.3, 20.5.5, 20.6, 20.6.1)
2. Banwell, C.N. & McCash, E.M., 2007, Fundamentals of molecular spectroscopy, Tata McGraw Hill, 4th ed.

(Unit 4 – Chapter 1.1-1.3, 1.7, Chapter 2.1- 2.3 ; Unit 5 – Chapter 3.1-3.4, Chapter 4.1.1, 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. Murugesan, R.& Kiruthiga Sivarakash, 2006, Optics and Spectroscopy, S. Chand & Publ.

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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{137}{54}\right)$													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
Semester : V
Subject Code : 19UPYC85

Part : III Core-8
Hours : 75
Credits: 5

MATHEMATICAL PHYSICS

(For Students admitted from the Academic Year 2019-2020 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 differential equations.
- 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, Gamma Functions and Differential Equations

(15 hrs)

Beta function: Definition, Symmetry property, Evaluation and other forms – Gamma function: Definition, Evaluation and other forms – Relation between Beta and Gamma functions – Bessel's differential equation – Legendre's differential equation.

Unit IV: Laplace Transforms

(15 hrs)

Laplace Transforms: Definition – Laplace Transform of Derivatives, Integrals, Gamma function – The Inverse Laplace Transform: Definition – Convolution theorem – Applications of Laplace Transforms.

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. Murugesan.R (2014), 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 – 9.11;

Unit IV: 15.1, 15.8, 15.9, 15.14, 15.16,

15.26 – 15.28

Unit V : 17.1 – 17.10, 17.12 – 17.16

Reference Books

1. Gupta.A.B (2010), Fundamentals of Mathematical Physics, Kolkata: Arunabha Sen Pvt. 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.

Teaching Learning Methods:

- Lecture Method, ICT, Assignment, 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 various Special functions.

CO4: Acquire knowledge on Laplace Transforms and its applications to solve differential equations.

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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{118}{53}\right)$														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
Semester : V
Subject Code : 19UPYC95

Part : III Core-9
Hours : 75
Credit : 4

DIGITAL ELECTRONICS

(For Students admitted from the Academic Year 2019-2020 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 for circuit design.
- To develop skill in writing simple program for 8085 and its applications

Unit I Number systems, codes & Arithmetic Circuits (15 hours)

Binary number system – Binary to decimal conversion – Decimal to binary conversion – Octal numbers – Hexadecimal numbers – The ASCII code – the excess 3 code – the gray code- Binary Addition – Binary Subtraction – 2's complement Representation – Arithmetic Building Blocks (Half Adder & Full Adder) – Binary Multiplication and Division

Unit II Digital Principles & Combinational Logic Circuits (15 hours)

Digital Logic: (The Basic Gates – NOT, OR, AND, UNIVERSAL LOGIC GATES – NOR, NAND) boolean Laws and theorems – sum of products method – Truth table to Karnaugh map – Pairs, Quads & octets – Karnaugh Simplification – Don't care condition – Product of sums method – Multiplexers and De-Multiplexers – (Principles only) – Decoders & Encoders (Principles only)

Unit III Timing Circuits and Flip flops (15 hours)

555 Timer – (Astable, Monostable) – RS Flip flop – Gated Flip Flops (clocked RS flip Flops only) – Edge triggered D – Flip Flops - Edge triggered JK Flip Flops, JK Master slave flip flops

Unit IV Registers & Counters (15 hours)

Types of Registers – Serial IN serial OUT - Serial IN parallel OUT – Parallel IN serial OUT – parallel IN parallel OUT – Applications of Shift registers counters-Asynchronous counters – Synchronous counters-Presettable counters (Synchronous up – down counters)

Unit V Microprocessor (15 hours)

Digital Computers – Intel 8085 block diagram – Data and address bus – Pin configuration – Intel 8085 instructions – Opcode and operands –Addressing modes – Instructions- Assembly language programs – Addition of two 8 – bit numbers – 8-bit subtraction – One's complement of 8 bit number – Two's complement of 8-bit number – 8-bit multiplication.

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).

References:

1. Malvino, 1988, Digital Principles and Applications, McGraw Hill, New Delhi.
2. Morris Mano, 2007, Computer Architecture, Pearson Education, New Delhi.
3. 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:								Title of Paper: Digital Electronics					Sum of COs with PSOs and POs
	Programme Outcomes (PO'S)								Programme Specific Outcomes (PSO'S)					
Course Outcomes (CO'S)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{139}{54}\right)$														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
Semester : V
Subject Code : 19UPYE15 (A)

Part : III Core Elective-1
Hours : 45
Credit : 2

ASTROPHYSICS

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

Course Objectives

- To acquire the knowledge of telescopes and its applications in astronomy
- To acquire the knowledge of solar system objects
- To enrich the idea about sun and its activities
- To analyse the properties of stars and their evolution
- To classify the galaxies and the other stellar objects

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

Unit II The Sun and its Activities

9 Hours

The Sun -Internal Layers of the Sun -Atmospheres of the Sun – photosphere – chromosphere – corona -Solar Activities –sunspots – coronal holes – coronal mass ejections – solar flares – radio bursts – plages, faculae and granules - Sun-Earth relationship -Future of the Sun - Estimation of surface temperature of the Sun -Solar wind

Unit III Stars and their evolution

9 Hours

Nuclear reactions in star -Properties of stars -Classification of stars -Birth of stars – Hertzsprung-Russell diagram -Main sequence stars -Life time of main sequence stars -Stellar evolution -How long Sun shine? –Constellations - 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

Text Books:

1. Shanmugaraju, A., 2019, Introduction to Astrophysics, Arul Anandar College, Karumathur, Madurai.

References:

1. Baidyanath Basu, 2010, An introduction to astrophysics, 2nd ed., PHI Publ.
2. Abell, Morrison and Wolf, 1995, Exploration of the Universe, 8th 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.

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, stars, galaxies and tools in astronomy.
- CO 2:** Describe the occurrence of seasons on the earth and effects of solar activities on the Earth.
- CO 3:** Discuss the energy generation, properties of inner and outer layers of sun.
- CO 4:** Analyse the evolution of stars, properties of stars and galaxies.
- CO 5:** Acquire the knowledge about optical and astronomical telescopes

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

CO 2: Explain the communication systems like TV, Radio & fibre optics.

CO 3: Discuss the concepts of Internet and world wide web.

CO 4: Describe the process of E-mail and its uses.

CO 5: Analyse the features of E-commerce and virtual shop.

Mapping of Cos with PSOs & Pos:

SEMESTER V	Subject Code:								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	3		3	3	3	1		3	2	3	2	3	29
CO2	3	3		3	2	3	1	1	3	3	2	2	3	29
CO3	3	2		3	2	3	1		3	3	3	3	3	29
CO4	3	2		2	1	3	1		3	2	3	2	2	24
CO5	3	3		3	3	3			3	3	3	3	3	30
Grand total of COs with PSOs and POs													141	
Mean value of COs with PSOs and POs = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{141}{55}\right)$													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 Information Technology Strongly related with PSOs and POs		

Arul Anandar College (Autonomous), Karumathur
Department of Physics
INTERNSHIP
(For those who joined in June 2019 onwards)

Class	: B.Sc. PHYSICS	Part	: IV
Semester	: V	Duration	: 25 days
Subject Code	: 19UINT15	Credits	: 1

Objectives:

- To practice in a different learning experience
- To gain laboratory/industry/research experiences
- To acquire the employability skills

Outline

- The students shall undertake their internship from IV/V semester holidays and must submit the report and attendance certificate before the external examinations of VI semester.
- The students must periodically report their progress and status to their respective Staff-In-charge / supervisor.
- The students must complete their internship of 25 days by undertaking any one of the following ways
 - The students shall work as intern in any of the related forums of their feasibility such as laboratory/industry/research centers/institutions etc.
 - The students shall participate in the internship programs offered by other Institutions / Colleges / Universities.
 - The students shall work under faculty of other colleges and acquire exposure to any of the topics in physics.

Evaluation:

Internal - 50 marks

Progress Report and Viva

External – 50 marks

Competent person of the laboratory/industry/research centers/institutions

Total – 100 marks

Arul Anandar College (Autonomous), Karumathur

Department of Physics

Class : B.Sc. PHYSICS

Part : Self Learning Course

Semester : V

Hours :

Subject Code : 19UPYSL5

Credit : 3

THIN FILM SCIENCE

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

Course Objectives

- To understand the growth mechanism of thin films
- To study the preparation of various thin films by chemical deposition methods
- To describe the growth of various thin films by physical deposition methods
- To examine the properties of thin films using different instruments
- To discuss the use of thin films in different industrial applications.

Unit -I Introduction

Classifications of Thick film, thin films, nano films and ultrathin films; Nucleation & Growth: capillarity theory, atomistic and kinetic models of nucleation, basic modes of thin film growth, stages of film growth & mechanisms.

Unit-II Growth Techniques- Chemical deposition methods

Sol- Gel method, Spray Pyrolysis, Electrodeposition, Chemical bath deposition.

Unit-III Growth Techniques-Physical deposition methods

Thermal Evaporation, E-Beam Evaporation, Sputtering, Pulsed laser deposition

Unit-IV Characterization Techniques

X-ray diffraction, UV-Visible, FT-IR, Raman and Photoluminescence spectroscopy, SEM technique.

Unit-V Applications

Applications of nano films as functional coatings (wear resistant, optical coatings etc.), data storage (CDs and DVDs), sensors, magnetic storage, transparent conducting oxides, photovoltaic solar cells etc.

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. Makhlof 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)

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: 19UPYSL5								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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{126}{51}\right)$														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

Class : B.Sc. PHYSICS
Semester : VI
Subject Code : 19UPYD06

Part : III Core-10
Hours : 75
Credit : 5

THERMODYNAMICS AND STATISTICAL MECHANICS
(For Students admitted from the Academic Year 2019-2020 onwards)

Course Objectives

- To understand the concepts of transmission of heat and related experiment
- To study the thermodynamics concepts by Laws of thermodynamics.
- To elaborate the concepts of change in entropy and its applications in phase transition
- To explain the classical statistics distribution functions and their applications
- To acquire knowledge in quantum statistics and compare all the three statistics.

Unit I Transmission of Heat (15 hours)

Introduction - Conduction – Coefficient of Thermal Conductivity – Temperature Gradient – Thermal Diffusivity – Lees’ Method for Bad Conductors. Radiation – Black Body (Definitions) – Stefan’s Law – Derivation of Newton’s Law of Cooling from Stephen’s Law - Experimental verification of Stefan’s Law – Newton’s Law of Cooling – Specific Heat Capacity of a Liquid- Joule’s Electrical Method

Unit II Thermodynamics I (15 hours)

Distribution of Energy in the spectrum of a Black Body – Wien’s Displacement - Rayleigh Jeans Laws - Planck’s Law – Solar Constant – Temperature of the sun - Solar Spectrum Derivation –Deduction of Wien’s, Rayleigh Jeans Laws – Zeroth law, First Law & Second Law of Thermodynamics (Statement only)

Unit III Thermodynamics II (15 hours)

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- Maxwell’s Thermodynamical Relations – Thermodynamic Potentials (Definition only) – First Order Phase transition and Second Order Phase transition (Definition only) – Helium I and II.

Unit IV Classical Statistics (15 hours)

Fundamentals of Postulates of Statistical Mechanics – Density of quantum states of Energy of Particles- Statistical Ensembles – Kinds of Particles- Ideal gas - Statistical Equilibrium – Maxwell Boltzmann Energy Distribution Law - Maxwell Boltzmann Distribution Law in General form- Maxwell Boltzmann Distribution Function for an Ideal Gas.

Unit V Quantum Statistics (15 hours)

Introduction – Bose Einstein Distribution Law – Photon Gas - Fermi Dirac Distribution Law – Electron Gas –Comparison of the three Statistics.

Text Books:

1. Brijlal, Subramaniam, &Hemne, 2008, Heat & Thermodynamics, S. Chand & Company
(Unit – I: Ch.15.1, 15.10, 8.1, 8.6, 8.12, 8.20, 8.21, 8.22, 14.6
Unit – II: Ch.8.13- 8.15, 8.17, 8.26, 8.27, 8.31, 4.2, 4.7, 4.28

Unit – III: Ch.5.1-5.7, 5.9, 5.15, 6.3, 6.5, 6.18, 6.19, 7.12

Unit – IV: Ch. 10.8 to 10.11, 11.1to11.3; Unit – V: Ch. 12.1, 12.5, 12.6, 12.8, 12.9, 12.15

References:

1. J.K.Sharma and K.K.Sarkar, 1988, Thermodynamics and Statistical Mechanics– (2nd enlarged Edition.), Himalaya Publishing House, New Delhi.
2. Mathur, D.S., 1988, Heat and Thermodynamics –5th Ed., S.Sulthan Chand & Sons, New Delhi
3. Sears, 1975, Thermodynamics - Addison- Narosa Publishing House, New Delhi.
4. Agarwal and Eisner, Statistical Mechanics – New Age International Publ.

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 transmission of heat and related experiments.

CO2: Illustrate the thermodynamics concepts by Laws of thermodynamics.

CO3: Explain the concepts of change in entropy and its applications in phase transition

CO4: Derive the classical statistics distribution functions and analyze their applications

CO5: Acquire knowledge in quantum statistics and compare all the three statistics.

Mapping of COs with PSOs & POs:

SEMESTER VI	Subject Code:								Title of Paper: THERMODYNAMICS AND STATISTICAL 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	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		1	3	2	3	3	3	27
CO5	3	2		2	2	3			3	2	3	3	3	26
Grand total of COs with PSOs and POs													127	
Mean value of COs with PSOs and POs = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{127}{52}\right)$													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 Thermodynamics and Statistical Mechanics Strongly related with PSOs and POs		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class : B.Sc. PHYSICS
Semester : VI
Subject Code : 19UPYD16

Part : III Core -11
Hours : 75
Credit : 5

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

Course Objectives:

- To facilitate the learners in understanding the basic nuclear properties and applications of NMR.
- To equip the students in enumerating different nuclear models.
- To inculcate the students with the knowledge of Particle accelerators & Detectors.
- To assist the learners in explaining various nuclear reactions and properties of neutron.
- To strengthen the students' basic knowledge on nuclear energy and elementary particles.

Course Outline:

Unit 1 Nuclear Structure I (15 hours)

Nuclear Composition – Atomic masses – Nuclear electrons - Some nuclear properties – Spin and Magnetic moment – Applications of NMR (Proton NMR, C_{13} NMR) – Nuclear Magnetic Resonance - Stable nuclei – Nuclear decay - Binding Energy – Binding energy per nucleon – Strong interaction.

Unit 2 Nuclear Structure II (15 hours)

Liquid Drop Model – Corrections to the formula - Shell Model – Magic numbers – Reconciling the models – Island of stability - Nuclear Forces – Meson Theory of Nuclear Forces – Discovery of the pion - Nuclear Matter – Two nucleon potential – Qualitative features of the nuclear forces.

Unit 3 Detectors, Accelerators & Radio activity (15 hours)

Nuclear Radiations – GM Counter – Bubble Chamber – Scintillation Counters – Particle Accelerators – Betatron – Synchrotrons (Electron, Bevatron). Radioactivity – Radioactive Series – Radioactive Equilibrium – Velocity and Range of Alpha - Geiger Nuttal Experiment – Geiger Law – Geiger Nuttal Law – Origin of the Line and Continuous Spectrum – Neutrino Theory of Beta Decay – K Electron Capture

Unit 4 Nuclear Reactions & Neutron (15 hours)

Energy Balance and Q Value – Threshold Energy – Nuclear Transmutations by Alpha Particles – Protons – Deuterons – Neutrons and Electron – Neutron – Discovery – Production – Mass – Spin – Charge – Magnetic Moment – Neutron Diffraction – Biological Effects – Absorption by Matter – Classification – Neutron Sources – Neutron Detection.

Unit 5 Nuclear energy & Elementary particles (15 hours)

Fission -Energy Release – Bohr and Wheeler Explanation by Drop Model – Nuclear Fusion – Source of Stellar Energy – Thermonuclear Reactions – Hydrogen Bomb - Elementary Particles – Baryons – Hyperons – Leptons – Mesons – Particles and Antiparticles – Fundamental Interaction – Elementary Particle Quantum Numbers – Conservation Laws and Symmetry – Quark Model – Composition of Hadrons – Colored Quarks – Generations.

Text Books:

1. Arthur Beiser, Shobhit Mahajan, S.Rai Choudhury, 2010, Concepts of Modern Physics, 6th edition, McGraw Hill, New Delhi.

(Unit I – Ch.11 & Unit II – Ch.11)

- Murugesan, R., 1995, Modern Physics, S.Chand Publ., New Delhi.
[Unit I & II – Ch.8,
Unit III – relevant sections in Ch.9,10,11,
Unit IV – relevant sections in Ch.12,
Unit V – relevant sections in Ch.13 and 15.)

References:

- Tayal, D.C., 1995, Nuclear Physics, Himalaya Publishing House.
- Richtmeyer, Kensard, Cooper, 1976, Modern Physics, McGraw Hill, New Delhi.
- Arthur Beiser, 1987, Concepts of Modern Physics, McGraw Hill, Singapore.
- Devanathan. V, 2006, Nuclear Physics, Narosa Publishing House, 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: 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:								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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{120}{51}\right)$														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
Semester : VI
Subject Code : 19UPYD26

Part : III Core -12
Hours : 75
Credit : 5

SOLID STATE PHYSICS

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

Course Objectives

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

Unit 1 Elements of Crystallography (15 hours)

Introduction – Some Fundamental Definitions in Crystallography – Miller indices – Lattice Parameters of an Unit Cell – Crystal Structures of Important Engineering Materials and Stacking Sequences – Other important structures (diamond, Zinc blende, NaCl, CsCl) – Polymorphism and Allotropy.

Unit 2 Bonding in solids & Thermal Properties of Solids (15 hours)

Introduction – Interatomic Forces and Cohesive Energy – Different Types of Bonds in Solids – Lattice Energy of Cohesive Energy of Ionic Crystals.

Specific Heat Capacity of Solids – Einstein's Theory of Specific Heat Capacity – Debye's Theory of Specific Heat Capacity of a Solid.

Unit 3 Electron theory of metals (15 hours)

Introduction – the classical free electron theory – Electrical conductivity of a metal (based on Drude and Lorentz theory) – the quantum free electron theory – band theory of solids – derivation of ohm's law – thermal conductivity.

Unit 4 Magnetic properties (15 hours)

Introduction – 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)

Introduction – 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 2- Secs 2.1 – 2.6.
Unit II - Chap.1 Secs.1.1 – 1.4
Unit III – Chap.6 Secs. 6.1 – 6.5, 6.9 – 6.10
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

References:

1. P.K.Palanisamy, 2003, Solid State Physics, SCITECH Publ.
2. S.O.Pillai, 2005, Solid State Physics, New Age International.
3. 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 crystal systems and structure of various materials.

CO2: Correlate the bonding with the properties of solids.

CO3: Calculate the energy levels and energy-level spacing of a free electrons in metals.

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: 19UPYD26								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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{135}{51}\right)$													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
Semester : VI
Subject Code : 19UPYD36

Part : III Core-13
Hours : 75
Credit : 4

NANOPHYSICS

(For Students admitted from the Academic Year 2019-2020 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 (15 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.

Unit 2: Nanomaterials (15 Hours)

Quantum dots – Quantum wires – Quantum well – Fullerenes – Buckminster fullerene – Carbon nanotubes: Properties –Synthesis: Plasma arc-discharge method – Laser ablation technique – Chemical vapour deposition – Applications of carbon nanotubes. Nanocomposites – Nanohybrids – Nanoclusters and Nanoparticles

Unit 3: Preparation of Nanomaterials (15 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 4: Characterization Techniques (15 Hours)

X-ray Diffraction: Principle – Instrumentation – Determination of structural parameters. Scanning electron microscope (SEM) – Transmission electron microscope (TEM) –Energy Dispersive X-ray Analysis (EDAX) - UV-Vis spectroscopy: Some important optical parameters – Photoluminescence (PL) spectroscopy.

Unit 5: Applications of Nanomaterials (15 Hours)

Nanoelectronics – Molecular electronics – Nanophotonics – Nanorobotics – Nano mechanics – Band gap engineered quantum devices – Photo-electrochemical cells – Plasmonic wave guides – CNT emitters – Gold nanoparticles in catalysis. 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; Unit 2 - Chapter 2.1-2.11
Unit 3 - 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 4 -Chapters 4: 4.1, 4.2 (4.2.1), 4.6, Chapter 5: 5.2,5.5 Chapter 6: 6.2, Chapter 7: 7.2, 7.3,7.4 ;Unit 5 – Chapter 9: 9.1-9.12]

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).

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: 19UPYD36								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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{136}{51}\right)$													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
Semester : VI
Subject Code : 19UPYE26 (A)

Part : III (Core Elective-2)
Hours : 45
Credit : 2

BASIC ELECTRIC PRINCIPLES AND APPLICATIONS
(For Students admitted from the Academic Year 2019-2020 onwards)

Course Objectives:

- To acquire the knowledge on basics of electricity & fundamental laws.
- To enrich knowledge on heating effects of electric current.
- To compare the uses of different lamps.
- To understand the basics of Transformers.
- To describe the generation and transmission of electricity.

Unit I Nature of electricity and fundamental laws (12 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)- direct current- alternating current –laws of resistance – variation in resistance with temperature-combination of resistances –ammeter- voltmeter. work, power, energy.

Unit II Heating effects of electric current (12 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, air circulator, electric kettle, electric iron, water heater: immersion water heater, storage water heater). Fuse (classification, parts, types)-precautions for renewing a fuse.

Unit III Illumination (12 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 (12 hours)

Introduction- principle- types of transformers-construction –cooling of transformer- step up transformer- step down transformer- advantages of transformer- uses.

Unit V Generation and transmission of electricity (12 hours)

Generation of Thermal power, hydro power, nuclear power and non – conventional power, transmission of power.

Text Books:

1. P.S.Dhogal, 1986, 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, 1986, 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, 1988, Non- conventional energy sources, Khanna Publications.
UNIT V- Ch 1 (relevant sections)

References:

1. M.L Anwani, 2018, Basic electrical engineering-Dhamp at Rai & co (p) LTD.
2. B.L .THERAJA, A.K THERAJA, 2002, Electrical technology, S.Chand & Company Ltd, 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

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 illumination and application in different lamps.

CO 4: Discuss the concept of transformers.

CO 5: Explain the generation and transmission of electricity.

Mapping of COs with PSOs & POs:

SEMESTER VI	Subject Code: 19UPYE26								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		2	2	1	1		3	2	2	3	3	24
CO2	3	3		2	3	2	1		3	3	3	3	2	28
CO3	3	3		2	3	3			3	3	3	2	3	28
CO4	3	2		3	3	2			3	3	2	3	3	27
CO5	3	3		3	2	2			3	3	2	3	2	26
Grand total of COs with PSOs and POs														133
Mean value of COs with PSOs and POs = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{133}{52}\right)$														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 Basic Electric Principles and Applications Strongly related with PSOs and POs		

Arul Anandar College (Autonomous), Karumathur
Department of Physics

Class : B.Sc. PHYSICS
Semester : VI
Subject Code : 19UPYE26 (B)

Part : III (Core Elective-2)
Hours : 45
Credit : 2

MEDICAL PHYSICS

(For Students admitted from the Academic Year 2019-2020 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 comprehend the principles of modern medical imaging systems

UNIT I: BIOPOTENTIAL ELECTRODES AND TRANSDUCERS (12 Hrs)

Transport of ions through cell membrane - Bio electric potential - Design of medical instruments - Electrodes - Micro & Surface - Transducers (active, passive, resistive transducers only).

UNIT II: BIO SIGNAL AMPLIFIERS AND RECORDERS (12 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) - Characteristics of recording systems (writer and pen damping effects) - Electrocardiography (origin of cardiac action potential) – Encephalography (origin of EEG) - Electromyography (recording setup) –Recorders with high accuracy.

UNIT III: PHYSIOLOGICAL ASSIST DEVICES (12 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: SPECIALIZED MEDICAL EQUIPMENTS (12 Hrs)

Blood flow meters (EM blood flow meter, Principle only) - Gas analysers (IR gas analyser)– Oximeters (vitro and vivo) - Blood cell counters - Electron microscope - Radiation detectors (Geiger muellar counter only) - Photometers and calorimeters (filter, spectrophotometer) - Digital thermometers - Audio meters (Human air) - X-ray tube - X-ray Machine (Block diagram of X-ray machine only).

UNIT V: MODERN IMAGING SYSTEMS (12 Hrs)

Lasers in medicine (laser action only) - Endoscopes - Cryogenic Surgery - Nuclear imaging Techniques - Computer Tomography (principle only) - Thermography (IR) - Ultrasonic imaging system (principle only) - Magnetic resonance Imaging(principle only) - Positron emission tomography - Digital subtraction angiography.

Text Book

Dr. M. Arumugam - Bio medical Instrumentation - Anuradha Publication - 2016.
Unit – I Chapter –1: 1.4, 1.6

Chapter–2: 2.2, 2.4, 2.4.5, 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: 6.10, 6.10.1, 6.13, 6.13.1, 6.15
 Chapter –7: 7.2, 7.4, 7.5, 7.5.1, 7.5.2, 7.6, 7.7, 7.8, 7.9
 Unit – V Chapter –10: 10.3, 10.4, 10.5, 10.6, 10.7, 10.8, 10.8.1, 10.9, 10.10, 10.11, 10.12

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

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: Compare the various modern medical imaging 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	2	0	2	2	3	0	0	3	3	2	2	3	25
CO5	3	3	0	3	2	3	0	1	3	3	3	2	3	29
Grand total of COs with PSOs and POs													133	
Mean value of COs with PSOs and $POs = \frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{133}{52}\right)$													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	Total hours	: 90 (45 per sem)
Semester	: V & VI	Credit	: 3
Subject Code	: 19UPYP36	Hours/Week	: 3

PHYSICS LAB – III (General)

(For Students admitted from the Academic Year 2019-2020 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 Hartmann's formula - spectrometer
3. Determination of Small angle prism - spectrometer
4. Determination of n for d , d for i - - spectrometer
5. Determination of self-inductance of a coil by Owen's bridge
6. Determination of self-inductance of a coil by Anderson's bridge
7. Determination of emf of a thermocouple by Potentiometer
8. Determination of temperature coefficient of resistance Potentiometer
9. Determination of Impedance and power factor – LR circuit
10. Determination of Galvanometer – conversion of ammeter
11. Determination of Galvanometer – conversion of voltmeter
12. Determination of comparison of emf of two cells by B.G.
13. Determination of comparison of capacitances by B.G.
14. Determination of absolute capacitance by B.G.
15. Determination of mutual inductance by B.G.
16. Determination of Horizontal component of Earth's magnetic field – Tangent Galvanometer
17. Determination of B-H Hysteresis Curve
18. Determination of LCR – series resonance circuit
19. Determination of LCR – Parallel resonance circuit
20. Determination of Dielectric constants of air, solid and liquid

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 optical parameters
- 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: 19UPYP36								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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{134}{50}\right)$													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 (45 per sem)
Semester	: V & VI	Credit	: 3
Subject Code	: 19UPYP46	Hours/Week	: 3

PHYSICS LAB – IV (Electronics)

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

Course Objectives:

- To study the various characteristics 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:

1. Single stage amplifier with feedback
2. Two stage amplifier with feedback
3. Two stage amplifier without feedback
4. Clippers and clampers using diode and CRO
5. Colpitt's oscillator
6. Monostable multivibrator using transistor
7. Schmitt trigger – IC 555
8. Astable multivibrator using transistor
9. Opamp – IC 741 - characteristics
10. Opamp – IC 741 – differentiator and integrator
11. Opamp – IC 741 – adder and subtractor
12. Logic gates using discrete components
13. Logic gates using ICs
14. Logic gates – using IC universal gates
15. Logic gates – Ics – Demorgan's theorem
16. Logic gates - ICs – Boolean expressions
17. XOR and XNOR – Using ICs
18. Half adder and full adder
19. R-S, J-K and D flip-flops
20. Mod 5 and Mod 10 counters
21. Ring counters
22. Shift registers
23. Microprocessor – 8085 – perform addition, subtraction
24. Microprocessor – 8085 – perform 1's and 2's complement subtraction
25. Microprocessor – 8085 – perform multiplication and division

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 multivibrators and compare the theoretical and experimental frequency

CO 4: Perform the arithmetic 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: 19UPYP46								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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{132}{50}\right)$													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		

Course Outcomes

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

- **CO 1:** Acquire knowledge on the fiber optic communication systems.
- **CO 2:** Understand the concept of propagation of light in optical fibres.
- **CO 3:** Analyze the different types of fibers and modes.
- **CO 4:** Explain the basics of semiconductors.
- **CO 5:** Analyze the working of LEDs and various forms of optical communications.

Mapping of COs with PSOs & POs:

SEMESTER VI	Subject Code: 22UPYSL6								Title of Paper: OPTICAL COMMUNICATION					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	3	2			3	2	3	2	3	26
CO2	3	3		2	3	2			3	3	2	3	2	26
CO3	3	3		2	3	3			3	2	3	2	3	27
CO4	3	2		3	2	2			3	3	2	3	3	26
CO5	3	3		2	3	2			3	3	2	2	3	26
Grand total of COs with PSOs and POs													131	
Mean value of COs with PSOs and POs = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{131}{50}\right)$													2.62	

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			2.62
Observation	COs of Optical Communication 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
Semester : I
Sub.Code : 22PPYC11

Part : CORE-1
Hours : 90
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, Cramer’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 transform by 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

- 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
- Pipes and Harvill, 1970, Applied Mathematics for Engineers and Physicists- III, Edition, McGraw Hill International Book Company.
- Joshi, A.W., II Edition, 1995, Matrices and Tensors in Physics- Wiley Eastern Ltd., New Delhi (Unit II: Ch. 1.1 – 1.10).
- B.D.Gupta, 2004, Mathematical Physics –Vikas Publishing house.
- Arfkan and Weber, 2005, Mathematical Methods for Physicists, 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{125}{50}\right)$													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
Semester : I
Sub.Code : 22PPYC21

Part : CORE-2
Hours : 90
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 poisson bracket – Equations of motion in Poisson 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. Aruldas, 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{126}{52}\right)$														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
Semester : I
Sub. Code : 22PPYC31

Part : CORE-3
Hours : 90
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]

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

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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \frac{127}{51}$													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 pyrhelimeter 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, cyclone 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{150}{58}\right)$													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
Semester : II
Sub.Code : 22PPYC42

Part : Core-4
Hours : 90
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, , contravariant and covariant vectors – Tensors of Higher rank – contravariant, covariant and mixed tensors of second rank –Tensors of higher rank –Algebraic 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. Aruldas, 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, 4.31 Chap: 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{121}{50}\right)$													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
Semester : II
Sub.Code : 22PPYC52

Part : CORE-5
Hours : 90
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 –Eigenvalues 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- 1st order correction- 2nd order correction – Anharmonic oscillator: 1st order correction - Ground state of Helium - Stark effect – Degenerate energy levels – 1st 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. Aruldas, 2008, Quantum Mechanics, 2nd 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, 3rd 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{123}{50}\right)$													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		

- 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
- Malvino A.P. & Leech D., Goutam Saha, 2010, Digital Principles and Application (7th Ed.): Tata McGraw Hill, New Delhi
- Ramesh Gaonkar, 2013, Microprocessor Architecture, Programming and applications with the 8085 (6th Ed.): Penram International Publishing.
- Morris Mano, 2016, Digital Logic and Computer Design (1st Ed.): Pearson Education India.
- J. Millman & C. Halkias, 2017, Integrated Electronics (2nd Ed.): Tata McGraw Hill, New Delhi
- 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{125}{50}\right)$													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		

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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{111}{50}\right)$													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. Raj, 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{143}{57}\right)$													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
Semester : I & II
Sub.Code : 22PPYP12

Part : CORE LAB - 1
Hours : 90
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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{128}{50}\right)$													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
Semester : I & II
Sub.Code : 22PPYP22

Part : Core Lab - 2
Hours : 90
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 of SCR 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 of OP-AMP
11. Demonstrate the characteristics and applications of UJT
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 generator using OP-AMP
17. Solve simultaneous equations and differential equations using OP-AMP
18. Design and circuit construction of 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \frac{133}{50}$													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
Semester : III
Code : 22PPYC63

Part : Core-6
Hours : 90
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 continuum states- Fermi's Golden Rule-Absorption and Emission of Radiation-Electromagnetic Field-Electric dipole Approximation –Transition 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. Aruldas, 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).

- P M Mathews, K Venkatesan, A Textbook of Quantum Mechanics, 2nd ed., McGraw Hill Education (2017).
- Eugen Merzbacher, Quantum Mechanics, 3rd ed., John Wiley & Sons (1998).
- J. J. Sakurai, Jim Napolitano, Modern Quantum Mechanics, 3rd ed., Cambridge University Press (2020).
- Richard, L. Liboff, Introductory Quantum Mechanics, 4th ed., Pearson education (2002).
- S. Devanarayanan, Quantum Mechanics: Principles & Applications, 2nd ed., Createspace Independent Publication (2016).
- 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{129}{50}\right)$													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
Semester : III
Code : 22PPYC73

Part : Core-7
Hours : 90
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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{122}{50}\right)$													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
Semester : III
Code : 22PPYC83

Part : Core-8
Hours : 90
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 – Asymmetric top molecules – Microwave spectrometer – Information derived from rotational spectra.

UNIT – II Infrared Spectroscopy (18 hrs)

Vibrational energy of a diatomic molecule – 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 transition 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 coarse structure – 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 Fortrat Parabolae – 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:

- Aruldas, 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).
- Banwell and McCash, 2007, Fundamentals of Molecular Spectroscopy –Tata McGraw Hill
- Jack D.Graybel, 1993, Molecular Spectroscopy –McGraw Hill.
- G.M.Barrow, 2021, Introduction to Molecular Spectroscopy –Hassell Street Press.
- 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{138}{50}\right)$													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 Waals 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 monoatomic 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{135}{50}\right)$													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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{135}{50}\right)$													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
Semester : III & IV
Subject Code : 22PPYP34

Part : Lab - 3
Hours : 90
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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} =$ $\left(\frac{134}{52}\right)$													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		

Unit III – Ch.11 and 12 (relevant titles)

Unit IV – Ch. 16 (relevant titles)

Unit V – Ch. 16, 17 and 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{125}{50}\right)$													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		

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

- Irving Kaplan, 2002, Nuclear Physics, Revised Ed., Addison Wesley, New York.
- Roy and Nigam, 2014, Nuclear Physics. 2nd Ed., New Age Intl., New Delhi.
- Fujia Yang and Joseph Hamilton, 2010, Modern atomic and Nuclear Physics, Revised Ed., McGraw Hill.
- 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{134}{50}\right)$													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		

3. Senior John, M., 2014, Optical Fiber communication: Principles and Practice, 3rded., 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{133}{50}\right)$													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		

Chapter - 10: Sections: 10.1, 10.2, 10.3.

- R. S. Khandpur, 1999, Handbook of Biomedical Instrumentation - Tata McGraw-Hill, New Delhi.
- 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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{119}{47}\right)$													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
Semester : III & IV
Code : 22PPYD14

Part : Core
Hours : 180
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 = $\frac{\text{Grand total of COs with PSOs and POs}}{\text{Number of COs relating with PSOs and POs}} = \left(\frac{137}{50}\right)$													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) 10 x 1=10
(Each unit carry 2 questions)

Section B:

Either or Choice – Short answer question (5) 5 x 6 =30
(2/3 problems may be asked)
(One question from each unit)

Section C:

Either or Choice – Long answer question (5) 5 x 12 =60
(One question from each unit)

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
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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
(One problem may be asked)

2x 6 =12

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

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.