DEPARTMENT OF PHYSICS

(2017 – 2020)

Aim:

To provide physics education of high quality by offering an intellectually stimulating environment in which students have the opportunity to develop their skills to the best of their potential.

Objectives:

1. To acquire basic knowledge so that they may be able to pursue higher studies.
2. To develop self study methods and problem solving techniques in students.
3. To sharpen the experimental skills by recording and processing data systematically.
4. To inculcate in students the team spirit, leadership qualities and scientific temper.

Eligibility Norms for admission:

Those who seek admission to B.Sc. Physics Programmme must have passed the Higher Secondary Examinations conducted by the Board of Higher Secondary Examinations, Tamil Nadu with Physics and Mathematics as Part – III subjects or examination recognized and approved by the Syndicate of the Manonmaniam Sundaranar University, Tirunelveli.

Duration of the Course: 3 years

Medium of instruction: English

Passing minimum

A minimum of 40% in the external examination and an aggregate of 40% is required. There is no minimum pass mark for the continuous internal assessment.

Components of the B.Sc. Physics programme

Part III – (Major and Allied)

Major	Core – Theory papers	(10 x 100)	1000
	Practical (Core applied)	(4 x 50) + (3 x 100)	500
	Elective – Theory papers	(4 x 100)	400
	Major – Total marks		**1900**

Allied (I & II)

Theory	(4 x 100)	400
Practicals	(2 x 100)	200

Allied – Total marks **600**

Part III – Total marks **2500**

All theory papers and Allied practicals carry 100 marks each

Major practicals during I & II year carry 50 marks each

Major practical during III year carry 100 marks each

Practical examination will be held only at the end of the even semesters.

Course Structure

Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI	Total	
							Hours	Credits
Language	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
English	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Major Core - Theory	4 (4)	4 (4)	4 (4)	4 (4)	6 (6)+ 6 (6)+ 5 (5)	6 (6)+ 6 (6)+ 5 (5)	50	50
Major Core - Practic Tutorial	2	2 (4)	2	2 (4)	2+2+2	2+2+ 2 (6)	20	14
Elective	-	-	4 (4)	4 (4)	5 (5)	5 (4)	18	17
Allied - Theory	4 (4)	4 (4)	4 (4)	4 (4)	-	-	16	16
Allied	2	2 (2)	2	2(2)	-	-	8	4

Practical								
AECC	2 (2)	2 (2)	-	-	-	-	4	4
SBC	-	-	2 (2)	2 (2)	2 (2)	2 (2)	8	8
NMEC	4 (3)	4 (3)	-	-	-	-	8	6
*FC – I (Values for Life)	-	(1)	-	-	-	-	-	1
*FC – II (Personality Development)	-	-	-	(1)	-	-	-	1
*FC – III (HRE)	-	-	-	-	(1)	-	-	1
*FC – IV (WS)	-	-	-	-	-	(1)	-	1
*SDP - Certificate Course	-	(1)	-	-	-	-	-	1
*SLP – Extension Activity (RUN)	-	-	(1)	-	-	-	-	1
* STP – Clubs and Committees/NSS	-	-	-	(1)	-	-	-	1
Total	**30 (19)**	**30 (27)**	**30 (21)**	**30 (28)**	**30 (25)**	**30 (30)**	**180**	**150**

Total number of hours = 180

Total number of credits = 150

*** Courses / Programmes conducted outside the regular working hours**

Courses offered

Semester	**Course**	**Subject code**	**Paper**	**Hours/wk**	**Credits**
I	**Part I**	TL1711/ FL1711	Language: Tamil / French	6	3
	Part II	GE1711	General English	6	3
	Part III	PC1711	Major Core I - Mechanics and Properties of Matter	4	4
		PC17P1	Major Practical I - Physics Lab I	2	-

		AP1711	Allied I – Allied Physics – I (for I B.Sc Maths)	4	4
		AP17P1	Allied Practical – General Physics Lab	2	-
	Part IV	*AEC171*	AECC – Ability Enhancement Compulsory Course: English Communication	2	2
		PNM171	NMEC – Everyday Physics I	4	3
		VEC172	Foundation Course I – Values for Life	-	-
	Part V	SDP172	Skill Development Programme (SDP) – Certificate course	-	-
		STP174	Student Training Programme (STP) – Clubs and Committees/NSS	-	-
II	**Part I**	TL1721/ FL1721	Language: Tamil / French	6	3
	Part II	GE1721	General English	6	3
			Core II –Thermal Physics Sound	4	4
		PC17P1	Major Practical I - Physics Lab I	-	2
		PC17P2	Major Practical II - Physics Lab II	2	2
		AP1721	Allied I – Allied Physics - II (for I B.Sc Maths)	4	4
		AP17P1	Allied Practical – General Physics Lab	2	2
	Part IV	*AEC172*	AECC – Ability Enhancement Compulsory Course: Environmental Studies	2	2
		PNM172	*NMEC – Every Day Physics II*	4	3
		VEC172	Foundation Course I – Values for Life	-	1
	Part V	SDP172	Skill Development Programme (SDP) – Certificate course	-	1

		STP174	Student Training Programme (STP) – Clubs and Committees / NSS	-	-
III	**Part I**	TL1731/ FL1731	Language: Tamil / French	6	3
	Part II	GE1731	General English	6	3
	Part III	PC1731	Major Core III – Electricity and Magnetism	4	4
		PC1732 PC1733 PC1734	Major – Elective - I a) Non conventional Energy sources b) Medical Physics c) Physics of the earth	4	4
		PC17P3	Major Practical III - Physics Lab III	2	-
		AP1731	Allied II – Allied Physics - I (for II B.Sc Chemistry	4	4
		AP17P1	Allied Practical – General Physics Lab	2	-
	Part IV	SBC173/ SBC174	SBC – Yoga / Computer Education	2	2
		VEC174	Foundation Course II – Personality Development	-	-
	Part V	STP174	Student Training Programme (STP) – Clubs and Committees / NSS	-	-
		SLP173	Service Learning Programme (SLP) Extension Activities (RUN)	-	1
IV	**Part I**	TC1741/ FL1741	Language: Tamil / French	6	3
	Part II	GE1742	General English	6	3

	Part III	PC1741	Major Core IV – Analog System and Application	4	4
		PC1742 PC1743 PC1744	Major – Elective - II a) Fibre Optics b) Microprocessor c) Communication System	4	4
		PC17P3	Major Practical III - Physics Lab III	-	2
		PC17P4	Major Practical IV - Physics Lab IV	2	2
		AP1741	Allied II – Allied Physics - II (for II B.Sc Chemistry	4	4
		AP17P1	Allied Practical – General Physics Lab	2	2
	Part IV	SBC173/ SBC174	SBC – Yoga / Computer Literacy	2	2
		VEC174	Foundation Course II – Personality Development	-	1
	Part V	STP174	Student Training Programme (STP) - Clubs and Committees/NSS	-	1
V	**Part III**	PC1751	Major Core V - Elements of Modern Physics	6	6
		PC1752	Major Core VI - Waves and Optics	6	6
		PC1753	Major Core VII - Solid State Physics	5	5
		PC1754 PC1755 PC1756	Major – Elective - III (a) Programming with C++ (b) Applied Physics (c) Bio Physics	5	5
		PC17P5	Major Practical V - Physics Lab V	4	-
		PC17P6	Major Practical VI - Physics Lab VI	2	-

	Part IV	PSK175	*SBC – Preparation for Competitive Examinations	2	2
		HRE175	Foundation Course III - Human Rights Education (HRE)	-	1
VI	**Part III**	PC1761	Major Core VIII - Mathematical Methods of Physic	6	6
		PC1762	Major Core IX - Digital System and Application	6	6
		PC1763	Major Core X - Nuclear Physics	5	5
		PC1764 PC1765 PC1766	Major – Elective - IV (a) Nanomaterial and its application (b) Basic Astrophysics (c) Digital Signal Processing	5	4
		PC17P5	Major Practical V - Physics Lab V	-	2
		PC17P6	Major Practical VI - Physics Lab VI	2	2
		PC17P7	Major Practical VII - Physics Lab VII	4	2
	Part IV	PSK176	*SBC – Project	2	2
	Part V	WSC176	Foundation Course IV - Women's Studies (WS)	-	1
			TOTAL	**180**	**150**

***SBC for the V & VI semesters is offered by the departments for their students**

- There is a subject oriented Skill Based Course during the V semester and a subject based group project (5 members) during the VI semester for two hours each per week. There will be a group viva voce examination for the group project.
- To make other major students aware of basic physics principles and its applications in day today life we provide this NMEC course during I and II semester.

Self Learning – Extra Credit Course

Semeste	Subject co	Title of the paper	Hours/week	Credits
III / V	PC17S1	Physics for Competitive Examination – I	-	2
IV/ VI	PC17S2	Physics for Competitive Examination – II	-	2

Instruction for Course Transaction

Theory (Major Core) paper hours

Components	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI
Lecture hours	45	45	45	45	75	75
Assignment / Group discussion	10	10	10	10	10	10
CIA (Test, Quiz)	5	5	5	5	5	5
Seminar	-	-	-	-	-	-
Total Hours / semester	60	60	60	60	90	90

Theory (Elective/ Allied) paper hours

Components	Elective				Allied	
	Sem. III	Sem. IV	Sem. V	Sem. VI	Sem. I/III	Sem. II / IV
Lecture hours	45	45	60	60	45	45
Problem Solving / Group discussion	10	10	10	10	10	10
CIA (Test, Quiz)	5	5	5	5	5	5
Total Hours	60	60	75	75	60	60

Practical Hours

	Semester	Hours per week	Total hours / semester
Major	**I / II / III / IV**	2	30
	V / VI	2+2+2 = 6	90
Allied	**I / II / III / IV**	2	30

Value Added Courses

S.No.	Name of the course	Total hours	Credit
I	Video Editing - Photoshop	30	1
II	Domestic appliance service	30	1

1. To practice our students to take video shorts and bring it in short film Forms.
2. Hands on training for our students to service their own domestic appliances

Examination Pattern

Ratio of Internal and External:

(Major / Elective / Allied) **25:75** **NMEC 40: 60**

Components of Internal:

Test	:	15	Test	:	20
Quiz	:	5	Quiz	:	10
Assignment	:	5	Assignment	:	10
Total	**:**	**25**	**Total**	**:**	**40**

Question Pattern (Major / Allied/ Elective)

Internal Test	Marks	External Exam	Marks
Part A 4x1 (No Choice)	4	Part A 10x1 (No Choice)	10
Part B 2x5 (Internal Choice)	10	Part B 5x5 (Internal Choice)	25
Part C 2x8 (Internal Choice)	16	Part C 5x8 (Internal Choice)	40
Total	**30**	**Total**	**75**

Question Pattern (NMEC)

Internal Test	Marks	External Exam	Marks
Part A 4x1 (No Choice)	4	Part A 10x1 (No Choice)	10
Part B 3x3 (Internal Choice)	9	Part B 5x3 (Internal Choice)	15
Part C 1x7 (Internal Choice)	7	Part C 5x7 (Internal Choice)	35
Total	**20**	**Total**	**60**

Practical Papers

Major – I & II years

Internal : 20 marks

External : 30 marks

Total : 50 marks

Internal : 20 marks

Performance of the experiments : 2.5

Regularity in attending practical

and submission of records: 2.5

Model exam : 10

Record : 5

Total : 20 marks

External : 30 marks

Major practicals : 20

Minor practicals : 10

Spotters (5 x 1½) : 7.5

Record : 2.5

Total : 30 marks

Practical Papers (Major - III year & Allied)

Internal : 40 marks

External : 60 marks

Total : 100 marks

Internal : 40 marks

Performance of the experiments : 10

Regularity in attending practical

and submission of records: 5

Record : 10

Model exam : 15

Total : 40 marks

External : 60 marks

Major practicals : 25

Minor practicals : 20

Spotters (4 x 2½) : 10

Record : 5

Total : 60 marks

Semester I
Mechanics and Properties of Matter (Major Core –I)
Subject Code: PC1711

No of hours per week	No of credits	Total no of hours	Marks
4	4	60	100

Objective:1. To impart knowledge on basic aspects of dynamics, conservation laws, kinematics, collisions and elasticity.

2. To acquire skills and practical knowledge in everyday life.

Unit I: Fundamentals of Dynamics

Reference frame – Inertial frames – Newton's laws of motion and its limitations – Galilean transformations – Law of conservation of momentum and energy – Time period and orbital speed of a satellite – Impulse of force – Projectile on inclined plane and down to inclined plane – range and time of flight- Two body problem and reduced mass – Bifilar pendulum - stable, unstable and neutral equilibrium – equilibrium of bodies suspended and supported.

Unit II: Conservation Laws and Kinematics

Conservation laws in general– Concept of work power and energy – Conservative forces – Energy: Work energy principle – Conservative force as negative gradient of potential energy – Curl F=0 – Law of conservation of mechanical energy – Moment of Inertia –Moment of Inertia of a Circular Disc- Moment of inertia of a diatomic molecule – Moment of Inertia of a rectangular block.

Unit III: Collisions and Hydrostatics

Elastic and inelastic Collision – fundamental principles of impact – direct impact of two smooth spheres and its loss of kinetic energy –oblique impact of two smooth spheres and its loss of kinetic energy – Pressure and thrust- Thrust on a plane immersed in a liquid – center of pressure- center of pressure on a rectangular lamina and triangular lamina- laws of flotation- meta centric height- Equation of continuity- Euler's equation and Bernoulli's theorem.

Unit IV: Elasticity

Moduli of Elasticity – Work done in a strain – Torsion of a body – Torsional oscillations of a body – Bending of beams-Definitions – Expression for the bending moment – Depression of the loaded end of a cantilever –Measurement of Young's Modulus - Uniform and non-uniform bending of a beam.

Unit V: Viscosity and Surface tension

Streamline flow and Turbulent Flow – Poiseuille's formula for the flow of a liquid through a capillary tube – Poiseuille's method for determining coefficient of viscosity of a liquid – Terminal Velocity and Stokes' Formula – Stokes' method for the coefficient of viscosity of a viscous liquid - Explanation of surface tension on Kinetic theory – Drop weight method of determining the surface tension of a liquid – Experiment to determine the interfacial tension between water and kerosene.

Text Books:

1. Mathur, D.S. (1998). *Mechanics*. New Delhi: S. Chand & Company Ltd.
Unit I: 2.3 – 2.6, 2.8, 2.14
Unit II: 5.1 – 5.6, 6.1

2. Murugeshan, R. (2005). *Properties of Matter.* New Delhi: S. Chand & Company Ltd.
Unit II: 7.1, 7.5, 10.6
Unit IV: 1.1 – 1.2, 1.5, 1.9, 1.13 – 1.16, 1.21
Unit V: 2.2 – 2.3, 2.5, 2.8 – 2.9, 3.2, 3.17 – 3.18

3. Murugeshan, R. (2005). *Mechanics and Mathematical Physics.* New Delhi: S. Chand & Company Ltd.
Unit I: 1.1, 2.1, 2.2, 2.4, 2.5, 3.9, 3.10
Unit II: 2.6
Unit III: 1.2, 1.4, 1.5, 4.1-4.5, 5.1, 5.3, 5.4

Reference Books:

1. Robert Resnick, David Halliday. Jearl Walker. (2007). *Fundamentals of Physics*. (10^{th} ed.). USA:Wiley and Sons Inc.
2. Kleppner, D., Kolenkow, R.J. (2014). *An Introduction to Mechanics*.(2^{nd} ed.). UK: Cambridge University Press.

3. Kittel, C., Knight, W. (2007). *Mechanics.* (2nd ed.). USA:Tata McGraw-Hill.
4. Fowles, G.R., Cassiday, G.L. (2005). *Analytical Mechanics.*(7th ed.). USA: Cengage Learning.

Semester I
Major Practical I
Physics Lab – I
Subject Code: PC17P1

No of hours per week	No of credits	Total no of hours	Marks
2	2	30	50

Objective: 1. To understand the basic concepts of properties of matter.

2.To Prove Hook's Law and to determine (i) the elastic constants (Youngs Modulus, Rigidity Modulus and Poisson's Ratio) (ii) Verify the Perpendicular axis theorem, To determine Coefficient of viscosity, Surface tension.

Any six experiments

1. Young's Modulus – Uniform bending – Pin & Microscope
2. Young's Modulus – Non Uniform bending – Scale &Telescope
3. Young's Modulus – Cantilever depression – Pin & Microscope
4. Rigidity Modulus – Torsion Pendulum
5. Verification of perpendicular axes theorem – Bifilar Pendulum
6. Viscosity – Variable pressure head
7. Viscosity – Stoke's Method
8. Surface tension and interfacial surface tension
9. Coefficient of Viscosity of water – Capillary Flow method (Poiseuille's method)
10. Comparison of radii by capillary flow method.
11. Surface tension by capillary rise method.
12. Rigidity modulus by static torsion - Scale &Telescope

Reference Books

1. Squires, G.L. (2015). *Practical Physics.* (4th Ed.), Cambridge University Press.
2. Flint, B. L., H.T. Worsnop. (1971). *Advanced Practical Physics for students*. Asia Publishing House.
3. Michael Nelson., Jon M. Ogborn. (1985). *Advanced level Physics Practicals.* (4th Ed.), Heinemann Educational Publishers.

Semester I or III

Allied Physics Paper –I

(Common for I B.Sc. Mathematics and II B.Sc. Chemistry students)

(AP1711/AP1731)

No of hours per week	No of credits	Total no of hours	Marks
4	4	60	100

Objectives:1. To understand the behavior of waves, oscillations, properties of matter and optics.

2. To study the physical concepts behind natural phenomena.

Unit I: Waves and Oscillations: Simple harmonic motion (Definition, Example) - Transverse vibrations of a stretched string – Velocity – Frequency – Laws – Verification using Sonometer - Melde's experiment - A.c. frequency using sonometer – Ultrasonics – Piezoelectric effect – Production of ultrasonic & piezoelectric– Reverberation.

Unit II: Elasticity & Bending moment: Elasticity – Different moduli – Poisson's ratio - Bending of beam – Expression for the bending moment – Young's modulus by non-uniform bending — Torsion pendulum - Determination of rigidity modulus.

Unit III:Viscosity & Surface tension: Streamline flow & turbulent flow - Coefficient of viscosity – Definition - Determination – Poiseuille's formula – Terminal velocity – Stoke's law – Determination of Viscosity of highly viscous liquid - Surface tension: Excess of Pressure inside a drop and bubble – Jaegar's Method.

Unit IV: Physical Optics: Interference – Interference in thin film – Production of colors of thin films – Air wedge – Test for optical flatness – Diffraction – Plane transmission diffraction grating – Determination of wavelength of light using transmission grating – Polarization: polarization by reflection – Double refraction – Nicol prism - Optical activity – Specific rotatory power.

Unit V: Geometrical Optics: Refraction of light – Refraction through prism - Refraction through thin prism – Dispersion through a prism – Expression for dispersive power - Combination of two prisms to produce dispersion without deviation and deviation without dispersion – Direct vision spectroscopy.

Text Book:

Murugeshan. R, (2016). Allied Physics Paper I & II, New Delhi:S. Chand & company Pvt Ltd.

UnitI : Chapter 1:1.1,1.5-1.13,1.15
Unit II : Chapter 2: 2.1,2.2,2.3,2.5,2.6,2.8,2.12,2.13
Unit III : Chapter 2: 2.14,2.15,2.16,2.17,2.20,2.21,2.22,2.24,2.27,2.28,2.29
Unit IV : Chapter 6: 6.2,6.3,6.4,6.5,6.6,6.8,6.10,6.11,6.12,6.13,6.14,6.16,6.17,6.19
Unit V : Chapter 5: 5.1,5.6,5.10,5.11,5.12,5.13,5.14

Reference Books:

1. Brijilal, Subramanyam, N. (1985). Properties of Matter. (Fourth Ed.), New Delhi: Eurasia Publishing House Pvt. Ltd.
2. Robert F. Kingsbury. (1966). Elements of Physics. (First Ed.) , London: Van Nostrand Company Inc.
3. Ubald Raj, A., Jose Robin. G. (2012). Allied Physics. Indira Publications, Marthandam.
4. Bhargava, N.N., Kulshreshtra,D.C., Gupta,S.C. (1984). Basic Electronics and Linear Circuits. (Sixteenth Ed.), New Delhi: Tata McGraw-Hill publishing Co.

Semester I or III

Allied Practical – General Physics Lab

Subject Code: (AP17P1/AP17P3)

(Common for I B.Sc Mathematics and II B.Sc Chemistry students)

No of hours per week	No of credits	Total no of hours	Marks
2	2	60	100

Objective:

1. To elucidate theory through simple experiments in physics.
2. To make the students more innovative, inhands on experiments.

Any twelve experiments

1. Uniform bending – Optic Lever
2. Non- Uniform bending – Microscope
3. Newton's law of cooling – verification
4. Specific heat capacity of liquid – cooling
5. Thermal conductivity – Lee's Disc
6. Compound Pendulum – to find g
7. Torsion Pendulum – Rigidity modulus
8. Comparison of viscosities of two liquids-Burette method
9. Surface tension and Interfacial surface tension –Drop weight method
10. Spectrometer – Dispersive power
11. Spectrometer- Grating normal incidence
12. Newton's Rings – R and n
13. Air wedge – thickness of a wire
14. Carey Foster Bridge – Specific resistance
15. Calibration of voltmeter – Potentiometer
16. LCR series Resonance Circuit
17. Logic gates – AND, OR, NOT
18. AC frequency – Sonometer
19. LCR – Parallel Resonance circuit.
20. Characteristics of Zener diode

Reference: Material prepared by the department.

Semester I
Non Major Elective Course
Everyday Physics – I – PNM171

No of hours per week	No of credits	Total no of hours	Marks
4	3	60	100

Objective:1. To introduce the basic concepts in physics and their applications in everyday life.
2.To Know how physics is applied in day to day life situations.

Unit I: Mechanical Objects
High-Flying Balls – Bicycles - Tricycles and Static Stability - Bicycles and Dynamic Stability - Leaning While Turning – Pedaling Bicycles - Rockets and Space Travel - Rocket Propulsion - The Ultimate Speed of a Spacecraft - Orbiting Earth - Orbiting the Sun: Kepler's Laws – Travel to the Stars: Special Relativity.

Unit II: Fluids and Motion
Air and Air pressure- Pressure, density and temperature - Earth atmosphere - Lifting force of a balloon - Water's viscosity- Flow in a straight hose - Bent hose - Flow through a nozzle - Turbulence - Laminar airflow - Turbulent airflow.

Unit III: Heat and Thermodynamics
Heat and temperature – Heat moving through metal – Heat moving with air – Heat moving as light – warming the room – Water, steam and ice – Phases of matter – Melting ice and freezing ice – Evaporating water and condensing steam – Relative humidity – Subliming ice and depositing steam – Boiling water – Earth's temperature and the Green house effect – Air conditioners – Moving heat around

Unit IV: Electricity
Static electricity – Coulomb's law – Uses of static electricity – Pollution control – Smoke stacks – Air freshener – Photocopier – painting cars – Electric current- Theory of electricity – Heating effect of electricity – Application of heating effect - Toaster – Flash lights – Electric bell – How batteries work - How electricity delivers energy – Promising energy for the future.

Unit V: Modern Physics
Nuclear Weapons- The Nucleus and Radioactive Decay - Fission and Fusion - Chain Reactions and the Fission Bomb - The Fusion or Hydrogen Bomb - Radiation and Radioactivity - Nuclear Reactors - Nuclear Fission Reactors Fission Reactor Safety and Accidents -X-Rays - Making X-Rays - Using X-Rays for Imaging.

Text Book:

1. Louis A. Bloomfield. (2013). *How Things Work The Physics of Everyday Life.* (Fifth Ed.), United States America: The Wiley.
   Unit I: Chapter 4: 4.1, 4.2
   Unit II: Chapter 6: 6.1 – 6.3
   Unit III: Chapter 7: 7.1 – 7.3, Chapter 8: 8.1, 8.2
   Unit IV: Chapter 10: 10.1 – 10.3
   Unit V: Chapter 15: 15.1 – 15.3

Reference Books:

1. BrijLal, Subramaniam. (2008). *Heat and thermodynamics*, S. Chand & Company Ltd.
2. Arthur Beiser. (2006). *Concepts of Modern Physics*. (6^{th} Ed.), Tata McGraw-Hill Edition.

Semester II

Thermal Physics and Sound (Major Core –II)

Subject Code: PC1721

No of hours per week	No of credits	Total no of hours	Marks
4	4	60	100

Objectives:

1. To introduce the concepts of the kinetic theory of gases along with some of its applications.
2. To understand the laws of thermodynamics, Thermodynamic Potentials, Transmission of heat, Acoustics and Ultrasonics.

Unit I: Kinetic theory of Gases

Kinetic model – Expression for the pressure exerted by a gas – Kinetic energy per unit volume of a gas –Maxwell's law of Equipartition of Energy – Relation between molar specific heat and degrees of freedom – Specific heats of mono and diatomic gases – Mean free path – Expression for mean free path – Transport phenomena – Viscosity – Thermal conductivity – Self diffusion - Maxwell's velocity distribution law – Experimental verification of Maxwell's law.

Unit II: Laws of Thermodynamics

Thermodynamic systems – Zeroth law of thermodynamics – Internal energy - First law of thermodynamics –Application of First law of thermodynamics – Specific heat of a gas - Isothermal process– Isochoric process – Isobaric process– Adiabatic process– Work done during an Isothermal process - Work done during an Adiabatic process – Reversible and irreversible process – Carnot's cycle - Second law of thermodynamics – Concept of entropy - Change in entropy in a reversible process - Change in entropy in an irreversible process – The T-S diagram - Third law of thermodynamics.

Unit III: Thermodynamic Potentials and Transmission of heat

Maxwell's Thermodynamic relations – Application of Maxwell's Thermodynamic relations - Specific heat equation – Joule Thomson cooling - Joule Thomson coefficient – ClausiusClapeyron's Equation – The TdS equations – Coefficient of thermal conductivity – Lee's disc method for bad conductors – Convection – Black body – Stefan Boltzmann law - Derivation of Stefan's law and Newton's law of cooling from Stefan's law – Specific heat capacity by Newton's law of cooling.

Unit IV: Waves and Oscillations

Simple harmonic motion – Differential equation of motion executing S.H.M. – Solution of the differential equation of motion – Composition of two S.H.M. along the same direction and at right angles – Lissajous figure – Free, Forced and Resonant Vibrations – Vibrating Systems: Modes of vibration – stationary vibrations in strings – Sonometer: Laws of transverse vibration of strings – A.C frequency by sonometer – Melde's string.

Unit V: Acoustics and Ultrasonics

Introduction – Ultrasonic production – Magnetostriction method – Piezoelectric method – Detection of ultrasonic waves – Thermal method – Piezoelectric crystal method – Kundt's tube method – Application of ultrasonic waves: Depth of sea, sonar – Introduction to Acoustics – Classification of sound –Reverberation - Absorption coefficient – Sabine's formula – Factors affecting the architectural acoustics and their remedies.

Text Books:

1. Brijlal, Subrahmanyam, Hemne, P.S. (2014). *Heat, Thermodynamics and Statistical Physics.* (3rd ed.). New Delhi: S. Chand & Company Ltd.
   Unit I: 1.3, 1.4, 1.19 - 1.21, 2.9, 2.14.
   Unit II:4.1, 4.2, 4.6, 4.7, 4.10, 4.10.1, 4.10.2, 4.10.3, 4.12, 4.13, 4.20, 4.24, 4.28, 5.1, 5.4, 5.6, 5.7, 5.15.
   Unit III: 15.1, 15.11, 8.6, 8.12, 8.20, 8.21, 6.3, 6.4.1, 6.4.2, 6.4.3, 6.4.7, 6.5, 6.9.
2. Gupta, A.B. (2014). *Thermal Physics.* (3rd ed.). India: H.P. Roy Books and Allied (P) Ltd.
   Unit I: 3.2, 3.5, 3.7, 3.8, 3.11, 3.16
3. Govinda Rajan, S.R., Murugaiyan, Jayaraman, T. (1977). *Sound.* Rouchouse& Sons.
   Unit IV: Chapter II: 1, 3 – 6.
4. Ghosh, M., Bhattacharya, D. (2006). *A text book of Oscillations, Waves and Acoustics.* (3rd ed.) New Delhi: S.Chand &Company Ltd.
   Unit IV: 2.1, 2.4, 2.5, 2.8 – 2.10.
5. Brijlal, Subrahmanyam. *Waves and Oscillations*. New Delhi: S. Chand & Company Ltd.
   Unit IV: 3.1 – 3.3, 3.5 – 3.6.
6. Palanisamy, P.K. (2012). *Engineering Physics.* India: Schitech Publications Pvt. Ltd.
   Unit V: 9.1, 9.2, 9.2.1, 9.2.2, 9.3.1 - 9.3.3, 9.6.1.a, 9.6.1.b, 9.8, 9.9, 9.12 - 9.14, 9.16.

Reference Books:

1. Thomas, W., Sears, Gerhard, L. Salinger. (2004). Thermodynamics, Kinetic theory and Statistical Thermodynamics. Narosa Publishing House.
2. BrijLal, Subramaniam. (2008). Heat and thermodynamics. New Delhi: S. Chand & Company Ltd.
3. Subramaniam, N., BrijLal. (1995). A Text Book of Sound. (2nd ed.). India:Vikas Publishing House.

Semester II
Major Practical II - Physics Lab – II
Subject Code: PC17P2

No of hours per week	No of credits	Total no of hours	Marks
2	2	30	50

Objective: 1. To understand the basic concepts of thermal physics and sound.

2.To demonstrate and determine certain physical constants.

Any six experiments

1. Newton's law of cooling – Verification.
2. Specific Heat Capacity by Cooling.
3. Thermal Conductivity of a bad conductor – Lee's Disc.
4. Sonometer – Verification of the laws of transverse vibration.
5. Sonometer – Frequency of A.C. Mains.
6. Melde's String – Frequency of the Vibrator.
7. Lissajous Figure.
8. Compound Pendulum.
9. Thermal conductivity of air
10. Thermal conductivity of good conductor – Forbe's method.

Reference: Material prepared by the department.

Semester II or IV
Allied Physics Paper –II
(Common for I B.Sc Maths and II B.Sc. Chemistry students)
Subject code: (AP1721/AP1741)

No of hours per week	No of credits	Total no of hours	Marks
4	4	60	100

Objective:1. To understand the basic principles of electricity, electromagnetism and electronics.

2.To make an awareness in physical concepts behind electricity and electronics.

Unit I: Thermal Physics

Conduction in solids: Thermal conductivity – Lee's disc method – Relation between thermal and electrical conductivities - Weidemann – Franz law – Convection : Newton's law of cooling – Determination of specific heat capacity of liquid – Radiation: Distribution of energy in the spectrum of black body – Results.

Unit II: Current Electricity

Ohms law- Electrical conductivity - Kirchoff's law - Wheatstone's bridge – condition for balance (no derivation) – Carey Foster's Bridge – Measurement of specific resistance – Determination of temperature coefficient of resistance – Potentiometer - calibration of voltmeter and ammeter.

Unit III: Electromagnetism

Electromagnetic Induction – Faraday's laws – Lenz's law – self-inductance – mutual inductance – Experimental determination of mutual inductance - Coefficient of coupling –Alternating current – Mean, RMS, peak - A.C. Circuits – LCR in series.

Unit IV Semi conductor Electronics

Semiconductors – pn junction diode – Half wave and full wave rectifier – Bridge rectifier- Zener diode - Regulated power supply- transistor – CE Configuration only.

Unit V: Digital Electronics

Number systems- decimal –binary – Conversion of Decimal Number into Binary Number (double dabble method) – binary addition, subtraction, multiplication and division – Logic gates – OR, AND, NOT, XOR, NAND and NOR gates –truth tables – NAND and NOR as Universal gates.

Text Books:

1. Ubald Raj.A., Jose Robin.G.(2012). *Allied Physics*. Marthandam: Indira Publications.
   Unit I: Chapter 3
   Unit II: Chapter 5
   Unit III: Chapter 2
2. Madhavan, Y, Thiagarajan., M, Annadurai., B, Balu.,T., Selvarajan. *Electromagnetism and Electronics*- Allied Physics Paper IV. Saravana offset.
   Unit III: Chapter 2:2.1,2.2,2.4,2.5,2.8,2.9,2.10
   Unit IV: Chapter 4: 4.1 – 4.7, 4.10
   Unit V: Chapter 5: 5.1 – 5.7,5.9 – 5.14

Reference Books:

1. Brijilal, Subramanyam, N. (1985). *Properties of Matter*. (4th Ed.), New Delhi: Eurasia Publishing House Pvt. Ltd.
2. Robert F. Kingsbury. (1966). *Elements of Physics*, (1st Ed.), London:Van Nostrand Company Inc.
3. Bhargava, N.N., Kulshreshtra, K.C., Gupta, S.C. (1984). *Basic Electronics and Linear Circuits.* (16th Ed.), New Delhi: Tata McGraw-Hill publishing Co.
4. Murugeshan. R. (2016). *Allied physics Paper I & II.* New Delhi: S. Chand & company Pvt Ltd.

Semester II

Non Major Elective Course
Everyday Physics- II (PNM172)

No of hours per week	No of credits	Total no of hours	Marks
4	3	60	100

Objective:1. To provide basic knowledge on the concepts of electricity and electronics along with some applications.

2.To explain the wonders of world using the principles of physics.

Unit I: Basic electricity

Static electricity – Cells and batteries – Conductors and insulators – Resistors – Thermistors and light dependent resistors.

Unit II: Diodes and Capacitors

Structure of a diode – Light emitting diodes – Radio – Tape recorder – Record player.

Unit III: Transistors

Structure of transistor – Switching using transistors – High frequency oscillators.

Unit IV: Transistor amplifier

Transistor as an amplifier – Single stage amplifier – Two stage amplifier.

Unit V: Analog, Digital electronics and Integrated circuits

Continuous and non-continuous systems – Examples of analog systems – Logic gates – Structure of integrated circuits – The microprocessor.

Text Book:

1. Arnold, R.B. (1986). A first electronics course. England: Stanely Thorens (publishers) Ltd.
   Unit I: 1.1 – 1.10
   Unit II: 2.1 – 2.4, 6.1 – 6.4
   Unit III: 3.1. 3.2, 4.1 – 4.5
   Unit IV: 5.1 – 5.4
   Unit V: 7.1 – 7.5, 8.1 – 8.4

Reference Books:

1. Ryder, J.D. (2004). Electronics: Fundamentals and Applications. Prentice Hall International, INC., Englewood Cliffs.
2. Salivahanan, S., Kumar, N.S., (2012). Electronic Devices and Circuits. (3rd Ed.), New Delhi Tata McGraw-Hill Publishing Company Limited.

Semester III

Major Core III: Electricity and Magnetism

Subject Code: PC1731

Number of hours per week	No of credits	Total number of hours	Marks
4	**4**	**60**	**100**

Objectives:1. To provide knowledge on the basic concept of electric and magnetic fields.
2.To understand the laws and theorems in electromagnetism and their application.

Unit I: Electric Field:

Coulomb's Law - Electric field - Electric field due to a point charge – Electric dipole –Force and Torque – Potential energy of a dipole in a uniform electric field – Lines of force – Flux of the electric field – Gauss law – Application: Electric field due to a uniformly charge sphere – Electric field due to a uniform Infinite cylindrical charge – Electric field due to an infinite plane sheet of a charge.

Unit II: Electrostatic Potential:

Conservative nature of electrostatic field – Potential difference – Electric potential as line integral of electric field – Potential at a point due to a point charge – Relation between electric

field and electric potential - Potential at a point due to a uniformly charged conducting sphere – Electric potential energy – Electrical Images — Capacity of a conductor - Condensers – Capacitance of spherical capacitor - cylindrical capacitor – Parallel plate capacitor.

Unit III: Magnetic field and Electromagnetic induction:

Magnetic field – Definition of magnetic field$\vec{B}$ – Magnetic force on a particle – Magnetic field lines – Magnetic force on a current carrying wire – Torque on a current loop – Magnetic dipole moment -Faraday's law of electromagnetic induction- Lenz law- Explanation of Faradays law- Self inductance- Mutual inductance- Coupling of two coils with flux linkage-Magnetic energy stored in the inductance.

Unit IV: Electrical Circuits and Network theorems :

Introduction – Kirchoff's laws – Series circuit – AC through an L-R circuit – AC through an C-R circuit – LCR in series resonance circuit – Vector diagram method – The series circuit at resonance - Parallel resonance circuit.

Network theorems: Introduction – Ideal constants – Voltage and constant current source – Superposition theorem – Reciprocity theorem – Thevenins theorem – Norton's theorem – Maximum power transfer theorem.

Unit V: Electrical Measurements:

AC bridges: Introduction – AC bridges for measuring capacitance – The Desauty bridge – AC bridges for measuring inductance –Anderson's L-C bridge – Owen's L-C bridge – Moving coil galvanometer – Correction for damping in Ballistic galvanometers – Measurement of charge sensitivity of a ballistic galvanometer – Determination of the absolute capacity of a condenser

Text Books :

1. Murugesan, R. (2011). *Electricity and Magnetism*. (9th ed.). Ram Nagar, New Delhi: S.Chand& Company Ltd.
   Unit I : 1.2, 1.4 -1.7, 1.11, 2.1 – 2.2, 2.5 – 2.6, 2.8 – 2.9
   Unit II : 3.1 – 3.5, 3.8 – 3. 10, 4.1, 4.5
   Unit V : 18.1 – 18.6
2. Brijilal, Subrahmanyam, N. (1982.) *Electricity and Magnetism*. (9th Ed.). Delhi: Ratan Prakashan Mandir, Educational and University publishers.
   Unit V: 12.4 - 12.5, 12.7, 12.9, 13.36, 13.39
3. Sehgal, Chopra, Sehgal. (1991). *Electricity and Magnetism*. (4th ed.).
   Unit IV : 10.1 – 10.2, 11.12 – 11.13- 11.16, 11.19- 11.21, 11.26
   Unit V: 12.1 – 12.2, 12.7 – 12.8
4. Halliday, Resnick, Walker. (2006). *Fundamentals of Physics*. (6th Ed.). Wiley.,India Pvt Ltd-
   Unit I : 29.1, 29.2, 29.7 – 29.9
5. SatyaPrakash. (1995). *Electromagnetic Theory & Electrodynamics*. (8th ed.). KedarNath, RamNath& Co.-Meerat
   Unit III : Chapter 6: 6.1-6.2,6.8-6.11

Reference Books:

1. David J. Griffiths. (2004). *Introduction to Electrodynamics*. (3rd ed.).New Jersy: Prentice Hall of India Private Ltd.
2. Vasudeva, D.N.(1983). *Fundamentals of Magnetism and Electricity*. Ram Nagar, New Delhi: S.Chand & Company Ltd.
3. Tayal D.C. (1993). *Electricity and Magnetism*. USA:Himalaya Publishing House.

Semester III

Elective I (a): Non – Conventional Energy Sources (Elective – I)

Subject Code: PC1732

Number of hours per week	No of credits	Total number of hours	Marks
4	4	60	100

Objectives: 1. To provide knowledge on various alternative sources of energy.
2. To create awareness about the non-conventional energy sources which will solve the energy crisis.

Unit I: Solar Energy

Introduction- Solar water heating - Solar electric power generation- Solar photo voltaics – Agriculture and industrial process heat – Solar distillation – Solar cooker - Solar green houses - Solar production of hydrogen

Unit II: Wind Energy

Basic principles of wind energy conversion - Nature of the wind- Power in the wind- Site selection considerations - Basic components of WECS - Classification of WEC systems - Advantages and disadvantages of WECS - Wind energy collectors - Horizontal axial machines

Unit III: Bio Energy

Bio mass- Bio conversion technologies- Wet processes- Dry processes- Photosynthesis- Bio gas generation-Factors affecting biodigestion or generation of gas – Classification of Bio gas plants - Constructional details of digesters

Unit IV: Geo Thermal Energy and Chemical energy

Nature of geo thermal fields – Geo thermal sources - Hydrothermal resources - Vapour dominated systems - Liquid dominated systems – Geo pressured resources - Magma resources - Fuel cells - Design and principle of operation of a fuel cell – Types of fuel cell – Advantages and disadvantages of fuel cells – Conversion efficiency of fuel cells – Types of electrodes – Work output and emf of fuel cells – Applications of fuel cells

Unit V: Energy from the ocean and Hydrogen energy

Introduction- Ocean thermal electric conversion(OTEC) - Methods of ocean thermal electric power generation- Open cycle OTEC system- Closed or Anderson OTEC cycle- Heat exchangers- Bio fouling- Site selection- Energy utilization- Hybrid cycle- Prospects of ocean thermal energy conversion in India- Hydrogen energy- Hydrogen production- Electrolytic production of hydrogen- Thermo chemical methods.

Text Book:

Rai, G.D. (2008). *Non-conventional energy sources*, (4th ed.).New Delhi: India: Khanna Publishers.

Unit I : 5.1-5.2, 5.6-5.8, 5.11-5.13

Unit II :6.2:6.2.1-6.2.2 (excluding maximum power), 6.4-6.8 (excluding 6.8.3-6.8.4)

Unit III :7.1-7.5,7.6, 7.10

Unit IV :8.3-8.5 (excluding low temperature liquid dominated system), 8.6, 8.8, 10.1

Unit V : 9.1-9.2.11, 11.1-11.2

Reference Books:

1. Sukhatme, S.P. (1997). *Solar energy*. (2nd ed.) India: Tata McGraw Hill Education.
2. Rai, G.D. (1995). *Solar Energy Utilization*. (5th ed.). New Delhi: Khanna Publishers.

Semester III
Elective I (b): Medical Physics (Elective – I)

Subject Code: PC1733

Number of hours per week	No of credits	Total number of hours	Marks
4	4	60	100

Objectives: 1. To impart knowledge on the physical principles involved in the living body.
2. To develop the skills in Medical diagnostic and imaging systems.

Unit I: PHYSICS OF THE BODY-I

Basic Anatomical Terminology: Standard Anatomical Position - Planes. Familiarity with terms like – Superior – Inferior – Anterior – Posterior – Medial – Lateral - Proximal and Distal. Mechanics of the body:Skeleton – forces and body stability. Muscles and dynamics of body movement. Physics of Locomotors Systems: joints and movements - Stability and Equilibrium. Energy household of the body:Energy balance in the body – Energy consumption of the body - Heat losses of the body - Thermal Regulation. Pressure system of body:Physics of breathing, Physics of cardiovascular system.

Unit II: PHYSICS OF THE BODY-II

Acoustics of the body:Nature and characteristics of sound - Production of speech - Physics of the ear - Diagnostics with sound and ultrasound. Optical system of the body:Physics of the eye. Electrical system of the body:Physics of the nervous system - Electrical signals and information transfer.

Unit III: PHYSICS OF DIAGNOSTIC SYSTEMS

X-RAYS:Electromagnetic spectrum - production of x-rays - x-ray spectra – Brehmsstrahlung - Characteristic x-ray. X-ray tubes & types: Coolidge tube - x-ray tube - Design - Tube cooling stationary mode - Rotating anode x-ray tube - Tube rating – Quality and intensity of x-ray. X-ray generator circuits - Half wave and full wave rectification - Filament circuit - Kilo voltage circuit - Types of X-Ray Generator - High frequency generator - Exposure timers and switches - HT cables - HT generation.

Unit IV: MEDICAL IMAGING PHYSICS:

Evolution of Medical Imaging - X-ray diagnostics and imaging - Physics of nuclear magnetic resonance (NMR) - NMR imaging - MRI Radiological imaging - Ultrasound imaging - Physics of Doppler with applications and modes - Vascular Doppler. Radiography: Filters – Grids – Cassette - X-ray film - Film processing - Fluoroscopy. Computed tomographyscanner-principle & function – Display – Generations - Mammography. Thyroid uptake system and Gamma camera (Only Principle, function and display).

Unit V: RADIATION , PROTECTION AND THERAPEUTIC SYSTEMS

Principles of radiation protection - Protective materials-radiation effects – somatic - Genetic stochastic and deterministic - Effect. Personal monitoring devices: TLD film badge - pocket dosimeter - OSL dosimeter.Radiation dosimeter. Natural radioactivity - Biological effects of radiation – Radiationmonitors**.** Steps to reduce radiation to Patient - Staff and Public. Dose Limits forOccupational workers and Public. AERB: Existence and Purpose. Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging - Radioisotope imaging equipment - Single photon and positron emission tomography. Therapeutic nuclear medicine: Interaction between radiation and matter Dose andisodose in radiation treatment. Medical Instrumentation: Basic Ideas of Endoscope and Cautery - Sleep Apnea and C pap Machines - Ventilator and its modes.

Text Books:

1. Thayalan, K. (2009). *Basic Radiological Physics* (2nd ed) New Delhi: Jaypee Brothers Medical Publishing Pvt. Ltd.
2. Irving P. Herman. (2007). *Physics of the human body*. (1st ed)Atlanta, NewYork: Springer.
3. Bushberg.J.T, Seibert J.A, Leidholdt E.M, Boone J.M(2002) *The essential physics of Medical Imaging*.(2nd ed.) Philadelphia, USA: Lippincott Williams &Wilkins..

Reference Books:

1. Cameron, J.R, Skofronick J.G. (1978). *Medical Physics (*1st ed*)*. New York:Wiley.
2. Curry T.S, Dowdey J.E, Murry R.C, (1990). *Christensen's Physics of Diagnostic Radiology, (4 thed).* Philadelphia, USA: Lippincot Williams & Wilkins.
3. Khan, F.M., (2003). *Physics of Radiation Therapy* (3rd ed.). USA: Lippincot Williams & Wilkins.
4. Livingstone. R.S, (2007)*Handbook of Physics in Diagnostic Imaging.*(1st ed). Chennai: B.I. Publication Pvt Ltd.

5. Johns, H.E, Cunningham J.R, (1983)*The Physics of Radiology.(4th ed)* Springfield,U.S : Charles C Thomas Pub Ltd.

Semester III
Elective I (c): Physics of Earth (Elective – I)

Subject Code: PC1734

Number of hours per week	No of credits	Total number of hours	Marks
4	4	60	100

Objectives: 1. To provide the knowledge regarding the origin of the Universe and its dynamical processes.

2.To understand the various important topics in geophysics.

Unit I: The Earth and the Universe:

Origin of universe - Creation of elements and earth - Introduction to various branches of Earth Sciences - General characteristics and origin of the Universe - The Milky Way galaxy - Solar system - Earth's orbit and spin - The Moon's orbit and spin - The terrestrial and Jovian planets - Meteorites & Asteroids - Earth in the Solar system – Origin - size – shape – mass – density - Rotational and revolution parameters and its age.

Unit II: Structure:

The Solid Earth: Mass – Dimensions - Shape and topography - Internal structure - Magnetic field - Geothermal energy. The Hydrosphere: The oceans, their extent, depth, volume, chemical composition. River systems - The Atmosphere: variation of temperature - Density and composition with altitude - clouds. The Cryosphere: Polar caps and ice sheets. Mountain glaciers.The Biosphere: Plants and animals. Chemical composition - mass. Marine and land organisms.

Unit III: Dynamical Processes:

The Solid Earth: Origin of the magnetic field - Source of geothermal energy - Convection in Earth's core and production of its magnetic field – Mechanical layering of the Earth - Introduction to geophysical methods of earth investigations - Concept of plate tectonics - Sea-floor spreading and continental drift - Geodynamic elements of Earth - Mid Oceanic Ridges – Trenches - Transform faults and island arcs - Origin of oceans - Continents - Mountains and rift valleys - Earthquake and earthquake belts - Volcanoes: types products and distribution - The Hydrosphere: Ocean circulations - Oceanic current system and effect of coriolis forces - Concepts of eustasy - Tend – air-sea interaction - Wave erosion and beach processes – Tides – Tsunamis - The Atmosphere: Atmospheric circulation - Weather and climatic changes - Earth's heat budget - Cyclones.

Unit IV: Climate:

Earth's temperature and greenhouse effect - Paleoclimate and recent climate changes - The Indian monsoon system - Biosphere: Water cycle - Carbon cycle - Nitrogen cycle - Phosphorous cycle - The role of cycles in maintaining a steady state.

Unit V: Evolution:

Time line of major geological and biological events - Origin of life on Earth - Role of the biosphere in shaping the environment - Future of evolution of the Earth and solar system: Death of the Earth - Disturbing the Earth – Contemporary dilemmas -Human population growth - Atmosphere: Green house gas emissions - Climate change - Air pollution - Hydrosphere: Fresh water depletion - Geosphere: Chemical effluents - Nuclear waste - Biosphere: Biodiversity loss – Deforestation - Robustness and fragility of ecosystems.

Text Books:

1. Jay Melosh, H. (2011). *Planetary Surface Processes*. (1st ed.). Cambridge: Cambridge University Press.
2. Emiliani C. (1992). "*Planet Earth"- Cosmology, Geology and the Evolution of Life and Environment.*(1st ed) (reprint 2007) NewYork: Cambridge University Press.

Reference Books:

1. John Harte.(1988), *Consider a Spherical Cow: A course in environmental problem solving.* New Jersey,University Science Books.
2. Peter McLaren DonaldDuff, Arthur Holmes, (1993) *Holme's Principles of Physical Geology*. (4 thed) NewYork: Chapman & Hall.

Semester III

Physics Lab – III

Subject Code: PC17P3

No of hours per week	No of credits	Total no of hours	Marks
2	2	60	100

Objectives: 1. To understand the concepts of electricity and magnetism through experiments.

2. To demonstrate the working of deflection magnetometer, BG, Desauty's and Owen's bridge.

Any seven experiments

1. Determination of figure of merit using B.G.
2. Determination of absolute capacity of condenser using B.G
3. Determination of mutual inductance of two coils using B.G

4. Desauty's bridge – comparison of capacitance.
5. Owen's bridge – determination of self inductance of coil.
6. Verification of Thevinins and Nortons theorem.
7. LCR- Series and parallel resonance circuit.
8. Anderson's Bridge
9. Thermistor Characteristics

Semester IV
Major Core –IV: Analog Systems and Applications
Subject Code: PC1741

No of hours per week	No of credits	Total no of hours	Marks
4	4	60	100

Objectives:

1. To study and analyze the basic concepts and action of semiconductor diodes transistors and operational amplifiers.
2. To analyze the working of electronic circuits and applications.

Unit I: Semiconductor diodes and transistors

Semiconductor materials – Intrinsic semiconductors – Extrinsic semiconductors – N-type semiconductor – P-type semiconductor – P-N Junction – P-N Junction with no external voltage – P-N junction with forward bias – P-N junction with reverse bias – V-I characteristics of a P-N junction diode – Static and dynamic resistance of a diode – Half wave rectifier – Bridge Rectifier – Calculation of ripple factor and rectification efficiency – Filters (π filter) – Zener diode – Voltage regulator – Junction transistor structure – Working of transistor – Amplifying action – Three configurations – Transistor characteristics (CE configuration only).

Unit II: Transistor amplifier

Transistor biasing – Selection of operating point – Bias stabilization – Fixed bias and Voltage divider bias – Single stage transistor amplifier – Equivalent circuit method – Development of transistor AC equivalent circuit – h-parameter equivalent circuit – Analysis of a single state CE amplifier using hybrid models: Input and output impedance, current-voltage and power gain.

Unit III : Feedback in amplifiers

Concept of feedback in amplifiers – Types of feedback – Voltage gain of amplifier – Effect of negative feedback on gain stability, distortion and noise, input impedance, output impedance and bandwidth – Amplifier circuits with negative feedback – RC coupled amplifier without bypass capacitor – Emitter follower.

Unit IV : Oscillator

Need for an oscillator – Generating sine wave using tuned oscillator circuit – Frequency of oscillations in LC circuit – Sustained oscillations – Positive feedback amplifier as an oscillator (Barkhausen criterion) – Starting voltage – LC oscillators – Hartley and Colpitt's oscillators – Basic principle of RC oscillator – RC phase shift oscillator.

Unit V: Operational amplifier

Parameters of a general amplifier – Ideal operational amplifier – Inverting amplifier – Non-inverting amplifier – Difference amplifier – Operational amplifier circuits – Voltage follower – Summing amplifier – Integrator – Differentiator – Log and antilog amplifiers – Comparators and Schmitt trigger.

Text Books:

1. Bhargava, N.N.. Kulshreshtha, D.C., Gupta, S.C. (2002). *Basic Electronics and Linear circuits.* (35th reprint) New Delhi: Tata McGraw-Hill Publishing Company Limited.
   Unit 1: Chapter 3 : 3.2, 3.5, 3.6, 3.6.1-3.6.2
   Chapter 4 : 4.1, 4.2.1 - 4.2.3, 4.3, 4.5, 4.6.1 - 4.6.2, 4.7, 4.8.4, 4.9.3
   Chapter 5 : 5.2, 5.4- 5.6, 5.7.2
   Unit II: Chapter 7: 7.2 - 7.4, 7.6.1, 7.6.4
   Chapter 8 :8.2, 8.4, 8.4.1- 8.4.3
   Unit III: Chapter 12: 12.1-12.5
   Unit IV: Chapter13:13.1, 13.3, 13.3.1, 13.3.2, 13.4, 13.4.1, 13.5, 13.5.3, 13.5.4, 13.6, 13.6.1-13.6.2.

2. Rajiv Kapadia. (2012). *Operational Amplifiers and Linear Integrated Circuits*. Jaico Publishing House.
   Unit V: Chapter 1:1.2 - 1.7
   Chapter 2: 2.2.1- 2.2.3, 2.3.2

Reference Books:

1. Millman, J. Halkias, C.C. (1991). *Integrated Electronics*. New Delhi: Tata McGraw-Hill Publishing Company Limited.
2. Ryder, J.D. (2004). *Electronics: Fundamentals and Applications.* Prentice Hall International, INC., Englewood Cliffs.
3. Salivahanan, S., Kumar, N.S. (2012). *Electronic Devices and Circuits*. (3rd ed.). New Delhi:Tata McGraw-Hill Publishing Company Limited.

Semester IV

Elective – II (a) : Fibre Optics

Subject Code: PC1742

No of hours per week	No of credits	Total no of hours	Marks
4	4	60	100

Objectives:1. To Impart the basic knowledge of optic fibres and its application in communication.

2. To Enable the students to identify the running efficiency of public's internet, TV and phone cables running efficiently and safety.

Unit I: Optical Fibers

What are optical fibres – importance of optical fibres - Propagation of light waves in an optical fibre – Basic structure of an optical fibre and propagation of light wave through it. Acceptance

angle and acceptance cone of a fibre – Numerical aperture (General), numerical aperture of a G.I.fibre – modes of propagation – meridional and skew rays – Number of modes and cut – off parameters of fibres – single mode propagation – comparison of step and graded index fibres – application of fibres – fibre classification – stepped index fibre, stepped index mono mode fibre – disadvantage. Graded Index multimode fibre, plastic fibres.

Unit II: Light Sources and Detectors:

Introduction - LED – The processes involved in LED – structure of LED – LED materials – output power characteristics of LED – LASER – Laser operation – semiconductor laser diode – spatial emission pattern of laser - current versus output characteristics of a laser. Photo Detectors – Characteristics of Photo – detectors – Photoemissive Photo – detectors, PIN photodiode, Avalanche photo – diode, Photo – transistor, Bit-Error rate.

Unit III :Fibre fabrication, fibre losses and dispersion:

Fibre fabrication – external CVD-AVD-ICVD- characteristics of these methods – fibre drawing and coating – double crucible method. Attenuation in optic fibres – material loss – absorption loss – leaky modes – bending losses – radiation induced losses – Inherent defect losses – inverse square law losses – Transmission losses – Temperature dependence of fibre losses - and cladding losses – Dispersion in optical fibres – intermodal dispersion – mixing of modes – material chromatic dispersion – wave guide dispersion – dispersion power penalty – total dispersion delay – maximum transmission rate.

Unit IV: Optical couplers, splicing and measurement on optic fibres:

Types of optical couplers (Biconically tapered directional coupler, beam splitting directional couplers, T couplers). Calculators on couplers – splicing – mechanical splicing – steps involved in splicing procedure – losses in splices and connectors – loss comparison – measurement of numerical aperture and its related terms – OTDR – working – measurement of fibre loss by OTDR – limitations and advantages.

Unit V: Modulation and detection

Introduction – LED analog modulation – digital modulation – laser modulator (analog and digital) – formats of modulation – PCM – merits and demerits of PCM - intensity modulation – External optical modulators - electro optic modulator – acousto optic modulator – demodulation methods – direct detection methods – heterodyne detection receiver – Homodyne detection receiver – modulation parameter converters.

Text Book:

SubirkumarSarkar. (2008). *Optical fibres and fibre optic communication systems*. New Delhi: S. Chand & Company Ltd.

Unit I	:	Pages 1 – 27, 35-37 (Solved examples included)
Unit II	:	Pages 112 – 117, 120 – 126, 134 – 135, 138 – 142 (solved Examples included)
Unit III	:	Pages 39 – 44, 47 – 51, 81 – 94, 96 – 110 (solved examples included)
Unit IV	:	Pages 161 – 163, 166 – 169, 178 – 182, 184 – 195, 350 – 360, 370 (solvedexamplesincluded)
Unit V	:	Pages 254 – 264 Optoelectronics – A. Ubaldraj and G. Jose Robin, Indira Publication (2002). Pages 151 - 165

Reference Book:

1. Wilson, Hawkes. (2005). *An introduction Optoelectronics*. New Delhi: Prentice Hall of India.
2. Battacharya, P. (2002). *Semiconductor Optoelectronics*. New Delhi: PHI.

Semester IV
Elective II (b) : Microprocessor

Subject Code: PC1743

Number of hours per week	No of credits	Total number of hours	Marks
4	4	60	100

Objectives: 1. To introduce the basic concepts of microprocessor and to develop the assembly language programming skills

2. To develop the microprocessor based programs for various applications

Unit I: Microprocessor Architecture

The 8085 microprocessor unit – Address Bus-Data Bus- Control and status signals, power supply and clock frequency-externally initiated signals-Microprocessor Communication and Bus Timings (excluding timing diagram) – demultiplexing the Bus AD_7 – AD_0- Generating control signals – Detailed look at the 8085 microprocessor unit and its Architecture- Decoding and Executing an instruction-Example of an 8085-Based Microcomputer-Machine cycles and Bus Timings-Opcode Fetch Machine cycle-Memory Read Machine cycle- How to recognize Machine Cycles

Unit II: Introduction to 8085 Assembly language programming

Instruction classification – Instruction format-Instruction Word Size- Opcode Format-Data Format-Instruction and Data storage – How to write, assemble and execute a simple program – Overview of the 8085 instruction set-Writing and Hand Assembling a Program.

Unit III: Introduction to 8085 instructions

Data transfer operations – Arithmetic operations – Logic operations – Branch operations – Writing assembly language programs – debugging a program

Unit IV: Programming Techniques with Additional Instructions

Programming Techniques-Looping, Counting and indexing -Arithmetic operations related to memory – Logic operations: Rotate – Logic operations: Compare

Unit V: Counters and time delay

Counters and time delay – Illustrative program: hexa decimal counters – Illustrative programs : zero to nine (modulo ten) counter –Illustrative program – Generating pulse wave forms-Debugging Counter and Time Delay Programs

Text Books:

Ramesh. S. Goankar, (2013). *Microprocessor architecture, Programming and applications with the 8085*, (6 th ed.). India: Penram International Publishing Pvt Ltd.

Unit I - Chapter 4---4.1, 4.2

Unit II - Chapter 2---2.2 to 2.6

Unit III - Chapter 6---6.1 to 6.6

Unit IV - Chapter 7---7.1, 7.3 to 7.5

Unit V - Chapter 8--- 8.1 to 8.5

Reference Books:

1. NagoorKani, (2004) *Microprocessor and its Applications,* (1st ed.). Chennai: RBA Publications
2. Ram.B and Sanjay Kumar, (2013). *Fundamentals of Microprocessors and Microcontroller* (7th ed.). New Delhi: DhanpatRai Publications (P) Ltd

Semester IV
Elective II (c) : Communication System

Subject Code: PC1744

No of hours per week	No of credits	Total no of hours	Marks
4	4	60	100

Objectives:

1. To impart knowledge on the basis of communication techniques and its applications.
2. To and development of technology for communications like telephones, mobile and satellite systems.

Unit I: Amplitude Modulator:

Introduction to communication – means and modes - Needfor modulation - Block diagram of an electronic communication system - Brief idea offrequency allocation for radio communication system in India (TRAI) – Electromagneticcommunication spectrum - Band designations and usage - Channels and base-band signals.

Unit II: Frequency and Pulse Modulation:

Frequency Modulation (FM) andPhase Modulation (PM) - Modulation index and frequency spectrum – Equivalencebetween FM and PM - Generation of FM using VCO - FM detector (slope detector) - Qualitative idea of Super heterodyne receiver - **Pulse Modulation**: Channel capacity - Sampling theorem - Basic Principles- PAM, PWM, PPM, modulation and detection technique for PAM only - Multiplexing.

Unit III: Digital Pulse Modulation:

Need for digital transmission - Pulse Code Modulation - Digital Carrier Modulation Techniques - Sampling, Quantization and Encoding – Conceptof Amplitude Shift Keying (ASK) - Frequency Shift Keying (FSK) - Phase Shift Keying(PSK) - and Binary Phase Shift Keying (BPSK).

Unit IV: Satellite Communication:

Introduction - Need - Geosynchronous satellite orbits - geostationary satellite advantages of geostationary satellites - Satellite visibility - transponders (C - Band) - Path loss, ground station, simplified block diagram of earthstation - Uplink and downlink.

Unit V: Mobile Telephony System:

Basic concept of mobile communication - Frequency bandsused in mobile communication - Concept of cell sectoring and cell splitting - SIM number - IMEI number - Need for data encryption - Architecture (block diagram) of mobilecommunication network - Iidea of GSM, CDMA, TDMA and FDMA technologies - simplified block diagram of mobile phone handset - 2G, 3G and 4G concepts (qualitativeonly).

Text Books:

1. Roddy, D. & Coolen, J. (2008).*Electronic Communications*. (4th ed.).India: Pearson Education.
2. Kennedy, G. (1999). *Electronic Communication systems*. (3rded.). Newdelhi: Tata McGraw Hill.
3. Andrea Goldsmith. (2015). *Wireless communications*. India: Cambridge University Press.

Reference Books:

1. Tomasi, (2015). *Advanced Electronics Communication Systems*. (6thed.). United States: Prentice Hall.
2. Frenzel, (2012). *Principles of Electronic communication systems* . (3rd ed.).Newdelhi: Tata McGraw Hill.
3. Haykin, S. (2006). *Communication Systems.*(4th ed.). India: Wiley.
4. Roy Blake, (2002). *Electronic Communication system.* (5th Ed.). United States: Cengage Learning

Semester III
Physics Lab – IV

Subject Code: PC17P4

No of hours per week	No of credits	Total no of hours	Marks
2	2	30	100

Objectives: 1. To enable the students to understand the principle and working of analog electronic circuits through some basic experiments.
2. To demonstrate the working of Zener diode, oscillators and op-amp.

Any seven experiments:

1. V-I Characteristics of a Zener diode
2. Zener diode – Voltage regulator
3. Bridge rectifier – with and without filter
4. Single stage CE amplifier – with feedback
5. Single stage CE amplifier – without feedback
6. Logarithmic Amplifier

7. Addition of two DC voltages using Op-amp in inverting and non-inverting modes
8. Adder and subtractor using Op-amp
9. Differentiator and integrator using Op-amp

Semester V

Major Core –V: Elements of Modern Physics

Subject Code: PC1751

No of hours per week	No. of credits	Total No. of hours	Marks
6	5	75	100

Objectives: 1. To provide insight into wave- particle duality and its consequence.
2.To apply skill related to principle and concepts of modern physics.

Unit I: Particle Nature of Radiation

Introduction – Spectral distribution of blackbody radiation – Quantum hypothesis of Planck – Planck's law of radiation – Photoelectric Effect – Photoemission characteristics – Failure of electromagnetic wave theory – Einstein's Photoelectric equation – Millikan's verification of Einstein's equation – Continuous X-ray Spectrum – Compton effect – Energy of scattered radiation and recoil electron – Compton scattering Vs Photoelectric effect – Pair Production – Particle or Waves.

Unit II: Wave Nature of Particles

Introduction – de Broglie waves and wavelength – Wavelength Vs Voltage – Davisson – Germer experiment – Experiments of G.P Thomson – Frisch and Stern's method – Standing electron waves in a circular orbit – Heisenberg's Uncertainty principle – Uncertainty relation – Uncertainty principle and concept of Bohr orbits – Derivation of the Uncertainty principle – phase velocity and group velocity – Phase and group velocities of matter waves.

Unit III: Atomic spectra

Introduction – Spectra of H atom – Orbital magnetic moment of H atom – Larmor precession – Stern &Gerlach experiment – Electron Spin – Vector atom model – Spin-orbit interaction – Pauli's exclusion principle – Total angular momentum in multi-electron atoms – Energy levels and transitions of helium – Alkali spectra – Normal Zeeman effect – Anomalous Zeeman effect – Stark effect.

Unit IV: Atomic models and Quantum Mechanics

Introduction – Atomic spectra – Thomson's model – Rutherford's nuclear atom model – Bohr's model of hydrogen atom – Hydrogen spectrum – Ritz combination principle – Correction for finite nuclear mass – Discovery of heavy hydrogen – Hydrogenic atoms – Sommerfeld's model – Bohr's correspondence principle – Resonance, excitation and ionization potentials – Measurements of critical potentials – Merits and demerits of Bohr's theory

Schrodinger's wave equation – Schrodinger time dependent wave equation – Schrodinger time independent wave equation – Physical significance of the wave function – Applications of Schrodinger wave equation – Particle in a one dimensional potential well – Particle in three dimensional box – Degeneracy – Electrons in a metal.

Unit V: Special Theory of Relativity

Introduction – Frame of reference – Galilean transformations – Michelson-Morley experiment – Einstein's postulates – Lorentz transformations – Length contraction – Time dilation – Relativity of simultaneity – Addition of relativistic velocities – Relativistic mass – Mass-energy relation – Minkowski's four dimensional space – Time continuum – General theory of relativity – Massless particle.

Text Books:

1. Palanisamy, P.K. (2012). *Engineering Physics*. (1st ed.).,India: Scitech Publications (India) Pvt.Ltd.
   Unit IV: Chapter 8: 8.6, 8.7

   Unit V: Chapter 7: 7.1-7.16

2. Gupta, A.B. (2015). *Modern Physics*. (2nd ed.). Kolkatta: Books and Allied (p) Ltd.
   Unit I: Chapter 2: 2.1-2.15

   Unit II: Chapter 3: 3.1-3.13

   Unit III: Chapter 7, 7.1 – 7.16

   Unit IV: Chapter 4, 4.1 – 4.15

Reference Books

1. Aruldhas, G., Rajagopal, R. (2005).*Modern Physics*. (1st ed.). India: Prentice Hall of India Pvt Limited.
2. Arthur Beiser. (2006). *Concepts of Modern Physics*. (6th ed.). India: Tata McGraw-Hill Edition.

Semester V

Major Core VI: Waves and Optics
Subject Code: PC1752

No. of hours per week	No of credits	Total no hours	Marks
6	5	90	100

Objective:

1. To study the electromagnetic nature of light.
2. To enable the students to link the theory with day to day life.

Unit I:Geometrical Optics

Introduction – Refractive index and optical path – Sign convention – Refraction through lenses – Principle focii – Deviation produced by a thin lens – Power of alens - Aberrations – Spherical aberration in a lens –Methods of reducing spherical aberration (brief) – Chromatic aberration - Refraction through a prism – Angular and chromatic dispersion – Dispersive power- Achromatism in prism – Deviation without dispersion – Dispersion without deviation - Direct vision spectroscope – Condition for achromatism of two lenses placed in contact and separated by a finite distance.

UnitII:Wave Optics:

Oscillations – Waves – Travelling waves – Wave front and ray – Examples of waves – Characteristics – Mathematical representation – Phase velocity – Complex representation – Wave packet and band width – Group velocity – Propagation of light waves: Introduction – Maxwell's equations – Physical significance – Electromagnetic waves – Constitutive relations – Wave equation for free space – Velocity of Electromagnetic waves – Relation between refractive index and relative permitivity – Uniform plane waves – Transverse nature of plane waves – Relation between E and H in a uniform plane wave – Characteristic impedance.

Unit III:Interference:

Introduction – Young's experiment – Coherent source – Phase and path difference – Analytical treatment – Theory of inference – Fresnel's biprism – Fringes with white light – Lioyd's mirror – Interference in thin films – Interference due to reflected and transmitted light – Wedge shaped thin film – Testing the planeness – Newton's rings – Determination of λ.

Unit IV:Diffraction:

Fraunhofer diffraction : Introduction – Single slit – Intensity distribution – Double slit – Comparison between interference and diffraction – Fraunhofer diffraction at N slits – Plane diffraction grating – Theory – Principal maxima – Oblique incidence – determination of λ using grating – Dispersive power – Fresnel's diffraction : Introduction – Huygen's Fresnel theory – Fresnel's assumptions – Rectilinear propagation of light – Zone plate – Action of zone plate – Difference between convex lens and zone plate – Diffraction pattern due to straight edge – Narrow slit – Narrow wire.

Unit V:Polarization :

Transverse nature of light waves – Unpolarized and polarized light – Types of polarization – Production and analysis of plane polarized light – Polarizer and analyser – Anisotropic crystals – Double refraction – Ordinary and extra ordinary ray – Positive and negative crystals – Nicol prism – Quarter and half wave plates – Production and analysis of elliptically and circularly polarized light – Analysis of polarized light.

Text Books:

1. SubrahmanyamBrijilal,N.(2004). *A text book of optics*. (1st ed.).Newdelhi: S. Chand and Company Pvt.Ltd.
   Unit I: Sections: 1.1, 1.2, 1.5, 1.6, 2.1 – 2.3, 2.5, 2.7, 3.1, 3.5, 3.6, 3.12 – 3.14, 3.16, 3.18, 3.22 – 3.24, 3.27, 3.28
   Unit III: Sections: 8.1 – 8.6, 8.8, 8.9, 8.11, 8.15 – 8.17, 8.21 - 8.24

2. SubrahmanyamBrijilal, N., Avadhanulu, M.N.(2015). *A text book of Optics*. (25thed.). Newdelhi: S. Chand and Company Pvt.Ltd.

Unit II:Sections: 12.1 – 12.6, 12.8, 12.9, 12.11, 12.14
Unit II: Sections: 13.1 – 13.5
Unit IV: Sections: 17.1 – 17.7, 17.10, 17.11, 17.12
Sections: 18.1, 18.2, 18.2.1, 18.4 – 18.7.3, 18.7.6, 18.7.7
Unit V: Sections: 20.1 – 20.6.1, 20.8, 20.10,20.11, 20.11.2, 20.11.3, 20.12, 20.19.1, 20.19.2, 20.20 – 20.22

Reference Books:

1. Murugeshan, R., KiruthigaSivaprasath. (2014).*Optics and spectroscopy*.(9thed.). Newdelhi: S. Chand and Company Pvt. Ltd.
2. Gupta, A.B. (2010). *Modern Optics*. (2nded.).Kolkata: ArunabhaSen Books and Allied (P) Ltd.

Semester V

Major Core VII: Solid State Physics
Subject Code: PC1753

No of hours per week	No of credits	Total no of hours	Marks
5	5	90	100

Objectives:

1. To impart knowledge on the structure of crystals and the different types of materials.
2. To develop a scientific attitude at micro and nano scales of materials

Unit I: Bonding in Solids

Introduction – Bonding in solids – An overview of an atom – Condition for bonding – Octet rule and stability – Van der Waal's bonding – Ionic bonding – Covalent bonding – Dipole-dipole interactions – Hydrogen bonding – Metallic bonding – Mixed bonding – Calculation of ionization energies for compounds – Comparison of physical properties

Unit II: Crystalline Materials

Classification of solids – Periodicity in crystalline solids – Lattice translation vectors – Unit and primitive cells – Bravais lattices – Symmetry operations- Crystal indexing – Miller indices of lattice planes – Directions in crystals – Atomic packing factor (APF) – Density and lattice constant - Other common crystal structures

Unit III: Magnetic Materials

Magnetic and nonmagnetic materials – Magnetic dipole compared with electric dipole – Important terms in magnetism – Sources of permanent magnetic moment- Classification of magnetic materials – Theory of diamagnetism – Classical theory of paramagnetism – Theories of ferromagnetism – The Weiss exchange (molecular) field – Domain theory – Hysteresis – Hard and soft magnetic material- Antiferromagnetism - Ferrimagnetism

Unit IV: Dielectric Materials

Dielectrics – Polarizability and dielectric constant – Types of polarization – Langevin's theory of polarization in polar dielectrics – Piezoelectric materials – Ferroelectrics – Antiferroelectricity – Internal or local field – ClausiusMossotti equation- Lorentz- formula - Frequency and temperature effects on polarization - Dielectric breakdown - Dielectric loss – Classification of insulating materials – Important insulating materials

Unit V: Semiconductors and Superconductors

Bands in solids – Elemental and compound semiconductors – Conduction in semiconductors – Band structure of semiconductors – Concentration of charge carriers – Mobility and conductivity in semiconductors – Discovery of superconductivity – Superconductivity and magnetism – Critical magnetic field – Meissner effect – Magnetic induction in superconductors – Type I and Type II Superconductors – Isotope effect - Applications of superconductors.

Text Book :

Rita John. (2014). Solid State Physics. (1st ed.). New Delhi: McGraw Hill Education (India) Pvt. Ltd.

Unit I: Chapter1: 1.1-1.12

Unit II: Chapter 2: 2.1 – 2.7, 2.9 – 2.12, 2.15

Unit III: Chapter 8: 8.1 –8. 6, 8.7: 8.7.1, 8.10: 8.10.1, 8.10.4, 8.10.6, 8.10.7, 8.11-8.12

Unit IV: Chapter 10: 10.1 – 10.5, 10.6: 10.6.1 – 10.6.2, 10.7 – 10.15

Unit V: Chapter 7: 7.1 – 7.Chapter 9: 9.1 – 9.9, 9.20

Reference Books :

1. Charles Kiltel. (2004). Introduction to Solid State Physics. (8th ed.). Wiley India Pvt. Ltd.
2. Srivastava, J.P. (2015). Elements of Solid State Physics. (4th ed.). Prentice – Hall of India.
3. Ibach, H. Luth, H. (2009). Solid State Physics.(4th ed.). New York : Springer Berlin Heidelberg.
4. Wahab, M.A. (2011). Solid State Physics. (3rd ed.). New Delhi: Narosa Publications.

Semester V

Elective III (a): Programming with C++

Subject Code: PC1754

Number of hours per week	No of credits	Total number of hours	Marks
5	4	75	100

Objectives:

1. To apply C++ language to write simple programs for solving general Physics problems
2. To enable the students developing their own Applications using C++ and evolve as efficient software programmers

Unit I: Tokens, Expressions and Control Structures

Introduction – Tokens – Keywords – Identifiers and constants – Basic data types – User defined data types – Storage classes – Derived data types – Symbolic constants – Declaration of Variables – Dynamic initialization of variables – Reference variables – Operators in C++ - Scope resolution operator – Memory management operator

Unit II: Functions, Classes and Objects:

The main function – Function prototyping – Call by reference – Return by reference – Inline functions – Default arguments – Constant arguments – Function overloading – Friend and virtual functions.

Specifying a class – Defining member function – A C++ program with class – Making an outside Function inline - Nesting of member functions – Private member functions – Arrays within a class – Memory allocation for objects – Static data members – Static member functions – Arrays of objects – Friendly functions

Unit III: Constructors, Destructors and Operator overloading:

Constructors – Parameterized constructors – Multiple constructors in a class – Constructors with default arguments – Dynamic initialization of objects – Copy constructor – Dynamic constructors - Constructing two dimensional arrays – Destructors

Defining Operator overloading – Overloading Unary operators – Overloading Binary operators - Overloading Binary operators using friends – Manipulation of strings using operators – Rules for Overloading operators

Unit IV: Inheritance, Pointers and Virtual functions

Defining derived classes – Single inheritance - Making a private member inheritable – Multilevel inheritance – Multiple inheritance – Hierarchical inheritance – Hybrid inheritance.

Pointers – Pointers to objects – Pointers to derived classes – Virtual functions – Virtual constructors and destructors.

Unit V: Managing console I/O operations and Working with files:

C++ streams – C++ stream classes – Unformatted I/O operations – Formatted console I/O operations – Managing output with manipulators

Classes for file stream operations – Opening and closing a file – Detecting End of file – More about open (): file modes – File pointers and their manipulations

Text Book:

Balagurusamy, E.(2015). Object Oriented Programming with c++. (6^{th} ed.). New Delhi: McGraw Hill Education (India) Private Limited.

Unit I : 3.1 – 3.9, 3.11 - 3.15, 3.17
Unit II : 4.1 – 4.8, 4.10 - 4.11, 5.1, 5.3 – 5.13,5.15
Unit III : 6.1 – 6.9, 6.11, 7.1 – 7.6, 7.8
Unit IV : 8.1 – 8.8, 9.1 – 9.3,9.5 – 9.6, 9.8
Unit V : 10.1 – 10.6, 11.1 – 11.6

Reference Book :

1. Ravichandran, D. (2008). Programming with C++.(3rd ed.).New Delhi: TataMcGraw Hill Publishing company Ltd.

Semester V

Elective III (b): Applied physics

Subject Code: PC1755

No of hours per week	No of credits	Total no of hours	Marks
5	4	90	100

Objectives: 1. Tounderstand various concepts in medicine, astrophysics, communication, photography and videography.

2.To relatethe principles and concepts of medicine, astrophysics, communication, photography and videography in day to day life.

Unit I: Medical physics

Sources of biomedical signals – Origin bioelectric signals – Electrocardiogram (ECG) – electro encephalogram (EEG) – Electromyogram (EMG) – Phonocardiograph (PCG) – Digital Stethoscope, Cardiac Pacemakers

Unit II: Space physics

Vital statistics of the sun – Solar photosphere – Fraunhoffer lines – Structure of solar atmosphere – Solar interior – Sunspots and solar activity – Radio studies of quiet sun – Gross properties of the earth – Internal structure of the earth – The earth's magnetic field – Asteroids – Meteorites – Comets as members of the solar system.

Unit III: Fibre optics

Physical nature of optical fibre – Fibre classification – Fibre splices, connectors and couplers – Manufacturing of fibre – Advantages and disadvantages of using optical fibre as communication medium – Application areas of optical fibre – Fibre optic communication system – Optical transmitter – Optical receiver – Optical repeater – Optical telecommunication system – Different optical telecommunication links – Technologies of the optical network services.

Unit IV: Photography and Videography

Camera – Mechanical and auto interchangeable lenses – Telephoto – Wide angle – Zoom and macrolenses – Developing of the film – Printing – Principle of television – Colour composite video signal – Colour television systems (PAL, SECAM, NTSC) – Video camera : Pick up device – Optical section – Charge coupled device (CCD) – Electronic shutter – Handling highlight – HAD sensor – Advantages, limitation, resolution of CCD – Digital signal processing in camera.

Unit V : Satellite communication

Basic characteristics of satellites – Advantages of Sattellite communication – Use of microwave frequencies- Digital transmission, compression and routing – Improves space

platforms and launching systems – satellite orbit configurations – Evolution of satellite communication: SYNCOM- COMSAT – Specialized systems : DTH.

Text Books:

1. R.S. Khandhur, (2010). *Hand of biomedical Instrumentation*. (1st ed.). New York. Tata McGraw Hill Education Private Ltd.
   UNIT I: 1:1.4, 2.1, 2.1.1, 2.1.2, 2.1.3, 5.3, 5.4,25: 25.1-25.5
2. K.D. Abhyankar. (1999). *Astrophysics of the solar system*, (1st ed.). Hyderabad. University press Pvt. Ltd.
   UNIT II: 4.2 - 4.9 , 9.2, 9.3.
3. Anuradha De, (2003). *Optical fibre and laser – principles and applications*, (2nd ed.). New Delhi. New age international publishers.
   UNIT III: 2.2, 2.4, 2.7, 2.10, 2.11, 2.12, 4.3, 4.3.1- 4.3.3, 4.4, 4.4.1-4.4.2.
4. Paul Bedell, (2005). *Wireless Crash course*. (2nd ed.). New York Tata McGraw Hill Education Private Ltd.
5. Bruce R. Elbert, (2008) *Introduction to Satellite Communication*, Artech House Publication.
   UNIT V: 1.1: 1.1.1-1.1.4, 1.3, 2.1, 2.3: 2.3.1.

Reference books:

1. Leon W. Couch, (1988) *Modern communication systems*, New Delhi, India. Prentice Hall – India Pvt Ltd.
2. Killen,H.B.,(1988).*Digital communications with Fibre optic and satellite applications,* Prentice Hall International.

Semester V
Elective (c) : Bio Physics
Subject Code: PC1756

No of hours per week	No of credits	Total no of hours	Marks
5	4	75	100

Objective: 1. To use methods of physics to study biological process.
2.To understand the applications of biophysics in the field of medicine.

Unit I: Molecules of life:

Metabolites - proteins and nucleic acids - Their sizes - Types and roles in structures and processes – Transport - Energy storage - Membrane formation – Catalysis – Replication - Transcription – Translation - Signaling.

Unit II: Mathematical Model:

Typical populations of molecules of various types present in cells - Their rates of production and turnover - Energy required to make a bacterial cell - Simplified mathematical models of transcription and translation - Small genetic circuits and signaling pathways - Random walks and applications to biology – Mathematical models to be studied analytically and computationally.

Unit III: The level of a cell:

The numbers of distinct metabolites - Genes and proteins in a cell - Complex networks of molecular interactions: metabolic - Rregulatory and signalling Networks - Dynamics of metabolic networks - the stoichiometric matrix - Living systems as complex organizations - systems biology - Models of cellular dynamics – The implausibility of life based on a simplified probability estimate, and the origin of life problem.

Unit IV:The complexity of life:

At the level of a multicellular organism: Numbers and types of cells in multicellular Organisms - Cell types as distinct attractors of a dynamical system - Stem cells and cellular differentiation - Pattern formation and development - Brain structure: neurons and neural networks. Brain as an information processing system.

Unit V: Evolution:

The mechanism of evolution: variation at the molecular level - Selection at the level of the organism - Models of evolution - The concept of genotype-phenotype map.

Text Books:

1. Kim Sneppen, Giovanni Zocchi. (2005). *Physics in Molecular Biology.*
2. Chapman, Hall, Uri Alon. (2013). *An Introduction to Systems Biology*. (Special Indian ed.)
3. M. Ridley. (2009). Evolution. (3rd ed.),) Blackwell Publishers.

References:

1. Philip Nelson. (2004). *Biological Physics – Energy*. Information, Life. New York: W H Freeman & Co.
2. Rob Phillips et al. (2013). *Physical Biology of the Cell.* (2nd Ed.), London & NY: Garland Science, Taylor & Francis Group.

Semester V

Skill Based Course
Basic Electrical circuits and applications

No of hours per week	No of credits	Total no of hours	Marks
2	2	30	100

Objectives:1. To acquire knowledge on the basis of electrical parameters and circuits, electrical wiring, electrical instruments appliances used in daily life and to understand the concept of power generation.

2. To develop basic trouble shooting skillsin domestic appliances.

Unit I: Electrical quantities

Introduction to Electricity - Current - Voltage - Resistance - Ohm's Law - DC Circuit - Series Circuits - Parallel Circuits- AC Voltage - Magnetism & Electromagnetism – Alternating

Current (AC) - Sine Waves - AC vs. DC - AC Voltage - Sine Wave Values - Electric Power- Calculating Power - Kilowatt .

Unit II: Circuit elements and Power generation

Symbols of electrical elements - Resistors - Conductors - Inductor – Capacitor and transformer - Single phase and three phase - Star and delta connections - Rules of electric connections - Generation of electric power by thermal, hydro, and nuclear methods - Battery - Study of motors and Generators.

Unit III: Electrical Wiring

Systems of supply – Systems of wiring – Testing of wiring installation – Materials used for wiring – A lamp controlled by a switch – Number of lamps each controlled by its switch – Staircase connection – Earthing - Lamp holders, sockets - Fuse base - Distribution box –Trip switches - Earth connection - House wiring - Experimental study of main, distribution and switch boards.

Unit IV : Electrical Instruments and appliances

Voltmeter, Ammeter, Multimeter - Incandescent lamp- Fluorescent bulb, Choke and Starter – Electric Iron – Emergency lamp – Heater - Ceiling fan - Microphone – amplifier - Loudspeaker – Thermistor – LDR - LED – Electronic switch using transistor and relay - Battery eliminator.

Hands on training

a. Uses of tester &Multimeter.
b. A lamp controlled by a switch with fuse circuit. A lamp controlled by two switch
c. Calling bell.
d. Florescent lamp wiring and testing
e. Music bell
f. LDR application.
g. Working of a relay
h. Microphone – amplifier – Loudspeaker setup

Text Books:

Course material prepared by the Department.

Reference Book:

1. Arnold,R.B.(1986). *A first electronics course*. (1st ed.). Cheltenham, England:Stanley Thornes (Publishers) Ltd.
2. Theraja, B. L. (2002).*A text book in Electrical Technology*.(23rd ed.). New Delhi: S. Chand and Company

Semester VI

Major Core VIII: Mathematical methods of Physics

Subject Code: PC1761

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objective:1. To emphasize the use of mathematical tools which help in solving problems in physics.

2. To train topics in vector analysis, matrices, differential equations and Fourier analysis.

Unit I: Vector Analysis

Point function – Scalar field – Vector field – Gradient of a Scalar field – Physical interpretation – Lamellar Vector field – line, surface and volume integrals – Divergence of a vector function – Expression for divergence in Cartesian coordinates –Curl of vector function – Expression for curl in Cartesian coordinates – Physical significance of curl – Gauss divergence theorem – Green's theorem .

Unit II: Matrices

Eigen values - Eigen vectors – Characteristic equation of a matrix – Cayley – Hamilton theorem – Theorems on eigen values and eigen vectors – Diagonalization of matrices – Special type of matrices – Inverse of a matrix – Non-homogenous linear equations – Cramer's rule for solving non-homogenous linear equations

Unit III: Differential Equations

First order equations – Variables are separable – Homogenous equations – Non – homogenous equations reducible to homogenous ones – Linear differential equations – Equations of first order and higher degrees – Physical examples: Radioactive decay process.

Unit IV: Fourier Analysis

Harmonic oscillations – Harmonic synthesis and analysis – Fourier contribution – Fourier series –Dirichlet's theorem – Fourier coefficients – Fourier cosine and sine series – Symmetry – Complex form of Fourier series – Change in interval of expansion – Applications of Fourier series: Sawtooth wave - Half wave rectifier – Full wave rectifier.

Unit V: Random Variables and Probability

Random Variables – Simple random sample – Mean – Median – Mode – Dispersion – Elementary properties of probability – Conditional probability – Addition rule of probability – Multiplication law of probability – Probability distribution – Mean, variance and standard deviation of Poisson distribution.

Text Books:

1. Murugeshan, R. (2014). *Mechanics and mathematical Physics*. New Delhi: S. Chand & Company Pvt. Ltd.
   Unit I: Chapter: 7, Sections: 7.1 – 7.8, 7.10, 7.12
   Unit II:Chapter: 8 and 12: 12.1 – 12.3
2. Gupta, A.B. (2010). *Fundamentals of Mathematical Physics*. Kolkata: ArunabhaSen Pvt. Ltd.
   Unit III: Chapter 6, sections 6.2 (1 - 5), 6.3, 6.4.2.1
   Unit IV: Chapter 11, sections 11.2, 11.3 (1 – 5), 11.4.1
   Unit V: Chapter 15, sections 15.1, 15.2(1 – 3), 15.3 – 15.9

Reference Books:

1. Arfken, G.B.& Weber, H.J., Harris, F.E., (2013).*Mathematical Methods for Physicists*.

(7^{th}ed.).Noida. Elsevier.

2. George, F.& Simmons, (1991). *Differential Equations*. (2^{nd} ed.). New York McGraw Hill.

3. James Nearing, (2010). *Mathematical Tools for Physics*. (3^{rh} ed.). New York. Dover

Publications.

4. Zill, D.G. &Wright, W.S. (2012). *Advanced Engineering Mathematics*. (5^{th}ed.), Burlington.

Jones and Bartlett Learning.

Semester VI

Major core IX: Digital Systems and Applications

Subject Code: PC1762

No. of Hours per week	No of Credits	Total no of Hours	Marks
6	5	90	100

Objectives:1. To understand the different concepts in digital electronics, digital devices and applications.

2.To prepare students to perform the analysis and design of various digital electronic circuits.

Unit I : Logic gates and Boolean Algebra

Universal logic gates – NOR, NAND – De Morgan's theorems – Positive and negative logic – Boolean laws and theorems – Sum of products method – truth table to Karnaugh map (Three variable and Four variable maps) – Karnaugh simplifications – Don't care conditions – Product of sums method – Product of sums simplification.

Unit II : Number System

Binary number system – Binary to decimal conversion – Decimal to binary – Octal numbers – Hexadecimal numbers – Binary addition – Binary subtraction – 1^s and 2s complement method – Arithmetic building blocks – Half adder and full adder (truth table and Karnaugh map).

Unit III : 555 timer and flipflops

555 timer – Monostable multivibrator – Astable multivibrator – Frequency divider – Logic gate flip flop – R-S flip flop – Clocked R-S flip flop – J-K flip flop – R-S master slave flip flop – J-K master – Slave flip flop – D flip flop.

Unit IV : Registers and Counters

Types of registers – Serial In - Serial Out – Serial In - Parallel Out – Parallel In - Serial Out – Paralle In – Paralle Out - Ring counter – Decade counter: A MOD -5 counter – Shift counter – Shift counter Modulus.

Unit V : A-D and D-A converters

Analog to digital conversion, Digital to Analog conversion – A-D converter – Multiplexer – De multiplexer – Encoder: Decimal to BCD encoder – Decoders : BCD to decimal decoder – Differential instrumentation amplifier – Transducer – Instrumentation amplifier using Transducer Bridge – Temperature indicator – Analog weight scale.

Text Books:

1. Donald .P. Leach, Albert Paul Malvino, Goutam suba, (2006). *Digital Principles and Applications.* (6^{th} ed.). New Delhi: Tata, Mc Graw Hill publishing company.
   Unit I: Section – 2.2, 2.4, 3.1 to 3.3, 3.5 to 3.8
   Unit II : Section – 5.1 to 5.5, 6.1, 6.2, 6.7
2. G. Jose Robin and A. Ubald Raj. (2005). *Applied Electronics*. (1^{st} ed.). Marthandam: Indira publication.
   Unit III : Chapter – 3
   Unit V : Chapter – 5
3. Donald P Leach, Albert Paul Malvino. (2002). *Digital principles and application.* (5^{th} ed.). New Delhi: Tata Mc Graw Hill Publishing Company Ltd.
   Unit IV: Section : 9.1 – 9.6, 10.5, 10.7

Reference Books

Malvino, A.P. and Brown, J.A. (1997). *Digital Computer Electronics*. (3^{rd} ed.). New Delhi: Tata McGraw Hill Publishing Company

Question papers should have 20% weightage for problems in Part B.

Semester VI

Major core X: Nuclear Physics

Subject Code: PC1763

No of hours per week	No of credits	Total no of hours	Marks
5	5	90	100

Objective: 1. To enable the students to understand the properties, models and radioactive reaction of the nucleus.

2.To create awareness on nuclear reactions such as fission, fusion, radiation detectors and elementary particles so that students can shine.

Unit I : Properties of Nuclei

Constituents of nuclei - Isotopes, Isobars, Isotones and mirror nuclei - Nuclear mass and binding energy - Unit of atomic mass - Binding energy and stability of nucleus - Mass defect and packing fraction - Binding fraction Vs mass number curve - Nuclear size - Nuclear spin - Nuclear energy levels - Nuclear magnetic moment - Parity of nuclei - Nuclear quadrupole moment - Statistics of nuclei - Nuclear forces - Liquid drop model - Semi-empherical mass formula - Shell model.

Unit II : Radioactivity

Radioactivity - Radioactive reactions - Radioactive decay law - Statistical nature of radioactivity - Activity or strength of a radio-sample - Radioactive decay : Conservation laws - Radioactive series: Displacement law - Successive transformation – Radioactive equilibrium - Radioactive dating: Age of minerals, rocks - Alpha decay - Beta decay - Gamma decay.

Unit III : Nuclear Reactions

Nuclear Reactions: Basics - Conservation laws in nuclear Reactions - Energetics of nuclear Reactions - Crosssection of nuclear Reactions - Reaction mechanisms - Nuclear fission - Energy released in fission of U-235 - Liquid drop theory of fission - Nuclear chain reaction - Nuclear Reactor - Types of reactor - Breeder reactor - Fission bomb - Fusion: Thermo nuclear reaction - Source of stellar energy: Natural fusion - Uncontrolled fusion: Hydrogen bomb.

Unit IV : Radiation Detectors and Particle Accelerators

Introduction - Ionisation chamber - Proportional counter - Geiger Muller counter - Neutron detection - Cloud chamber - Scintillation counter - Photographic detection - Solid state track detector - Semiconductor detector - Particle accelerators - Linear accelerator - Cyclotron - Synchro cyclotron - Betatron .

Unit V : Elementary Particles

Introduction - Fundamental Interactions - Pions and Muons - K mesons - Hyperons - Antiparticles - Classification of elementary particles - Conservation laws - CPT theorem - Resonance particles - Symmetry classification of elementary particles - Quark model Unification of interactions - The standard model.

Text Books:

1. Gupta,A.B.(2015). *Modern Physics*. (2nd ed.). New Delhi: Books and Allied (P) Ltd.

Unit I: Chapter 18 : 18.1-18.3, 18.5-18.16, 18.17, 18.18, 18.18.1, 18.19, 18.19.1 - 18.19.4

Unit II: Chapter 19 : 19.1 - 19.9, 19.11

Unit III: Chapter 20: 20.1-20.16

Unit IV: Chapter 21: 21.1-21.5, 21.7, 21.7.1, 21.7.2, 21.9, 21.11-21.16, 21.17.2, 21.18

Unit V: Chapter 22: 22.1-22.9, 22.10, 22.11-22.14

2. Arthur Beiser. (2006). *Concepts of Modern Physics*. (6th ed.).New Delhi: Tata McGraw - Hill Edition,

Unit II: Chapter 12: 12.4-12.6, Appendix (theory of alpha decay)

Reference Books:

1. Tayal D.C. (2002). *Nuclear Physics*. (1st ed.). New Delhi: Himalaya Publishing House.

2. Roy R.R. and Nigam B.P. (1983). .*Nuclear Physics*, (2nd ed.). Bangalore: New age International Ltd.

3. SatyaPrakash, (2004). *Nuclear Physics and Particle Physics*.(1st ed.). New Delhi: S. Sultan Chand & Sons Publications.

Semester VI

Elective – IV (a): Nanomaterials and its Applications

Subject Code: PC1764

No of hours per week	No of credits	Total no of hours	Marks
5	4	75	100

Objectives :1. To gain knowledge on synthesis and characterization of nanomaterials.
2.To understand the advancements and applications of nanostructures.

Unit I : Introduction to nanotechnology

History of nanotechnology – Techniques in nanotechnology – Scientific Revolutions – Dimensions of nanostructures – One dimensional nanoscale– Two dimensional nanoscale – Three dimensional nanoscale– What makes 'nano' special? – Size matters – Nanocrystals – Length scale of Nanomaterials – Classificationof nanomaterials : Fullerenes, nanoparticles , nanorings, nanorods, nanoshells – Properties of nanoparticles over other materials

Unit II : Nanostructure Materials Synthesis and Characterization

Synthesis of nanomaterials: Plasma arcing, Chemical vapour deposition, sol-gel method, electro-deposition, ball milling – Properties of nanoparticles : Physical , chemical , electrical, optical , magnetic and mechanical properties – Nanocomposites – Characterization of nanomaterials – X-ray diffraction (XRD) –Scanning Electron Microscope (SEM) – Transmission Electron Microscope (TEM) – Analytical Electron Microscope – Significance of nanoparticles – Applications of nanomaterials – Applications of nanotechnology.

Unit III : Quantum wells, Quantum wires and Quantum Dots

Introduction – Potential well – Quantum well – Particle in a box – One-dimensional box – Two-dimensional box – Three-dimensional box –Superlattices– Types of Superlattices– Applications of quantum wells –Quantum wire – Density of States (3D, 2D, 1D, 0D) –Quantum dots – Electrons in mesoscopic structures.

Unit IV : Carbon Nanotubes

Discovery of nanotubes –Allotropes of carbon – Structure of carbon nanotubes – Categories of carbon nanotubes : Tours – Buckminster fullerene – Carbon nanohorns – Fullerite – Nanobud–Synthesis of carbon nanotubes: Laser method – Electrolysis – Chemical Vapour Deposition (CVD) –Purification of carbon nanotubes and fullerene –Applications of carbon nanotubes.

Unit V: Applications of Nanotechnology

Applications of nanomaterials and Nanowires – Solar power using nanotechnology: Solar cells, Plastic solar cells – Nanotechnology in textiles – Applications of nanocomposites –Nano optics – Nanotechnology in communication field – Quantum dot laser – Photonic crystals – MEMS – Mechanical oscillators – Thin film Optics

Text Books:

1. Manasi Karkare. (2008). *Nanotechnology: Fundamentals and applications*. (1 st ed.). Mumbai: I.K. International publishing house.

   UNIT I : Relevant topics in chapters 1& 2

   UNIT V: Relevant topics in chapters 3,6,7,8,11 and 12

2. Palanisamy. P.K (2012). *Engineering Physics.* (1st ed.). India: SciTech Publications Pvt.Ltd,

   UNIT II: Chapter 5 : 5.2, 5.4, 5.4.1-5.4.5, 5.5, 5.5.1 – 5.5.2, 5.6, 5.6.1-5.6.5, 5.7, 5.7.1-5.7.6, 5.8, 5.9

3. Sr. Gerardin Jayam. (2010). *Basic Nanophysics.* (1st ed.). Nagercoil: Dept. of physics, Holy Cross College.

   UNIT III: 2.1, 2.2, 2.2.1, 2.3, 2.3.1- 2.3.3, 2.4, 2.4.1, 2.5, 2.6, 2.7, 2.7.1-2.7.3, 2.8, 2.9

   UNIT IV: 3.1, 3.2, 3.3, 3.4, 3.4.1, 3.5, 3.5.1-3.5.3,3.6,3.6.1-3.6.3, 3.7, 3.8.

Reference Books:

1. Charles P. Poole Jr & Frank J. Owens.(2008). *Introduction to Nanotechnology* . (1st ed.). Germany: Wiley publications.

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2. Mohankumar . G. (2016). *Nanotechnology-Nanomaterials and Devices*. (1st ed.).New Delhi: Narosa publishing House.

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Semester VI
Elective IV (b): Basic Astrophysics
Subject Code: PC1765

No of hours per week	No of credits	Total no of hours	Marks
5	4	75	100

Objectives:1. The course enables the students to understand the historical evolution of Astrophysics and principles involved in Astrophysics.

2. The topics included are sun, stellar evolution, comets and the milky waygalaxy which play a key role in the future employability and global progress of students

Unit I: General Introduction

Historical development of Astronomy – Observational methods and scope of Astronomy – physical properties – apparent and absolute magnitude – luminosity – measurements of distances, mass, radius etc. of stars.

Optical telescope – resolving power – light gathering power of a telescope mounting – different types of telescope.

Unit II: Sun

Physical characteristics – sources and transport of energy atmosphere – chromospheres – solar corona – sunspots – limb darkening – solar cycle – solar magnetic field – plasma eruptions – solar flares.

Unit III: Stellar Evolution

Stellar structure – protostar – main sequence – red giant white dwarfs – supernova – planetary nebulae – neutron stars – black holes

Unit IV: Peculiar Objects

Variable stars – cephid variables – distance estimates – ALGOL – binaries pulsars – quasars – multiple stars – globular clusters – Comets – meteroids – asteroids – Chiron

Unit V: Galaxies

Our Galaxy – different types of galaxies – groups of galaxies – motion of galaxies – super cluster – large scale – structure of the universe.

Structure of Milky wave galaxy – nebulae – center of our galaxy – higher energy sources in our galaxy.

Text Books :

Abhayankar, K.D. (1999). *Astrophysics of the solar systems*, (1st ed.). New Delhi: University Press (India) Private Limited.

Unit I : Chapter 1: 1.1 to 1.9
Unit II : Chapter 4: 4.1 to 4.10
Unit III : Chapter 10: 10.1 to 10.6
Unit IV : Chapter 9: 9.1 to 9.11
Unit V : Chapter 11: 11.1 to 11.7

Reference Books:

1. Krishnaswamy, K.S. (1996). *Astrophysics – A modern perspective*. (1st ed.). Bangalore: New age Int. Lt. Publication.
2. Robert Robins., William Jefereys. (1998). *Discovering Astronomy*. (1st ed.). New York: Wiley Publication.
3. Jay M. paschoff. (1992). *Contemporary Astronomy* . (1st ed.). New Delhi: Tata McGraw Hill Publication.

Semester VI

Elective IV (c) : Digital Signal Processing (Elective - IV)
Subject Code: PC1766

No of hours per week	No of credits	Total no of hours	Marks
5	4	75	100

Objectives:1. Introduce signals systems, time and frequency domain concepts and the associated mathematical tools that are fundamental to all DSP techniques

2.Provide a through understanding and working knowledge of design, implementation, analysis and comparison of digital filters for processing of discrete time signals.

Unit I: Discrete-Time Signals and Systems:

Classification of Signals - Transformations of the Independent Variable - Periodic and Aperiodic Signals - Energy and Power Signals - Evenand Odd Signals - Discrete-Time Systems - System Properties. Impulse Response - Convolution Sum - Graphical Method - Analytical Method - Properties of Convolution - Commutative – Associative – Distributive – Shift - Sum Property System Response toPeriodic Inputs - Relationship Between LTI System Properties and the ImpulseResponse – Causality – Stability – Invertibility - Unit Step Response.

Unit II: **Discrete-Time Fourier Transform:**

Fourier Transform Representation of Aperiodic - Discrete-Time Signals - Periodicity of DTFT - Properties – Linearity - Time Shifting - Frequency Shifting - Differencing in Time Domain - Differentiation in Frequency Domain - Convolution Property. **The *z*-Transform:** Bilateral (Two-Sided) *z*-Transform - Inverse *z*-Transform - Relationship Between *z*-Transform and Discrete-Time Fourier Transform - *z*-plane.

Unit III: Filter Concepts: Phase Delay and Group delay - Zero-Phase Filter - Linear-Phase Filter - Simple FIR Digital Filters - Simple IIR Digital Filters - All pass Filters - Averaging Filters - Notch Filters.

Unit IV: Discrete Fourier Transform:

Frequency Domain Sampling (Sampling of DTFT) - The Discrete Fourier Transform (DFT) and its Inverse - DFT as a Linear transformation,Properties – Periodicity – Linearity - Circular Time Shifting - Circular Frequency Shifting- Circular Time Reversal - Multiplication Property - Parseval's Relation - Linear Convolution Using the DFT (Linear Convolution Using Circular Convolution) - Circular Convolution as Linear Convolution with aliasing.

Unit V: Fast Fourier Transform:

Direct Computation of the DFT - Symmetry and Periodicity Properties of the Twiddle factor (*WN*) - Radix-2 FFT Algorithms - Decimation-In-Time (DIT) FFT Algorithm - Decimation-In-Frequency (DIF) FFT Algorithm - Inverse DFT Using FFT Algorithms. **Realization of Digital Filters:** Non Recursive and Recursive Structures - Canonic andNon Canonic Structures - Equivalent Structures (Transposed Structure) - FIR FilterStructures - Direct-Form - Cascade-Form - Basic structures for IIR systems - Direct-Form I.

Text Books:

1. Tarun Kumar Rawat. (2015). *Digital Signal Processing*. India: Oxford University Press.
2. Mitra, S. K. (2009). *Digital Signal Processing*. India: McGraw Hill.
3. Lathi, B.P. (1998). *Modern Digital and Analog Communication Systems*. (3rd ed.). India: Oxford University Press.

Reference Books:

1. Schilling, R.J. Harris, S.L. (2005). *Fundamentals of Digital Signal processing using MATLAB.* Cengage Learning.
2. Cha, P.D. Molinder J.I. (2007). *Fundamentals of signals and systems*. Cambridge University Press.
3. Proakis, J.G. Manolakis, D.G. (2007). *Digital Signal Processing Principles Algoritham & Applications.* (4th ed.). Prentice Hall.

Semester V
Physics Lab – V

Subject Code: PC17P5

No of hours per week	No of credits	Total no of hours	Marks
4	2	60	100

Objectives :1. To demonstrate the fundamental principle of optics.
2.To determine the behavior of a ray at any optical surface (lenses, Prisms)

Any fourteen experiments

1. Refractive Index of material of prism using Sodium light.
2. Dispersive power of material of prism using Mercury light.
3. Cauchy's constant.
4. Hartmann's interpolation formula.
5. Newton's rings.
6. i – i' curve.
7. Air Wedge.
8. Wavelength of spectral lines of Mercury light with grating in oblique incidence.
9. Biprism.
10. Elliptical fringes.
11. i – d curve.
12. Hyperbolic fringes.
13. Hollow prism.
14. Specific rotatory power using Polarimeter.
15. Spectrometer – Grating – Normal Incidence.
16. Spectrometer – Grating – Minimum deviation.
17. Spectrometer – Grating – Rydberg constant.

Semester V
Physics Lab – VI

Subject Code: PC17P6

No of hours per week	No of credits	Total no of hours	Marks
4	2	60	100

Objectives:1. To demonstrate the basic logic gates, understand Boolean algebra and simplify simple Boolean functions by using basic Boolean properties
2.To Understand, analyse and design various combinational and sequential circuits (Flip flop, Counters, Encoder, Decoder etc.)

Any fourteen experiments

1. IC – 555 – Astablemultivibrator
2. IC – 555 – Monostablemultivibrator
3. Half & Full Adder
4. Universality of NOR
5. Universality of NAND
6. Flip – Flop (RS)

7. Flip – Flop (JK)
8. Logic gates – Using discrete components (OR, AND, NOT)
9. Verification of Boolean expressions and DeMorgan's Laws.
10. Decoder
11. Encoder
12. Half & Full Subtractor
13. Regulated Power Supply Using IC's
14. Up, Down Counter
15. Multiplexer
16. Schmidt trigger – IC 555

Semester V
Physics Lab – VII

Subject Code: PC17P7

No of hours per week	No of credits	Total no of hours	Marks
4	2	60	100

Objectives: 1. To apply object oriented programming techniques to solve computing Problems.

2.To develop programs using functions and classes (objects, array of objects, friend functions, passing and returning objects).

Any fourteen experiments

1. To read any two numbers through the key board and to perform simple arithmetic operation (addition, subtraction, multiplication and division) and display the results using Cin and Cout functions. Use do-while loop.

2. To display the name of the day in a week, depending upon the number entered through key board using Switch-Case statement

3. To test the validity of any entered character whether it belongs to the alphabetical set or a number or a special character

4. To find the sum of the series using for loop.
   a) Sum = $1 + 3 + 5 +$ ……. n
   b) Sum = $x - x^3/3! + x^5/5! - x^7/7! +$ ……$x^n/n!$
   c) Sum = $1 + 2^2 + 4^2 +$ …… $+ n^2$

5. To find the factorial of a number by using function declaration with/without using the return statement

6. To read a set of numbers from a standard input device and to find out the largest number in the given array using function declaration. Also sort them in the ascending or the descending order.

7. To read the elements of the given two matrices of order m x n and to perform the matrix addition and display the transpose of the result.

8. a) To display the content of any array using pointer arithmetic
   b) To read the data variables (such as Day, Month, Year) of a class by the member function and display the content of class objects on the screen in the format DD/MM/YYYY

9. To generate a series of Fibonacci numbers using constructor where the constructor member function has been defined in the scope of class definition / out of the class definition using the scope resolution operator.
10. To read the following information from the keyboard in which basic class consists of Name, Roll No. and Sex. The derived class contains the data members height and weight. Display the contents of the class using inheritance concept.

11. To write a LOOP programme to find the period of a pendulum of given length L, in a gravitational field. Accept the required values using the keyboard. Also display the result.
12. Develop a program in C++ to calculate the Young's modulus of a material from the data obtained from uniform bending method.
13. Define a class to represent a bank account Data members:
    1. Name of the depositor
    2. Account Name
    3. Type of Account
    4. Balance amount in the account.

    Member function
    1. To assign initial values
    2. To deposit an amount
    3. To withdraw an amount
    4. To display name and balance.

14. Solve quadratic equation

15. Multiplication of two matrices

16. Write a program that uses functions to compare two strings input by the user. The program should state whether the first string is less than, equal or greater than the second string.

Self – Learning Course
Physics for Competitive Examination - I (PC17S1)

No. of Credits	Marks
2	100

Objectives:

1. To have clear idea on the basics of Physics principles to face challenges/competitive exams.
2. To motivate the students for career opportunities.

Unit – I : Mechanics and waves

Dimensional analysis – Newton's laws of motion and applications – Variable mass systems – Projectiles – Rotational dynamics – Moment of inertia – Conservative forces and frictional forces – Gravitational potential and field intensity – Central forces – Kepler's Laws – Escape velocity and artificial satellite (including GPS) – Streamline motion – Viscosity – Poiseuille's equation – Application of Bernoulli's equation – Stokes law – Special theory of relativity – Lorentz transformation – Mass – Energy relation – Waves and simple harmonic motion – Lissajous figures – Damped oscillation – Undamped oscillation - Resonance – Beats – Stationary waves – Vibration of strings and air coloumns – Logitudinal waves in sould ultrasonics and applications.

Unit – II : Geometrical and physical optics

Laws of reflection and refraction from Fermat's principle – Matrix – Method in paraxial optics – Chromatic and spherical aberration – Optical instruments – Huygen's principle – Reflection and refraction of waves – Interference of light – Young's double slit experiment – Interference by thin films – Interferometers – Diffraction of light – Fraunhoffer diffraction – Fresnel diffraction – Polarization of light – Double refraction – Quarter – Wave plates and Half-wave plates – Polarizing sheets – Optical activities and its applications – Elements of fibre – Optics – Pulse – Dispersion in optical fibers – Material dispersion - Lasers – Applications of laser.

Unit – III : Heat and thermodynamics

Terminologies of thermodynamics – Thermal equilibrium and temperature (Zeroth Law of Thermodynamics) – Heat and the first law of thermodynamics – Kinetic theory and equation of state of an ideal gas – Mean free path – Distribution of molecular speeds and energies – Transport phenomena – Andrew's experiments – Vander - Waal's equation of state – Joule – Kelvin effect Brownian motion – Thermodynamic potential and Maxwell relation – Phase transition – Kirchhoff's laws of heat radiation – Black – body radiations – Stefan – Boltzmann's law – Spectral radiance and application to the cosmic microwave background radiation – Wien's displacement law – Planck's radiation law.

Reference Book:

Nayyar, N.K. (2009). Unique Quintessence of Physics (For M.Sc. Entrance Examinations (All Universities) & other Competitive Examinations). New Delhi: Unique Publishers.

Self – Learning Course

Physics for Competitive Examination - II (PC17S2)

No. of Credits	Marks
2	100

Objectives: 1. To have clear idea on the basics of Physics principles to face challenges/competitive exams.

2.To motivate the students for career opportunities.

Unit I : Electricity and magnetism

Electric charge : Coulomb's law – Electric field : Gauss's law – Electric potential – Van-De-Graff generator (High Voltage Generator) – Capacitors – Dielectric and polarization – Ohm's law – Kirchhoff's laws – Application of Kirchhoff's law : Two loop circuits – Combination of resistances – Magnetic field – Gauss's law for magnetism – Magnetic behaviour of matter – Magnetic susceptibility (Xm) and permeability. – Classification of magnetic materials – Circulating charges and Lenz's law – Cyclotron – Synchrotron – Hall effect – Biot-Savart's law – Ampere's circuital law – Inductance – Alternating current circuits – R.C., L.R., Single-loop, L.R.C. circuits – Impedance – Resonance – power in A.C. circuit – Displacement current – Maxwell's equations – Electromagnetic waves – Energy transport and Poynting vector.

Unit II : Atomic and nuclear physics

Photoelectric effect – Einstein's photoelectric equation – Bohr's theory of hydrogen atom – Stem-Gerlach experiment – Quantisation of angular momentum – Electron spin – Pauli's exclusion principle – Zeeman effect – X-ray spectrum – Bragg's law – Bohr's theory of the Mosley plot – Compton effect – Compton wavelength – Wave nature of matter – Wave particle duality – The de-Broglie wavelength – Heisenberg's uncertainty relationship – Schrödinger's equation – Potential step and barrier penetration – Radioactivity – Binding energy of nuclei – Nuclear fission and fusion – Classification of elementary particle and their interactions.

Unit III : Electronics

Conductors, semiconductors and insulators – Diodes in half-wave and full-wave rectification – Qualitative ideas of semiconductors – *p*-type and *n*-type semiconductor – Junction diode – Transistors – Number systems – Logic gates and truth-tables – Elements of microprocessors and computer

Reference Book:

Nayyar, N.K. (2009). Unique Quintessence of Physics (For M.Sc. Entrance Examinations (All Universities) & other Competitive Examinations). New Delhi: Unique Publishers.

Professional Ethics

Indian Knowledge System

Environment and Sustainability

DEPARTMENT OF PHYSICS

(2017 – 2020)

Aim:

To provide comprehensive knowledge in physics and technical skills which prepare thestudents to do research or take up prospective careers.

Objectives:

1. To make students achieve high academic excellence
2. To motivate them towards research activities
3. To inspire them to become scientists concerned about the welfare of the country
4. To build confidence in them which will enhance team spirit and creative leadership

Eligibility Norms for admission:

A pass in the B.Sc or equivalent examination as per the norms of Manonmaniam Sundaranar University, Tirunelveli with Physics as Major with the minimum of 50%. For SC / ST candidates a pass in B.Sc. Physics is sufficient.

Duration of the Course: 2 years

Medium of instruction: English

Passing minimum

A minimum of 50% in the external examination and an aggregate of 50% is required. There is no minimum pass mark for the continuous internal assessment.

Components of the M.Sc. Programme

Components	**Number of Papers**	**Maximum Marks/ Course**	**Total Marks**
Theory Papers (Core)	11	100	1100
Theory Papers (Electives)	4	100	400
Practicals	4	100	400
Theory / Project	1	100	100
Total	**20**	**20 x 100**	**2000**

Practical examination will be conducted only at the end of the even semesters

Course Structure

Distribution of Hours and Credits

Course	Sem. I	Sem. II	Summer vacation	Sem. III	Sem. IV	Total	
						Hours	Credits
Core - Theory	6 (4) + 6 (4) + 6 (4)	6 (4) + 6 (4) + 6 (4)	-	6 (4) + 6 (4)	6 (4) + 6 (4) + 6 (4)	66	44
Core - Practical	6	6 (5+5)	-	4	6 (4+5)	22	19
Elective	6 (5)	6 (5)	-	6 (5)	6 (5)	24	20
Project	-	-	-	8 (4)	-	8	4
*Life Skill Training - I	-	(1)	-	-	-	-	1
*Life Skill Training - II	-	-	-	-	(1)	-	1
*Summer Training Programme	-	-	(1)		-	-	1
TOTAL	**30 (17)**	**30 (28)**	**(1)**	**30 (17)**	**30 (27)**	**120**	**90**

*** Courses / Programmes conducted outside the regular working hours**

PG – Courses offered

Semester	Subject code	Title of the paper	Hours/week	Credits
I	PP1711	Core I - Classical and Statistical Mechanics	6	4
	PP1712	Core II - Electromagnetic Theory	6	4
	PP1713	Core III –Numerical and Computational methods	6	4
	PP1714 PP1715	Elective I – (a) Experimental techniques/ (b) Photonics	6	5
	PP17P1	Practical I - Advanced Physics Lab – I (General Physics)	6	-
II	PP1721	Core IV –Condensed Matter Physics	6	4
	PP1722	Core V - Mathematical Physics	6	4
	PP1723	Core VI –Quantum Mechanics	6	4
	PP1724 PP1725	Elective II – (a) Crystal Growth Techniques and Thin film Technology (b) Communication Physics	6	5
	PP17P1	Practical I - Advanced Physics Lab – I (General Physics)	-	5
	PP17P2	Practical II - Advanced Physics Lab – II (Programming with C++)	6	5
	LST172	Life Skill Training (LST) – I	-	1
III	PP1731	Core VII - Integrated Electronics	6	4
	PP1732	Core VIII - Microprocessor and Microcontroller	6	4
	PP1733 PP1734	Elective III – (a) Physics of the Cosmos/ (b) Radiation Physics	6	5
	PP17P3	Practical III- Advanced Physics Lab – III (Electronics)	4	-
	PP17P4	Project	8	4
IV	PP1741	Core IX – Material Science	6	4
	PP1742	Core X - Nuclear and Particle Physics	6	4
	PP1743	Core XI - Molecular Spectroscopy	6	4
	PP1744 PP1745	Elective IV – (a)Nano Physics/ (b) Quantum Field Theory	6	5
	PP17P5	Practical III- Advanced Physics Lab – III (Electronics)	-	4
	PP17P6	Practical IV – Advanced Physics Lab – IV (Microprocessor and Micro Controller)	6	5
	LST174	Life Skill Training (LST) – II	-	1
	STP171	Summer Training Programme	-	1
		TOTAL	**120**	**90**

Self Learning – Extra Credit Course

Semester	Subject code	Title of the paper	Hours/week	Credits
III	PP17S1	Physics for Lectureship exam - I	-	2
IV	PP17S2	Physics for Lectureship exam - II	-	2

Guidelines for Project

The objective of the project is to motivate the students for doing research and to inculcate in them self confidence and creativity. The project will be done by a group of two students and the topic of the project, theoretical or experimental can be chosenbased on their interest of research.

The II M.Sc. students will present their individual project work to the department staff members during the last week of February/first week of March, using PowerPoint. Internal marks (10 marks) will be given for the presentation and 30 marks for the project work and report. Project work is evaluated by the external examiner for 40 marks and 20 marks will be allotted for viva voce.

Each student will undertake Skill based studies/ Summer training programme / Project related to the subject in any institution / Industry during the I year summer vacationand present the report along with the evidence of the programme. It will be evaluated after getting the report from the respective institution and the student will be awarded an extra credit 1.

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Instruction for Course Transaction

Theory (Major Core / Elective) paper hours

Type	Sem. I	Sem. II	Sem. III	Sem. IV
Lecture hours	75	75	75	75
Problem solving/ Group Discussion / Guest Lecture/ Online Assignment/ Field Visit	5	5	5	5
CIA (Test, Quiz)	5	5	5	5
Seminar	5	5	5	5
Total hours / semester	**90**	**90**	**90**	**90**

Examination Pattern

Ratio of Internal & External – 30: 70

Internal Components and distribution of marks

Test	-	20 marks
Seminar	-	5 marks
Online Assignment	-	2.5 marks
Quiz	-	2.5 marks
Total	-	30 marks

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 6 x 1 (No Choice)	6	Part A 10 x 1 (No Choice)	10
Part B 2 x 4 (Internal Choice)	8	Part B 5x4 (Internal Choice)	20
Part C 2x8 (Internal Choice)	16	Part C 5x8 (Internal Choice)	40
Total	**30**	**Total**	**70**

Value Added Courses

S.No.	Name of the course	Total hours	Credit
I	Computer Hardware	30	1
II	Fundamentals of Telecom	30	1

(b) Practical Papers

Internal : 40 marks

External : 60 marks

Total : 100 marks

Internal : 40 marks

Performance of the experiments : 10

Regularity in attending practicals and

Submission of records : 10

Record : 5

Model exam : 15

Total : 40 marks

External : 60 marks

Major practicals	: 25
Minor practicals	: 20
Spotters (4 x 2½)	: 10
Record	: 5
Total	**: 60 marks**

.Semester I
Classical and Statistical Mechanics (Core – I)
Subject code: PP1711

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives:1. To have in depth knowledge of classical and quantum statistics.

2. Enable students (i) To link thermodynamics to the micro description used in classical statistical mechanics. (ii) To develop skills in formulating and solving physics problems.

Unit I: Single and many particle systems and central force problems

Mechanics of a particle – Mechanics of a system of particles – conservation laws. Central force problems – Reduction to the equivalent one body problem – the equations of motion and first integral- Kepler's problems – Inverse square law of forces – motion in time in Kelpler's problems.

Unit II: Hamiltonian Formulation:

Hamilton's canonical equations of motion - Deduction of canonical equations from variation principle-principle of least action- canonical or contact transformations – conditions for a transformation to be canonical, Hamilton Jacobi method - Poisson bracket – equations of motion in Poisson bracket form – Jacobi Poisson theorem – Angular momentum and Poisson's bracket.

Unit III: Rigid Body and small Oscillations:

Independent coordinates of a Rigid body – Euler angles – Infinitesimal rotation – Rate of change of a vector – Coriolis force.

Small oscillations: Stable and unstable equilibrium – formulation of the problem – Lagrange's equations of motion for small oscillations – Normal co-ordinates and normal frequencies of vibration – Systems with few degrees of freedom: Parallel pendulum – Linear triatomic molecule.

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Unit IV: Statistical mechanics:
The postulate of classical statistical mechanics – Postulate of Equal a Priori probability - Micro canonical ensemble – Derivation of Thermodynamics - Classical Ideal gas – Gibb's paradox - The ideal gases - The Ideal gases in Micro – canonical ensemble – Statistical weight – Entropy – Distribution Law – Maxwell-Boltzmann statistics – Bose-Einstein statistics – Fermi-Dirac statistics – Thermodynamic functions for Boltzmann gas.

Unit V: Ideal Fermi and Bose gases and applications
Ideal Bose gas – Bose Einstein condensation – Thermodynamic behavior when T<Tc - Thermodynamic behavior when T>Tc - Blackbody radiation - The photon gas - Ideal Fermi gas – weakly degenerate and strongly degenerate – Free electron theory of metals.

Text Books:

1. Herbert Goldstein Charles Poole John Safko.(1989). Classical mechanics. (2nd Ed.)
   Unit I: Chapter 3: 3.1, 3.2, 3.7, 3.8.
   Unit III: Chapter 4:4.1, 4.4, 4.8, 4.9, 4.10
2. Gupta, S.L., Kumar, V., Sharma Pragati Prakashan H.V., Meerut. (2004-05) Classical Mechanics. (21st Ed.)
   Unit I: Chapter I : 1.3, 1.4
   Unit II Chapter 3: 3.1 - 3.4, 3.7, 3.10 to 3.12, 3.14, 3.15.1, 3.21, 3.22 3.23, 3.24, 3.26
   Unit III: Chapter 8: 8.1 - 8.3, 8.5, 8.6(A), 8.6(D)
3. Kerson Huang. (1986). Statistical mechanics. Wiley Eastern Ltd.
   Unit IV: Chapter 7: 7.1, 7.2, 7.3, 7.5, 7.6
4. Sinha, S.K. (2007). Introduction to Statistical mechanics. New Delhi: Narosa Publishing House Pvt.Ltd.
   Unit IV: Chapter 6: 6.1, 6.4 – 6.6, 6.8, 6.10
   Unit V: Chapter 7: 7.1 – 7.3, Chapter 8: 8.1 – 8.3

Reference Books:

1. Gupta, A.B. (2015). Fundamentals of classical mechanics. Books and Allied (P) Ltd.
2. Arul Dhas,G. (2009). Classical mechanics. PHI Learning Private Limited.
3. Narayan Chandra Rana. (2004). Classical mechanics. Pramod Sharad Chandra Joag- Tata Mc- graw- Hill Publishing Company Ltd.
4. Saxena, A.K. (2010). An Introduction to Thermodynamics and Statistical Mechanics. New Delhi: Narosa Publsihing House Pvt.Ltd.

Semester I
Electromagnetic theory (Core – II)
Subject Code: PP1712

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objective: 1. To provide knowledge on the propagation of electromagnetic radiation.
2. To gain insight into the physical nature of electric and magnetic phenomena.

Unit I: Electrostatic field
Electrostatic field – Divergence and curl of electrostatic field – Gauss law and its applications – Electric potential – Introduction – Poisson's and Laplace equation – Method of Images - Solution of Laplace's equation using separation of variables in Cartesian Coordinates – Electrostatic fields in conductors and dielectrics – induced dipoles and

polarizability – Polarization – bound charges - field inside a dielectric – Susceptibility permittivity and dielectric constant – Boundary value problems with linear dielectrics – Electro static energy in dielectric media.

Unit II: Magnetostatic field

Lorentz's force law – cyclotron motion – cycloid motion – continuity equation – Biotsavart's law for a line current, surface current and volume current – divergence and curl of B – Ampere's law - applications of Ampere's law – comparison of magneto statics and electrostatics – magnetic vector potential – Torques and forces on magnetic dipoles – effect of magnetic field on atomic orbits – magnetic susceptibility and permeability in linear media and non-linear media.

Unit III: Electrodynamics

Ohm's law – Electromagnetic induction – Faraday's law – inductance – energy in magnetic fields – Maxwell's equations - Maxwell's equation free space and linear isotropic media – Boundary conditions on the field at interfaces – Integral and differential forms – Boundary conditions – Continuity equation – Poynting theorem – Poynting vector – Conservation of momentum.

Unit IV: Propagation of Electromagnetic waves

Wave equation for E and B monochromatic plane waves – energy and momentum in electromagnetic waves – electromagnetic waves in matter – propagation in linear media – reflection and transmission at normal incidence and oblique incidence – Fresnel's equations – Electromagnetic waves in conductor – skin depth – Reflection at a conducting surface - wave guides – TE waves in rectangular wave guide - Co-axial transmission lines.

Unit V: Relativistic Electrodynamics

Einstein's two postulates – Covariant and contra variant vector – Concept of four vectors – Minkowski force – Covariance of Electrodynamics equations – Maxwell's equations in four vector – Four vector form of Lorentz equations – Relativistic Lagrangian and Hamiltonian force equations for a relativistic charged particle in external electromagnetic field.

Text Books:

1. David J. Griffiths. (2004). *Introduction to Electrodynamics*. III Ed., Prentice Hall of India Private Ltd.
   Unit I: Section 2.1.1 - 2.1.4, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.3, 3.2, 3.3, 3.4.1, 4.1.1, 4.1.2, 4.1.4, 4.4.1 – 4.4.3
   Unit II: Section 5.1.1, 5.1.2, 5.1.3, 5.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.4.1, 5.4.3, 6.1.2, 6.1.3, 6.4.
   Unit III: Section 7.1.1, 7.2.1, 7.2.3, 7.2.4, 7.3.1 – 7.3.6, 8.1.1, 8.1.2, 8.2.3.
   Unit IV: Section 9.1.1, 9.1.2, 9.1.3, 9.1.4, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 9.3.2, 9.3.3, 9.4.1, 9.4.2, 9.5.1, 9.5.2., 9.5.3
   Unit V: 12.1.1, 12.1.4, 12.2.4, 12.3.5
2. John David Jackson.(1983). *Classical Electro Dynamics.* II Ed., New Delhi: Wiley Eastern Ltd.
   Unit V: 11.1, 11.6, 11.9, 12.1

Reference Books:

1. Reitz and others. (1987). *Foundations of Electromagnetic Theory*. III Edition. New Delhi: , Narosa Publishing House.

2. Paul Lorrain and Date Corson. (1986). *Electromagnetic Fields and Waves*. II edn., CBS publications and Distributors.

Semester I
Numerical and Computational Methods (Core – III)
Subject Code: PP1713

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objective: 1. To introduce the numerical methods for solving algebraic, differential and matrix equations and its applications in Physics.

2. To make students able to understand and analyse various mechanical problems that require the use of numerical / computational methods.

Unit I: Interpolation and Extrapolation:

Finite differences – Forward difference – Backward Differences – Central Differences– Newton's formula for Interpolation – Central Difference Interpolation formulae – Guass' Central Difference Formulae – Stirling's Formula – Lagrange's Interpolation Formula – Error in Lagrange's Interpolation Formula – Hermite Interpolation Formula – Divided Differences and their Properties Newton divided difference formula – Interpolation by Iteration.

Unit II: Solution of Algebraic and Transcendental Equations: Zeros of linear and non-linear algebraic equations and transcendental equations: The Bisection method – Newton Raphson method –Ramanujan's Method -Birge – Vieta method.

Solution of simultaneous equations: Direct methods: Gauss elimination – Gauss Jordon Methods –Modification of the Gauss Method to Compute the Inverse – Solution of Linear Systems – Iterative methods: Gauss Seidal and Gauss Jacobi methods.

Unit III: Numerical differentiation and Integration:

Numerical differentiation: Methods based on interpolation: Finite difference and undetermined coefficients – Differentiation using Newton's forward and backward difference formulae – Errors in numerical differentiation.

Numerical Integration: Trapezoidal Rule – Simpson's 1/3 Rule – errors – Simpson's 3/8 rule – Monte Carlo integration – evaluation of simple integrals.

Unit IV: Numerical solutions of ordinary Differential equations:

Solution by Talor's Series - Picard's Method of Successive Approximations - Euler's method – Runge–Kutta Methods – Predictor-Corrector Methods: Adam's – Moulton method and Milne's method – Boundary-value Problems – Finite-difference Method

Unit V: Introduction to MATLAB Programming

Basic of MATLAB –MATLAB windows - On-line help - Input-Output - File types- Platform dependence - General commands- Input – Indexing - Matrix Manipulation - Creating Vectors - Matrices and vectors – Matrix and array operations- Arithmetic operations- Relational operations - Logical operations - Elementary math functions - Matrix functions - Character strings - linear algebra- Solving a linear system- Gaussian elimination - Finding eigenvalues & eigenvectors - Matrix factorizations.

Text Books:

1. Sastry, S.S. (2009). Introductory Methods of Numerical Analysis. (3rd ed.) Prentice Hall of India Ltd.
   UnitI: Chapter 3: 3.3.1 - 3.3.3, 3.6, 3.7: 3.7.1 – 3.7.2, 3.9: 3.9.1 – 3.9.3, 3.10: 3.10.1, 3.10.2.
   Unit II: Chapter 2: 2.1, 2.2, 2.5 - 2.6 Chapter 6: 6.3.2, 6.3.3, 6.3.4, 6.4.
   Unit III: Chapter 5:5.2, 5.2.1, 5.4, 5.4.1- 5.4.3, 5.4.7
   Unit IV: Chapter 7: 7.2 - 7.4, 7.5 - 7.6, 7.10: 7.10.1
2. Jain,M.K., Iyengar, S.R.K., Jain, R.K. (2000). Numerical methods, Wiley Eastern Limited.
   Unit II: Chapter 2: 2.8
   Unit III: Chapter 5:5.2
3. William Press, H., Teakolsky, S.A., Vetterling, W.T., Flannery, B.P. (2002). Numerical Recipes in C++. CambridgeUniversity Press.
   Unit III: Chapter 7: 7.6

4. Rudra Pratap, (2006). 'Getting started with MATLAB 7' (2nd ed.) . Oxford University Press.
   Unit V: Sections 1.6, 3.1, 3.2, 5.1: 5.1.1-5.1.4

Reference Books:

1. Raja Raman, V. (2003). Computer Oriented Numerical Methods . Prentice Hall of India Ltd.
2. Xavier, C. (1996). Fortran 77 and Numerical Methods. New Age International Ltd.

Semeter I

a. Experimental Techniques (Elective – I)

Subject Code: PP1714

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objective:

1. To provide knowledge on the measurements including error, signal and thermal analysis, nuclear radiation measurement using counters and detectors.
2. To gain insight in different experimental and analytical techniques involving mass spectroscopy, surface and laser spectroscopy, vacuum techniques, diffusion pumps, measuring gauges and sensors.

Unit I: Mathematical techniques and signal analysis:

Error – Types of Error – Error in a series approximation – General Error formula. Curve Fitting : Linear curve fitting law of the types $y=ax^b$, $y=a\ e^{bx}$ – principle of least squares – straight line fitting by LSF method – Signal analysis : Signal to noise ratio – source of noice in instrumental analysis – signal to noise enhancement.

Unit II: Nuclear radiation measurements

Methods of detection of free charge carrier – Ionization chamber – G.M. counter - Semi-conductor detectors – Methods based on light sensing - Scintillation detector – Wilson cloud chamber – Nuclear emission techniques – Solid state nuclear track detectors.

Unit III: Mass spectroscopy and Vacuum techniques

Introduction: Ion production – Volatile – In volatile – Field desorption – Laser desorption – Fast atom bombardment (FAB) - Secondary ions mass spectroscopy (SIMS) – Californium plasma desorption – Ion analysis – Components of mass spectrometers – Resolution – Production and measurements of low pressure. Exhaust pumps – Rotary pumps – Diffusion pumps – Pirani and ionization gauges.

Unit IV: Solid state, surface and Laser spectroscopy

Vibration studies of surfaces – Electron energy loss spectroscopy (EELS) – Electronic spectroscopy of surfaces – Photoelectron spectroscopy (PES) Ultraviolet PES (UPES) – Auger electron spectroscopy (AES) – X-Ray fluorescence (XRF). Helium – neon laser, Semiconductor lasers - Lasers in medicine

Unit V: Thermal analysis, Sensors and transducers

Introduction - Thermal analysis instruments – Types of measurement – Main Techniques – Thermal events – Thermo gravimetry- Differential thermal analysis and Differential scanning calorimetry – Interpretation of DTA and DSC - Application of DTA and DSC - Sensors/transducer specification – Classification of sensors – Displacement and position tensor – Potentiometer – Strain gauges –Capacitive sensor – Linear variable differential transformer – Piezoelectric sensor – Temperature sensor – Resistance temperature detector - Thermistor - photodiode.

Text Books:

Unit I:

1. Sastry, S.S. (2009). Introductory Methods of Numerical Analysis. (3rd ed.). Prentice-Hall of India Ltd.
   Chapter 1: 1.3 – 1.5, Chapter 3: 3.3: 3.3.1 – 3.3.3, 3.6, 3.9: 3.9.1, 3.10: 3.10.1, Chapter 4: 4.2.1, 4.2.2
2. Douglas A. Skoog, James Holler, F., Stanley R. Crouch.(2007). Instrumental Analysis.Cengage Learning

Unit II:

3. Ghoshal. (2002). Nuclear Physics. (1st ed.). Chand and company Ltd reprint
   Chapter 7: 7.1 - 7.3, 7.5 – 7.8, 7.10, 7.11, 7.14, 7.15

Unit III:

4. Dudley H. Williams, Ian Fleming. (1987). Spectroscopic methods in organic chemistry. McGraw Hill.
   (Relevant topics from chapter IV)
5. Gurdeep Chatwal, ShamAnand. (1985). Spectroscopy (Atomic and Molecular). Himalaya Publishing house
   Chapter 10.1 - 10.3, 10.5
6. Verma, K.L. (1965). Properties of matter. S. Nagin& Co.,
   Chapter 11 : 11.8, 11.9, 11.10, 11.11, 11.13, 11.14, 11.15, 11.20, 11.21

Unit IV:

7. Colin N. Banwell, Elaine M. McCash. (1999). Fundamentals of Molecular Spectroscopy. Tata McGraw- Hill Publishing Company Limited
   Chapter 8 - 8.1: 8.1.1, 8.2: 8.2.1, 8.2.2, 8.2.3
8. Thyagarajan, K., Ghatak, A. K. (1982). LASERS. Theory and Applications, Macmillan India Limited.
   Chapter 9: 9.4, 9.8 , Chapter 14: 14.5

Unit V:

9. Micheal E. (2002). Brown. Introduction to Thermal Analysis, Techniques and Applications. Tata McGraw hill.
   Chapter 1, 2, 3
   Chapter 4: 4.1 - 4.3, 4.7, 4.11.
10. Paul P.L. Regtien. (2007). Sensors for Mechatronics. Elsevier- E-book
    Relevant topics

Reference Books:

1. Raja Raman, V. (2003). Computer Oriented Numerical Methods. Prentice – Hall of India Ltd.
2. Svanberg. (2009). Atomic and Molecular Spectroscopy. (4^{th} ed.). Springer.
3. Sawhney, A.K. (2000). A course in Electrical and Electronic Measurements and Instrumentation. Delhi: DhanpatRai & Co.(P) Ltd.
4. Bernhard Wonderlich, Verlag Berlin, Heidelberg. (2005). Thermal Analysis of Polymeric Materials. Springer.

Semester I
b. Photonics (Elective - I)
Subject Code: PP1715

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives:1. To study the optical properties of solid.
2. To introduce the topic of non linear effects of light on matter.

Unit I: Optical properties of solids

Introduction – Classical model-Drude model – Ionic conduction – Optical refractive index and relative dielectric constant – Optical absorption in metals, insulators and semiconductors - Colourcentres – Excitons – luminescence – Maser and laser – Population inversion – Lasers – Properties of laser beam and uses of lasers – Semiconductor lasers – Gas lasers – Liquid lasers – Free electron lasers - Phosphors in fluorescent lights – Application of lasers – Physics of optical fibers – Step-index fibers – graded-index fibers - Holography.

Unit II: Plasma, optical & reflectance excitons

Dielectric function of a electron gas – Dispersion relation for electromagnetic wave – Transverse optical modes in a plasma – Transparency of alkali metals in the ultra violet – Longitudinal plasmal oscillations – Plasma – Polaritons – LST relation.
Optical reflectance – Kramers – Kronig relations – Example – Frenkelexciton – Alkali halides – Molecular crystals – Moltt – Wannierexcitons – Exciton condensation into electron – Hole drops – Raman effect in crystals.

Unit III: Non-linear interaction of light & matter

Introduction - General classification – Non resonant interactions – Non linear polarization of the medium – Second order effects – Generation of the second Harmonic –

Phase matching – Frequency mixing of two monochromatic fields – Pockel's effects – Electron optical beam deflection – Optical rectification.

Unit IV: Non linear optical spectroscopy

Homogeneous and in homogeneous broadening – Incoherent interaction – Bleaching – Transient absorption – Non – linear transmission – Stimulated emission – Spectral hole burning – General procedure – Steps of analysis – Choice of excitation light intensities – Choice of probe light intensities – Pump and probe light overlap – Light beam parameters – Sample parameters – Possible measuring errors – Conventional absorption measurements – Determination of the cross section – Reference bream method – Cross section of anisotropic particles.

Unit V: New developments in laser optics

Optical cooling and trapping of atoms – Photon recoil – Measurement of recoil shift – Optical cooling by photon recoil – Experimental arrangements – Three dimensional cooling of atoms – Optical trapping of atoms – Optical cooling limits – Bose – Einstein condensation – Evaporative cooling – Application of cooled atoms and molecules.

Text Books:

1. SPillai, S.O. (2006). Solid state physics. (6^{th}Ed.). Chennai: Reprint New age international (P) limited publishers.
   Unit I:Chapter: 12
2. Kittel , C. Introduction to solid state physics. (7^{th} Ed)., John Wiley & Sons Inc.,
   Unit II:Chapters: 10 & 11. **(**Relevant sections)
3. Ralf Maenzel . (2004). Photonics. Springer Publication
   Unit III:Chapters: 4.1 to 4.47
4. Ralf Maenzel. (2004). Photonics. Springer Publication.
   Unit IV:Chapter5 : 5.1 to 5.35, Chapter7: 7.1, 7.2 : 7.2.1, 7.2.3.
5. W. Demtroder. (2004). Laser spectroscopy. (3^{rd} Ed), Springer publications.
   Unit V: Chapter 4: 4.1.1 to 4.1.11

Reference Books:

1. Thyagarajan, K., Ghatak, A.K. ,(1981). Lasers: Theory and applications. New York:Plenum Press.

2. Bahaa, E. A., Saleh **,** Malvin Carl Teich. (2007). Fundamentals of Photonics. **(**2nd Ed.), Wiley Interscience.

Semester II
Condensed Matter Physics (Core – IV)
Subject Code: PP1721

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objective:1.To enable the students to understand crystal structure, phonons, energy bands, semiconductor crystals, magnetism and superconductivity.

2.To formulate the theory of lattice vibrations and apply it to determine thermal properties of solids.

Unit I: Crystal Structure

Structure of solid matter: The crystal lattice – Point symmetry – Point groups – The significance of symmetry – Simple crystal structure

Reciprocal lattice and determination of crystal structure : Bragg's law – Reciprocal lattice vectors – Construction – Diffraction condition – Laue equations – Brillouin zone – structure factor and atomic form factor – Measurement of diffraction pattern of crystal: The Ewald construction – Rotation method – Powder method – Determination of lattice constants

Unit II: Phonons

Crystal Vibration: Vibration of crystals with mono-atomic basis – Two atoms per primitive basis – quantization of elastic waves – Phonon momentum-Inelastic scattering by Phonons

Thermal Properties: Phonon heat capacity- Planck distribution-Normal mode enumeration-Density of states in one dimension- Density of states in three dimension-Debye model for Density of states-Debye T^3 law

Unit III: Energy Bands and Semiconductor crystals

Electronic band structure of solids - Nearly free electron model – Block functions – Kronig Penny model – Wave equation of electron in a periodic potential – Number of orbitals in a band – Insulators, semiconductors and metals. Band gap – Equations of motion – Effective mass - Physical interpretation of effective mass – Effective mass in semiconductors

Unit IV: Magnetism

Diamagnetism: Langevin diamagnetism equation- Quantum theory of diamagnetism of mononuclear systems- Quantum theory of paramagnetism - Hund rules - Ferromagnetic order - Curie point and the exchange Integral – Temperature Dependence of the Saturation Magnetization - Magnons – Thermal Excitation of Magnons – Ferrimagnetic order – Antiferro magnetic order – Ferro magnetic domains.

Unit V: Superconductivity

Superconductivity: Experimental survey- Occurrence of superconductivity-Destruction of superconductivity by magnetic fields- Meissner effect – Critical temperature – Heat Capacity - Energy gap – Isotope effect - Thermodynamics of the superconducting transitions – London equations – Coherence Length - BCS theory — Flux quantization in a superconducting ring- Duration of persistent currents- Type II super conductors Single Particle Tunneling – DC and AC Josephson effects – High temperature super conductors.

Text Books:

1. Kittel, C. (1996). Introduction to solid state physics (8^{th} ed.). John Wiley and Sons.
   Unit I: Chapter 2 (relevant topics)
   Unit II: Chapter 4 and 5 (relevant topics)
   Unit III: Chapter 7 and 8 (relevant topics)
   Unit IV: Chapter 11 and 12 (relevant topics)
   Unit V: Chapter 10 (relevant topics)
2. Ibach, H., Luth, H. (2004). Solid State Physics. Springer.
   Unit I: Sec. 2.1-2.5
3. Srivastava, J.P. (2004). Elements of solid state physics. Printice Hall of India
   Unit I: Sec. 3.8, 3.9
   Unit III: Sec. 8.5, 9.2.3

Reference Books:

1. Ali Omer, M., Addison. (2001). Elementary solid state physics. Wesly.
2. Pillai, S.O. (1997). Solid State Physics. New Delhi: New Age International,.
3. Madelung,O. (1978). Introduction to Solid State Theory. Springer.

Semester II
Mathematical Physics (Core – V)
Subject Code: PP1722

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objective:1. To emphasize the use of mathematical tools like evaluation of definite integrals of Physics in particular in the field of classical and quantum mechanics.
2.To demonstrate competence with a wide variety of mathematical tools and techniques.

Unit I: Complex Analysis

Analytic functions – Cauchy – Riemann equations in cartesian and polar forms– Harmonic functions - Cauchy's integral theorem – Cauchy's integral formula – Taylor's Series – Laurentz series – Cauchy's residue theorem –Singular points of an Analytic function – Evaluation of residues - application to evaluation of definite integrals – Integration around a unit circle –Jordan's Lemma.

Unit II: Polynomials

Legendre differential equation and Legendre functions – generating functions – Rodrigue's formula – Orthogonal Properties - recurrence formula – Bessel differential equation – Bessel functions of I kind - recurrence formula and generating functions – Hermite differential equations and Hermite polynomials - Generating functions & recurrence formula.

Unit III: Partial Differential equations and Green's function

Solution of Laplace equation in Cartesian coordinates- Solution of heat flow equations – Method of separation of variables – variable linear flow – One and two dimensional heat flow – Green's function for one dimensional case- general proof of symmetry property of Green's function- Eigen function: expansion of Green's function- Green's function for Poisson equation and solution of Poisson equation. Green's function for quantum mechanical scattering problem.

Unit IV: Tensors, Fourier and Laplace transforms

Contravarient and Covarient Tensors -Addition and subtraction – Outer product, inner product of tensors, Contraction of a tensor, Symmetric and anti-symmetric tensors – The Kronecker delta – Fourier transform- properties of Fourier transform - Fourier transform of a derivative – Laplace transform- properties of Laplace transform- Laplace transforms of the derivative of a function

Unit V: Group theory

Group postulates – abelian group – Cyclic group – Group multiplication table – Rearrangement theorem – Subgroups – Isomorphism and Homomorphism – Symmetry elements and symmetry operations – Reducible and irreducible representations - the great orthogonality theorem - character table for C_{2V}& C_{3V} point groups.

Text Books:

1. Pipes, Harwell. (1976). Mathematics for Physicists and Engineers. McGraw Hill International Book company.
   Unit I: Chapter 1 Sections 1.1 to 1.10, 1.12, 1.14, 1.15.
2. Satya Prakash. (2005). Mathematical Physics. (4^{th} ed.) New Delhi:S. Chand & Company Pvt. Ltd.
   Unit II: Chapter 6, Sections 6.7 to 6.11, 6.17, 6.21, 6.22, 6.29, 6.30, 6.31
   Unit III: Chapter 8, Sections 8.2, 8.7, 8.10, Chapter 10, Sections 10.3-10.7
   Unit IV: Chapter 9, Sections 9.2-9.5, 9.9-9.11
   Unit V: Chapter 12, Sections 12.1, 12.2, 12.4, 12.5, 12.6, 12.7, 12.13, 12.19, 12.21.
3. Joshi, A.W. (1995). Matrices and Tensors for Physicists. New Age International Publishers Limited.
   Unit IV: Chapter 15, Sections 15.3 to 15.5. Chapter 16, Sections 16.2 to 16.7

Reference Books:

1. Eugene Butkov. (1978). Mathematical Physics. New York, NY: Addison Wesley Publishing.
2. Courant, D. Hilbert. (1978). Methods of Mathematical Physics. New Delhi: Wiley Eastern Limited.
3. Arfken, Weber. (2001). Mathematical Methods for Physicists. (5^{th} ed.) San Diego. Elsevier Academic press.

Semester II
Quantum Mechanics (Core - VI)
Subject Code: PP1723

Number of hours per week	No of credits	Total number of hours	Marks
6	4	90	100

Objective: 1. To introduce the concepts of quantum mechanics and study their applications.
2.To use quantum mechanical principles to analyze advanced Physical phenomena of nature.

Unit I: Schrodinger Equations

Wave packet – Time dependent Schrödinger equation – Interpretation of the wave function – Time independent Schrödinger equation – Stationary states – Admissibility conditions on the wave function – Eigen functions and eigen values – Hermitian operator – Postulates of quantum mechanics – Simultaneous measurability of observables – General uncertainty relation – Dirac's notation – Equations of motion – Momentum representation – Linear Harmonic oscillator – Operator method.

Unit II: Angular Momentum

Angular momentum operators – Angular momentum commutation relations – Eigen values and eigen functions of L^2 and L_z– General angular momentum – Eigen values of J^2 and J_z – Angular momentum matrices – Spin angular momentum – Spin vectors for spin-(1/2) System – Addition of angular momentum : Clebsch-Gordon coeffiecients – Stern Gerlach Experiment.

Unit III: Approximation methods

Time independent perturbation theory: Basic concepts – Non-degenerate energy levels – Anharmonic oscillator – First-order correction – Effect of electric field on the ground state of hydrogen. Variation method :Variational principle – Ground state of Helium WKB Approximation : WKB method – Connection formula – Barrier penetration – Alpha emission

Time dependent perturbation theory: First order perturbation – Harmonic perturbation – Transition to continuum states – Absorption and Emission of radiation – Einstein's A and B coefficients – Selection rules.

Unit IV: Scattering theory

Scattering cross-section – Scattering amplitude – Partial waves – Scattering by a central potential: Partial wave analysis – Scattering by an attractive square-well potential – Scattering length – Expression for phase shifts – Integral equation – The Born approximation – Scattering by screened coulomb potential – validity of Born approximation.

Unit V: Relativistic Theory

Klein – Gordon Equation – Interpretation of the Klein-Gordon equation – Particle in a Coulomb field – Dirac's equation for a free particle – Dirac matrices – Plane wave solution – Negative energy states – Spin of the Dirac particle – Magnetic moment of the electron – Spin-orbit interaction.

Text Books:

1. Aruldhas, G. (2005). Quantum Mechanics. New Delhi: Prentice-Hall of India.
   Unit I : Chapter 2.4 - 2.6, 2.8 – 2.10, 3.3 – 3.10, 4.8

   Unit II : Chapter 8 : 8.1-8.9
   Chapter 1 : 1.14
   Unit III : Chapter 9 : 9.1 – 9.3, 9.5
   Chapter 10 : 10.1, 10.5
   Chapter 11 : 11.1 – 11.2, 11.4-11.5
   Chapter 12 : 12.2 - 12.7
   Unit IV : Chapter 14 : 14.1-14.4,14.6, 14.8-14.13
   Unit V : Chapter 15: 15.1-15.5, 15.9-15.12

Reference Books:

1. AjoyGhatak, Lokanathan, S. (2007). Quantum Mechanics : Theory and Applications. New Delhi: Macmillan India Ltd.
2. Mathews, P.M., Venkatesan, K. (2008). A text book of Quantum Mechanics. Delhi: Tata McGraw – Hill Publishing Company Ltd.

Semester II

a. Crystal Growth Techniques and Thin Films Technology (Elective II)

Subject Code: PP1724

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objective:1. To study the various theory of crystal growth crystal growth process and the preparation of thin films through various techniques.

2.To gain insight involved in crystal growth and thin film technology and apply the techniques in the field of research.

Unit I: Crystal growth theories

Introduction - Nucleation – Theories of nucleation – Classical theory of nucleation - Kinetics of Crystal Growth: Introduction – Singular and rough faces – Models on surface roughness - The Kossel Stranski Volmer (KSV) theory – The Burton Cabrera Frank (BCF) theory.

Unit II: Solution growth

Low temperature solution growth: Introduction – Solution, solubility and super solubility – Expression for super saturation – Methods of crystallization. Crystal Growth System:Classification – Constant temperature bath – Crystallizer – Attraction assembly – Seed, seed mount platform and crystal revolution unit - High temperature solution growth: Introduction – Principles of flux growth Gel Growth:Introduction – Principle of gel growth – Various types of gel – Structure of gel – Growth of crystals in gels – Experimental procedure – Biological crystallization.

Unit III: Hydro thermal and melt growth

Hydrothermal Growth:Introduction – Design aspects of autoclave. Melt growth: Growth from the melt – The Bridgman and related techniques – Crystal pulling – Convection in melts.

Unit IV : Thin Film technology

Introduction – Nature of film – Deposition technology – Resistance heating – Electron beam method – Cathodic sputtering - Chemical vapour deposition – Epitaxial deposition - Chemical deposition – Spray pyrolysis process - Film thickness and its control – Substrate cleaning.

Unit V : Conduction in thin films and some applications

Conduction in continous film – Conduction in discontinuous metal film – Semiconducting film – Intrinsic semiconductor – Extrinsic semiconductor – Impurity energy level – Conduction in insulator film – Technological applications.

Text Books :

1. Santhana Raghavan, P. and Ramasamy, P. (2004). Crystal growth processes and Methods. Chennai: KRV publications.
   Unit I: Chapter 2: 2.1 – 2.3.5 (solution growth not included)
   Unit II: Chapter 4: 4.1, 4.2, 4.8, 4.8.1, 5.4.1 – 5.4.7.3
   Unit III: Chapter 5: 5.2, 5.2.1 – 5.2.1.8, 3.1 – 3.5.2
2. Goswami, A.(2006). Thin film Fundamentals. New Age publishers .
   Unit – IV: Chapter 1: 1 – 11 (Pg 1- 13, 18 – 47).
   Unit V: Chapter 7: 1 – 3 (Pg 214 – 220)

4, 4.1 (Pg 235 – 239)

Chapter 8 : 1-4 (Pg 248 – 259)

Chapter 9: 4, 4.1 – 4.3 (Pg 314 – 319)

Chapter 14: 1 – 7 (Pg 519 – 533)

3. Kasturi Lal Chopra, Suhit Renjan Das. Thin Film solar Cells. New York & London: Plenum press.
   Unit IV: Chapter 5: 5.2.2, 5.2.2.1 – 5.2.2.3,
   5.3.1 – 5.3.1.1 – 5.3.1.3,

Reference Books:

1. Pamplin, B.R. (1980).Crystal Growth. Oxford: Pergamon.
2. Brice,J.C. (1986).Crystal Growth Processes. New York: John Wiley and Sons.
3. Henisch, H.K. (1988). Crystals in gels and Liesegang Rings. Cambridge: Cambridge University Press.
4. Mullin, J.W. (1993). Crystallization. Oxford: Butterworth – Heine man
5. Bunshah, R.F. (1982). Deposition Techniques for films and coatings – Developments and Applications. New Jersey: Noyer publications

Semester II

b. Communication Physics (Elective - II)

Subject Code: PP1725

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objective:1. To provide an introduction to the various modulation techniques used for telecommunication.

2.To gain insight in digital, wireless, satellite communication which provide future employability and progress of students.

Unit I: Modulation techniques

Amplitude modulation index – Average power of sinusoidal AM – Double sided suppressed carrier modulation (DSBSC) – Amplitude modulator circuits – Amplitude demodulator circuits – Amplitude modulated transmitters – AM receiver using phase locked loop (PL) – Single sideband principles – Single balanced modulators – Frequency modulation – Sinusoidal FM – Frequency spectrum for sinusoidal spectrum - Average power in sinusoidal FM

Unit II: Digital communication

Introduction – Synchronization – Asynchronous transmission – Probability of bit error in base band transmission – Eye diagrams – Digital carrier systems – Carrier recovery circuits – Differential phase shift keying (DPSK) – Hard and soft decision decoders.

Unit III: Fibre optic communication

Principles of light – Transmission in a fiber – Modes of propagation – Losses in fibres – light sources for fiber optics – photo detectors – Connectors and splices – Fiber optic communication link.

Unit IV: Wireless communication

Cellular Technology : Definition of cellular radio - The cellular concept - Cellular system objectives - Fundamental wireless system components: The mobile phone - The cell base station - The Backhaul network - The mobile switching center (MSC) - Interconnection to the public switched telephone network (PSTN) and the internet - Cell ase station : Overview - Criteria and methods for cell placement - Selecting cell base station locations - Cell base station deployment - Microcells - Picocells and Nanocells - Radio frequency operation and techniques: Wireless frequency bands - System interference - Cochannel interference - Adjacent-Channel interference - Intermodulation interference (IM) - Bluetooth - Ultra-Wideband wireless (UWB) - UWB Drivers - 3G Communication: 3G Systems and IMT 2000 - Universal mobile telecommunications system (UMTS) - UMTS Network architecture - The UMTS core network - 3G Applications

Unit V: Satellite communication

Kepler's first law – Kepler's second law – Kepler's third law – Orbits – Geostationary orbit – Power systems – Altitude control – Satellite station keeping – Antenna lock angles – Limits of visibility – Frequency plans and polarization – Transponders – Uplink power budget calculations – Downlink power budget calculations – Overall link budget calculations – Digital transmission – Multipole – Access methods.

Text Books:

1. Dennis Roddy & John Coolen . (2008). *Electronic communication.* (4th ed) . India: Pearson Education Pvt. Ltd.

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Unit I: Chapter 8: 81. – 8.4, 8.6, 8.9, 8.10, 8.11, 8.12, 8.13.
Chapter 9: 9.2, 9.
Chapter 10: 10.2 - 10.5
Unit II:Chapter 12: 12.1-12.4, 12.8 - 12.12.
Unit III:Chapter 20: 20.1 - 20.3, 20.5 – 20.8.

2. Paul Bedell . (2005). Wireless *Crash Course*. (2nd ed). NewDelhi: The McGraw-Hill Companies

Unit IV:Chapter 1: 1.1, 1.2, Ch 2: 2.6
Chapter 3: 3.1 – 3.4, 3.8, 3.9
Chapter 4: 4.3, 4.6, 4.8, 4.9
Chapter 7: 7.1, 7.2.1, 7.2.2, 7.7
Unit V:Chapter 19: 19.1 – 19.18

Reference Books:

1.Leon W. Couch II (1988). *Modern communication systems*, (4th ed). India: Prentice Hall Pvt.

2. Killen H.B. (1988). *Digital Communications with Fiber Optic and Satellite Applications*. (1st ed). India: Prentice Hall International Edition.

Semester III

Core VII: Integrated Electronics

Subject Code: PP1731

Number of hours per week	No of credits	Total number of hours	Marks
6	4	90	100

Objectives: 1. To provide knowledge in the basic structure and working concepts of electronic devices.

2. To acquire application skills involving digital integrated circuit.

Unit I: Electronic Devices

FET – Types – JFET – Principle and working - Salient features – Important Terms and parameters – JFET connections – Practical JFET – JFET applications – MOSFET – Types – Circuit operation – D-MOSFET – EMOSFET – SCR – Working – Equivalent circuit – SCR as a switch – Application of SCR – Triac – Construction – Operation – Characteristics - Applications – Applications of Diac.

Unit II: Digital Logic circuits and Flip Flops

Digital IC characteristics – Diodes and transistors in logic circuits – DTL type – AND, OR, NAND and NOR – RTL and TTL type NAND – ECL and I^2L circuits – Flip flops – NAND Latch – SR flip –flop, D flip – flop, JK flip flop – JK master – Slave flip flop – T-flip flop.

Unit III: Registers and Counters

Shift register – Ring counter – Shift counter (Johnson's counter) – Asynchronous counter / Ripple counter – Mod counters – 4-bit binary down counters – 4 Bit up/down counters – BCD using decoding gates – Synchronous counters – Design – Mod 3 counter – Random Sequence generator – Synchronous BCD counter.

Unit IV: Op-Amp Circuits

Characteristics and parameters –Op-amp comparator- Schmitt Trigger – Inverting and non-inverting amplifier –Voltage follower – summing and difference amplifier - Differentiator and Integrator – Current to voltage converter - Solution of Differential equation and simultaneous equation using op-amp - Instrumentation Amplifier using Transducer Bridge - Temperature indicator and controller –Light intensity meter – Measurement of flow and thermal conductivity –Analog weight scale – Differential input and output amplifier -Voltage to current converter –Very high impedence circuit - sample and hold system.

Unit V: Filter circuits and 555 Timer

Active filters – First order Low pass Butterworth filter – Filter design - frequency scaling – Second order Low pass Butterworth filter - First order and Second order High pass Butterworth filter – Higher order filters - Band pass filter –Wide and Narrow Band pass filter – Wide and Narrow Band Rejection filter -All pass Filter - 555 Timer - internal structure – Schmitt Trigger – Astable and Monostable multivibrators.

Text Books:

1. Mehta V.K., Rohit Mehta. (2016). *Principles of Electronics*. New Delhi: S.Chand and Company.
   Unit I: 19.1 – 19.13, 19.27 – 19.38, 20.1 – 20.8, 20.12, 21.2 – 21.6, 21.8, 21.9, 21.10
2. Vijayendran.V., Viswanathan.S. (2011). *Introduction to Integrated Electronics Digital and Analog*. (1st ed.).Chennai: (printers and Publishers) Pvt. Ltd.
   UnitII: 11.1 – 11.7, 11.8, 9.1 – 9.6
   Unit III: 10.1 – 10.7
   Unit IV: 13.3, 13.4, 14.1 – 14.13.
   Unit V: 17.1 – 17.4
3. Thomas L.Floyd. (1999). *Digital Fundamentals*.(3rd ed.). New Delhi: UBS-Publishers Distributers LTD.

Unit II: A – 8

4. Ramakant.A.Gayakwad. (2012). *Op-ampsand linear Integrated circuits*. (4th ed.).New Delhi: Eastern and Economy Edition PH1 learning private Limited.
   Unit IV: 6.6.1 , 6.6.1(a-e) 6.6.7,6.9,6.11, 8.15
   Unit V: 7.1 – 7.10

Reference Books:

1. Millman J. Halkias, C.C. (1991). *Integrated Electronics*. New Delhi: Tata McGraw-Hill Publishing Company Limited.
2. Ryder, J.D. (2004). *Electronics: Fundamentals and Applications*. United States: Prentice Hall International, INC., Englewood Cliffs.
3. Salivahanan, S., Kumar, N.S. (2012). *Electronic Devices and Circuits*. (3rd ed.). New Delhi: Tata McGraw-Hill Publishing Company Limited.
4. Donald .P. Leach, Albert Paul Malvino, Goutam suba. (2006).*Digital Principles and Applications.*New Delhi: Tata, Mc Graw Hill publishing company, Ltd..
5. Malvino A.P. and Brown J.A. (1997).*Digital Computer Electronics*. (3rd ed.). NewDelhi: Tata McGraw Hill Publishing Company.

Semester III

Core VIII: Microprocessor and Microcontroller

Subject Code: PP1732

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives: **1.** To provide knowledge on the hardware, programming and applications of 8085 microprocessor and 8051 microcontroller.
2.To gain hands on experience in interfacing peripherals to the microprocessor.

Unit I: Evolution and architecture of microprocessor 8085

Evolution of microprocessors – Intel 8085 microprocessor – Architecture – ALU – Timing and control unit – Registers (general purpose & special purpose registers) – Flags – Data and address bus – Pin configuration – 8085-based microcomputer – 8085 machine cycles and bus timings – Memory interfacing –Peripheral I/O – Memory mapped I/O

Unit II: Introduction to assembly language programming

Intel 8085 instructions – Opcode and operands – Instruction word size – Instruction set of Intel 8085 – Instruction and data formats – Addressing modes – Stack – Subroutines – Examples of assembly language programs: addition of two 8-bit numbers – 8-bit subtraction – One's compliment – Two's compliment – Square of a number – Largest number in an array – Ascending or descending order – Smallest number in an array

Unit III: (a) Data transfer schemes – Interrupts – Interfacing

Address space partitioning – Memory and I/O interfacing – Data transfer schemes – Programmed data transfer schemes – DMA data transfer scheme – Interrupts of Intel 8085 –

Hardware and software interrupts – Interrupt call locations – RST 7.5, 6.5 and 5.5 – Interfacing I/O devices – I/O ports: non programmable I/O port Intel 8212, Programmable Peripheral Interface (PPI) Intel 8255

(b) Microprocessor based data acquisition system

Analog to digital converter – Sample and hold circuit – Analog multiplexer – ADC 0800 – Interfacing of A/D converter ADC 0800 – Interfacing of ADC 0800 and analog multiplexer AM 3705 – Interfacing of ADC 0800, analog multiplexer and sample and hold circuit

Unit IV: Microprocessor applications

Delay subroutine – 7 Segment LED display – Display of decimal numbers – Display of alphanumeric characters – Formation of codes for alphanumeric characters – Generation of square wave or pulse – 8-bit multiplication – 8-bit division – Measurement of electrical quantities – Frequency measurement – Resistance measurement – Measurement of physical quantities – Temperature measurement and control – Measurement and display of speed of a motor – Microprocessor based traffic control

Unit V: The 8051 Microcontroller

Inside the 8051 – Introduction to 8051 assembly programming – Assembling and running an 8051 program – The program counter and ROM space in the 8051 – Data types and directives – 8051 Flag bits and the PSW register – 8051 register banks and stack – Pin description of 8051 – I/O programming – Bit Manipulation. Arithmetic Instructions: Addition of unsigned numbers, Addition of Individual bytes – Subtraction of unsigned numbers – Addition of Individual bytes – Subtraction of unsigned numbers – Unsigned multiplication and division.

Text Books:

1. Ramesh Goankar. (2013). *Microprocessor Architecture*. Programming and Applications with the 8085. (6th ed.). India: Penram International Publishing Pvt.Ltd.**Unit I:** Chapter 4: 4.2, 4.3
   Chapter 5: 5.1 (5.1.1, 5.1.2), 5.4 (5.4.1, 5.4.3)

2. Ram, B. and Sanjay Kumar. (2013). *Fundamentals of Microprocessors and Microcontroller*. (7th ed.). India: DhanpatRai Publications (P) Ltd.
3. **Unit I:** Chapter 1: 1.1, 1.2
   Chapter 3: 3.1.3 – 3.1.5
   Unit II: Chapter 3: 3.1.6 – 3.1.8
   Chapter 4: 4.1 - 4.3, 4.6
   Chapter 5: 5.5, 5.6
   Chapter 6: 6.1 – 6.6, 6.9, 6.11, 6.19, 6.21 (only), 6.22.1, 6.24 (only)
   Unit III: Chapter 7: 7.1, 7.2, 7.3, 7.4, 7.4.1 – 7.4.4, 7.5, 7.5.1 – 7.5.3, 7.6, 7.6.1, 7.7, 7.7.1 – 7.7.4
   Chapter 8: 8.1, 8.2, 8.4, 8.5, 8.6, 8.6.1 – 8.6.3
   Unit IV: Chapter 6: 6.29, 6.30
   Chapter 9: 9.2, 9.3, 9.3.3 – 9.3.5, 9.5, 9.5.1, 9.5.5, 9.6, 9.6.1, 9.6.5, 9.8, 9.9

4. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin, D. Makinlay. (2009). *The 8051 Microcontroller and Embedded Systems*. (2nd ed.).New Delhi: Pearson Education

5. **Unit V:** Chapter 2: 2.1 – 2.6
   Chapter 4: 4.1 – 4.2
   Chapter 6: 6.1 (Relevant topics)

Reference Books:

1. NagoorKani. (2004). *Microprocessor and its Applications.* (1st ed.). Chennai: RBA Publications.
2. Douglas. V. Hall. (1999). *Microprocessors and Interfacing – Programming and Hardware.* (2nd ed.). India: McGraw Hill.
3. Kenneth J. Ayala. (2004). *The 8051 Microcontroller – Architecture, Programming & Applications.* (2nd ed.). India: Penram International.

Semester III

Elective III (a):Physics of the Cosmos

Subject Code: PP1733

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives:1. The course enables the students to understand and realize the historical evolution of Universe and principles involved in Astrophysics

2. The topics included are Solar system, Comets, Galaxy, Cosmology and Astronomical Instruments which play a key role in the future employability and global progress of students.

Unit I: Solar system

Components of the solar system - The Sun - The Planet - Two types of planets-Satellites - Asteroids and Comets - Composition differences between the Inner and Outer planets - Bode's law: The search for order - Density as a measure of a planet's composition - Age of solar system - Origin of solar system - Interstellar cloud - Formation of the solar Nebula - Condensation in solar Nebula - Accretion and Planetesimals - Formation of Planets - Formation of Moons - Final stages of Planet formation - Formation of Atmospheres - Cleaning up the solar system

Unit II: Stars

Binary and multiple stars: Introduction – Visual Binary – Spectroscopic Binary – Eclipsing Binary – Multiple stars – Origin of Binary stars – Stellar masses and mass Luminosity Relation – Mass transfer in close Binary systems.

Neutron stars and Black holes: Discovery of pulsars – Rotating Neutron star model of pulsars – Period distribution and loss of rotational energy – Test of rotating neutron star model of pulsars Gold's model of pulsars, Black holes.

Unit III: Galaxies

Discovering Galaxies - early observations of Galaxies - Types of Galaxies - Differences in Stellar and Gas content of Galaxies - The cause of Galaxy types - Galaxy collisions and Mergers - Measuring properties of Galaxies - Galaxy distances - using Cepheid Variables - The Red shift and Hubble Law - Measuring the diameter of a Galaxy -Measuring

the Mass of a Galaxy - Dark Matter-Quasars as probes of Intergalactic Space -Gravitational Lenses-Galaxy clusters - The local group-Rich and Poor Galaxy clusters -Super clusters

Unit IV: Cosmology

Introduction – Red shift and the expansion of the universe – Matter Density in the universe and Declaration parameter –Perfect cosmological principle – Fundamental equation of cosmology. The current theories – Some important models of the universe – Observational tests of cosmological models.

Unit V: Astronomical Instruments

Light and its properties – Earth atmosphere and the electromagnetic radiation – Optical telescopes – Radio telescopes –Hubble space telescopes – Astronomical spectrographs – Photoelectric photometry – Spectrophotometry – Detectors and Image processing.

Text Books:

1. Thomas T., Arny. (1996). *Explorations –An Introduction to Astronomy*, (1st ed.). California: Mosby Version publications.
   Unit I: Chapter 6

   Unit III: Chapter 15, Section 15.1 - 15.3,15.5,15.6

2. Baidyanath Basu. (2006). *An introduction to Astrophysics.* (1st ed.). New Delhi: Prentile Hall of India PVT Lt publications.
   Unit II: Chapter 7, Sections 7.1 – 7.7 and 15.1 - 15.5, 15.8

   Unit IV: Chapter 21, Sections 21.1 – 21.7

   Unit V: Chapter 1, Sections 1.1 – 1.10

Reference Books:

1. Narlikar, J.V. (1995). *Structure of the Universe.*(1st ed.). New York: Oxford University Press.
2. George O., Abell. (1986). *Exploration of the universe*. (1st ed.). New Delhi: Saunder's college publishing.
3. Frark, H., Shu. (1982). *The Physical Universe An Introduction to Astronomy*. (1st ed.). California: University science books, Mill valley.
4. Abhyankar, K.D. (1989). *Astrophysics – Stars and Galaxies*. (1st ed.). New Delhi: Tata – McGraw Hill Publications.

Semester III

Elective III (b): Radiation Physics

Subject Code: PP1734

No of hours per week	Credit	Total No of Hours	Marks
6	5	75	100

Objective: 1. To inculcate the knowledge on Radiation sources and its detection, Diagnostic Radiology, and Radiation Dosimetry.

2. To develop the skill in industrial applications of radiation.

Unit I: Radiation Sources and its interaction with matter

Units and definitions-Fast electron sources-Heavy charged particle sources-Sources of electromagnetic radiation-neutron sources-Interactions of fast electron –Interaction of Heavy charged particle- Interaction of gamma rays-Interaction of neutrons

Unit II: Radiation Detection

General properties of Radiation detectors-Simplified Detector model-Modes of Detector operation-Ionization Chambers-Design and Operation of DC Ion Chambers-Proportional Counters-Design Features and its Performance-Geiger-Muller Counter- Geiger Counting Plateau-Design Features-Counting efficiency-Scintillation Detector Principles-Organic and Inorganic Scintillators.

Unit III: Accelarators for Radiation therapy and Diagnostic Radiology

Accelarators: Production of X-Rays and Accelarator beams- Medical and Industrial accelarators

Diagnostic Radiology: Physical principles of x-ray diagnosis, density, contrast, detail and definition of radiograph, choice of kV, mA, filtration, FSD, Screens, films, grids, contrast media, concept of modular transfer function and its applications, Radiographic techniques, Special procedure: Myelography, Tomography, Fluoroscopy, Pelvimetry, Film Processing, Image intensifiers and television monitoring, reduction of patient dose, quality assurance in diagnostic radiology.

Unit IV: Radiation Dosimetry

Dosimetry Fundamentals-Simple Dosimeter model in terms of cavity theory-Integrating Dosimeters-Thermoluminescence Dosimetry- Photographic Dosimetry-Chemical Dosimetry-Calorimetric Dosimetry-Scintillation Dosimetry-Semiconductor Detectors for Dosimetry

Unit V: Industrial applications of radiation and Hazard evaluation

Scientific and industrial applications of gamma rays- Based on gamma ray backscatter and on X-ray Fluorescence- Scientific and industrial applications of beta particles and electrons- Scientific and industrial applications of neutrons- Scientific and industrial applications of gamma rays- Scientific and industrial applications of protons and alpha particles. Application of tracer technology to industry and the environment- Tracer applications in the field.

Hazard evaluation by calculation, methods of calculation, area monitoring,and personal monitoring. Detection and measurement of contamination on work surface and person.

Text Books:

1. Knoll. G F**,** (1989), *'Radiation Detection and Measurement'*,(2 nd ed) NewYork:Wiley
2. Foldiak G**, (**1986).*'Industrial applications of radioisotopes' (1st ed)* NewYork: Elsevier Science Publishing Company.
3. Frank Herbert Attix, (2004*)"Introduction to Radiological Physics and Radiation Dosimetry" (1st ed)* Weinheim: WILEY-VCH Verlag Gmbh & Co. kGaA.
4. John R Lamarsh, (1983)**,***'Introduction to Nuclear Engineering'*,(2nded)New York: Addison Wesley Publishing Compan**y**

5. G.C Lowenthal & P.L. Airey, (2001*), 'Practical applications of Radioactivity and Nuclear Radiations'*(1st ed.).Cambridge : Cambridge University Press.

Reference Books:

1. Kenneth R Kase, Bjarngard B E and Attix F H, (1985), *The Dosimetry of ionising radiation*", Vol I (1st ed.). Orlando, Florida: Academic Press
2. Kenneth R Kase, Bjarngard B E and Attix F H, (1987), *The Dosimetry of ionising radiation*", Vol II (1st ed.). Orlando, Florida: Academic Press
3. Glasstone S and Sesonske A, (1986), *Nuclear Reactor Engineering(*4th ed)Delhi: CBS.
4. Erich J Hall, (1988). *'Radiology for the Radiologists' (*3rd ed) **.** New York: J B Lippincott Company.
5. Faiz M.Khan, (2003), *The Physics of Radiation therapy*, (3rd ed.). Philadelphia, USA: Lippincott Williams & Wilkins.

Semester IV

Core IX: Materials Science

Subject Code: PP1741

No. of hours per week	No. of credits	Total no. of hours	Marks
6	4	90	100

Objectives:1. To provide a clear idea on the properties, of functional materials.
2.To understand the fabrication and application of materials.

Unit I: Phase transformation

Phase rule- Single component systems- Binary Phase diagrams- Microstructural Changes during Cooling- The lever rule- Applications of phase diagrams- Phase transformations- Time scale for phase changes- The growth and the overall transformation kinetics of nucleation– Applications.

Unit II: Elastic Behaviour & Imperfections

Atomic model of elastic behavior- The modulus as a parameter in Design- Rubber-like elasticity- Anelastic behavior: Relaxation Processes- Viscoelastic behavior: Spring-Dashpot models- Crystal imperfections-Point imperfections- The geometry of dislocations- other properties of dislocations- surface imperfections.

Unit III: Oxidation, Corrosion and other deformation

Mechanisms of oxidation-oxidation resistant materials- the principles of corrosion- protection against corrosion- plastic deformation- the tensile stress- stress-strain curve- plastic deformation by slip creep- mechanisms of creep-creep resistant materials- Ductile fracture- Brittle fracture- Methods of protection against fracture.

Unit IV: Synthesis, fabrication and processing

Fabrication of metals- forming operations-casting- powder metallurgy- thermal processing of materials- annealing processes- heat treatment of steels- fabrication of ceramic materials- fabrication and processing of glasses- fabrication of clay products- powder pressing- tape casting- polymer additives- forming techniques for plastics.

Unit V: Composites

Particle-reinforced composites- large-particle composites- dispersion-strengthened composites- fiber-reinforced composites- influence of fiber length- influence of fiber orientation and concentration- the fiber phase- the matrix phase- Polymer –Matrix composites- metal-matrix composites- ceramic-matrix composites -carbon-carbon-composites- hybrid composites- Processing of fiber-reinforced composites : Pultrusion- Prepreg production processes- Filament winding.

Text Books:

1. Raghavan, V. (2007). *Materials Science and Engineering*. (5th ed.). New Delhi: Prentice-Hall of India Limited.

   Unit I: Chapter 7: 7.1, 7.2,7.3,7.4, 7.5, 7.7.

   Chapter 9:9.1,9.3.

   Unit II: Chapter 10: 10.1,10.2,10.3,10.4,10.5

   Chapter 6:6.1, 6.2, 6.3, 6.4

   Unit III: Chapter 13: 13.1,13.2,13.3,13.4

   Chapter 11:11.1, 11.2,11.3,11.12,11.13

   Chapter 12: 12.1,12.2,12.6

2. William D. Callister, Jr. (2001). *Fundamentals of Materials Science and Engineering,An Interactive e-Text*. (5th ed.). USA: John Wiley & Sons.
   Unit IV: Chapter 14: 14.1-14.10, 14.12,14.13.
   Unit V: Chapter 15:15.1 – 15.13.

Reference Books:

1. Wahab, M.A. (2015). *Solid State Physics- Structure and Properties of Materials*. (3rd ed.). New Delhi: Narosa Publishing House Pvt. Ltd.
2. Philip Philips. (2014). *Advanced Solid State Physics.* (2nd ed.). UK:Cambridge University Press.
3. Luigi Nicolais. & Gianfranco Carotenuto. (2014). *Nanocomposites – In Situ synthesis of polymer-embedded nanostructures.*USA:John Wiley & Sons.

Semester IV

Core X: Nuclear and Particle Physics

Subject Code: PP1742

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives:1. To provide knowledge about the nuclear force in the nucleus, the nuclear models, the nuclear radiations and the elementary particles.

2.To acquire working knowledge of the applications of nuclear and particle Physics.

Unit I: Nuclear forces

Exchange forces – Meson theory of nuclear forces – n-p and p-p scattering – Scattering length – Spin dependence of nuclear forces – Charge independence of nuclear forces - Ground state of deuteron – Properties of ground state of deuteron – Tensor forces – Excited state of deuteron – Magnetic moment and quadrapole moment of deuteron.

Unit II: Nuclear model

Liquid drop model: Weizsacker's mass formula - Equation of mass parabolas for Isobaric nuclei – Mass stability – Deformation of liquid drop - Bohr and Wheeler's theory of nuclear fission - Nuclear shell model – Evidence for the existence of magic numbers – Extreme single particle model – (square well of infinite depth, harmonic oscillator potential – spin orbit potential) - Predictions of nuclear shell model – Angular momenta and parities of nuclear ground states, magnetic moments – Schmidt lines.

Unit III: Radioactivity

Alpha decay: Properties of alpha particles and α decay – Velocity and energy of alpha particles – Gamow's theory of alpha decay – Geiger Nuttal law.

Beta decay: Properties of beta particles - General features of beta spectrum – Fermi theory of beta decay – Fermi and Gamow – Teller selection rule – Neutrino hypothesis – Properties of neutrino – Kurie Plot.

Gamma emission: Multi-pole radiation – Selection rules – Internal conversion and nuclear isomerism.

Unit IV: Nuclear reactions

Kinds of nuclear reactions, conservation laws, nuclear reaction kinematics – Compound nuclear theory - Reciprocity theorem - Breit Wigner dispersion formula - Neutron sources – Classification of neutrons as to energy - Neutron diffusion - Neutrons current density – Neutron leakage rate – Fast neutron diffusion and Fermi age equation – Four factor formula – Nuclear chain reaction – Critical size of a reactor - General aspect of reactor design.

Unit V:Elementary particles

Classification of elementary particles – Particle interactions – Symmetries and conservation laws – Invariance under charge, parity – Charge conjugation – Time reversal, Combined Inversion of C.P.T. - isospin – srangeness –- hyperons – leptons – Classification of hadrons .

Text Books :

1. Tayal, D.C. (1982). *Nuclear Physics*. (4th ed.). Mumbai: Himalaya Publishing House.

Unit I: Chapter 8: 8.1, 8.4, 8.5, 8.7 (A alone), 8.10

Unit II: Chapter 9: 9.3, 9.4 (1 and 2 only)

Chapter 13: 13.1 (F) – (Quantum Effects not included)

Unit III: Chapter 5: 5.3, 5.5, 5.6

Chapter 6: 6.1, 6.2 (Beta spectrum alone), 6.3, 6.5, 6.6

Chapter 7: 7.1, 7.3, 7.4, 7.6

Unit IV: Chapter 10: 10.1 - 10.3, 10.11, 10.14

Chapter 12: 12.1, 12.2, 12.5, 12.9

Chapter 15: 15.1, 15.2 (different shapes of reactors not included), 15.3.

Unit V: Chapter 16: 16.1, 16.2, 16.3, 16.4 – 16.10, 16.13 (only basic properties of elementary particles)

2.Roy, R.R. and Nigam, B.P. (1983). *Nuclear Physics*. (1st ed.). USA: New age International Ltd.

Unit I: Chapter 3: 3.2 – 3.7

Unit IV: Chapter 6: 6.4

3. SatyaPrakash. (2005).*Nuclear Physics and Particle Physics*.(1st ed.). New Delhi: Sultan Chand & Sons.

Unit I: Chapter 2: 2.14 – 2.16

Unit II: Chapter 7: 7.4, 7.8 (1& 2 only)

Reference Books:

1. Bernard L. Cohen. (1971). *Concepts of nuclear Physics*.(1st ed.). New Delhi: Tata McGraw Hill

2 . Herald Enge. (1971). *Introduction to Nuclear Physics*. (1st ed.). New Delhi: AddisionWesly Publishing Company.

Semester IV
Core XI: Molecular Spectroscopy
Subject code: PP1743

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives:1. To provide knowledge in the basic understanding of spectroscopy.

2. To gain insight ideas on instrumentation tools and its applications.

Unit I: Microwave spectroscopy

Classification of molecules - Interaction of radiation with rotating molecule – Rotational spectra of rigid diatomic molecules – Isotope effects in rotational spectra – Intensity of rotational lines – Non-rigid rotator – Vibrational excitation effects – Symmetric top molecules –Microwave spectrometer – Information derived from rotational spectra.

Unit II: Infrared spectroscopy

Vibrational energy of a diatomic molecule – Infrared spectra – Infrared selection rules – Vibrating diatomic molecule – Diatomic vibrating rotator – Asymmetry of rotation – Vibration band – Vibrations of polyatomic molecules – Rotation vibration spectra of polyatomic molecules – IR spectrophotometer – Instrumentation - Sample handling techniques – Fourier transform infrared spectroscopy – Applications (any two)

Unit III: Raman spectroscopy

Theory of Raman scattering – Rotational Raman spectra – Vibrational Raman spectra – Mutual exclusion principle – Raman spectrometer – Polarization of Raman scattered light - Structure determination using IR and Raman spectroscopy.

Unit IV: Electronic spectroscopy

Introduction – Vibrational coarse structure – Vibrational analysis of band systems – progressions and sequences – Information derived from vibrational analysis – Frank – Condon principle – Intensity of vibrational electronic spectra – Roatational fine structure of electronic – Vibration spectra – The Fortrat parabolae – Dissociation – Predissociation.

Unit V: Resonance spectroscopy

Nuclear magnetic Resonance (NMR): Magnetic properties of nuclei – Resonance condition – NMR instrumentation – Relaxation processes – Bloch equations – Chemical shift – Nuclear quadrupole effects.

Electron Spin resonance (ESR): Introduction – Principle of ESR – ESR spectrometer – Total Hamiltonian - Hyperfine structure.

Nuclear quadrupole resonance (NQR): The quadrupole nucleus – Principle of nuclear quadrupole resonance – Transition for axially symmetric systems - NQR instrumentation.

Text Book

Aruldhas. G. (2005) . *Molecular structure and spectroscopy.***(**2nd ed). New Delhi: Prentice-Hall of India private Ltd.

Unit I : Chapter 6: 6.1 – 6.7, 6.9, 6.13, 6.14

Unit II : Chapter 7: 7.1 – 7.7, 7.11, 7.15 – 7.18

Unit III: Chapter 8: 8.1 – 8.6, 8.8, 8.10

Unit IV: Chapter 9: 9.1 – 9.10

Unit V: Chapter 10: 10.1 – 10.5, 10.7, 10.15,

Chapter 11: 11.1 – 11.5

Chapter12: 12.1 – 12.3, 12.5

Reference Books:

1. Banwell . C.N. (1997). *Fundamentals of Molecular Spectroscopy*. (3^{rd} ed). New Delhi: Tata Mc Graw Hill Publishing Company Ltd.

2. Herzberz Van Nastrand G. (1989) .*Molecular spectra and molecular structure* (2^{nd} ed). Germany: Krieger publishing company Ltd.

Semester IV

Elective IV (a) : Nano Physics
Subject code: PP1744

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives:1. To understand the theoretical aspects of low dimensional semiconductor systems.

2.To provide an idea on the synthesis and applications of nanomaterials.

Unit I : Nanomaterials Synthesis and Characterization

Nano structures – Synthesis of nanoparticles : Sol-gel processing – Arrested precipitaiton –Biosynthesis of nanomaterials using plants – Carbon nanotubes - Electronic structure of carbon nanotubes - Types of carbon nanotubes - Synthesis of carbon nanotubes: Laser method- CVD (Pyrolysis of Hydrocarbons) – CVD method on flat surfaces - Solar production of carbon nanotubes – Properties - Applications – Fullerene – Properties of Fullerene. Structural characterisation: XRD – Scanning Tunnelling Microscope (STM) – Atomic Force Microscope (AFM) – Properties of nanomaterials. Structural characterisation: XRD – FTIR

Unit II: Quantum hetrostructures

Novel phenomena - Heterostructure – Growth of heterostructure – Molecular Beam Epitaxy –Band alignment – Quantum well – Superlattice - Doped Heterostructures – Quantum wells in heterostructures – Effective mass theory in heterostructures – Application of effective mass theory in quantum wells in heterostructures –Applications of heterostructures.

UNIT – III: Quantum well, quantum wires & quantum dots

Preparation of Quantum nanostructures - Size effects - Fermi gas and density of states - Calculation of the density of states – Quantum wire – Production, structure and uses – Quantum dot : production, epitaxially self assembled quantum dots – Electronic energy states – Application – Quantum well infrared detector – Quantum well and quantum cascade laser – Quantum dot laser.

Unit – IV : Magneto electronics and applications of nanotechnology

Nano crystalline soft magnetic materials – Permanent magnet materials – Preparation of magnetic nanomaterials - Super paramagnetism - Coulomb blockade – Single electron transistor - Spintronics - Giant magnetoresistance - Quantum Hall effect - Quantum spin Hall effect - Fractional quantum Hall effect - Applications of nanotechnology.

Unit V: Applications of Nanomaterials

Nanoelectronics – Introduction – Sensors – MEMS/NEMS – Solar cells – Displays – Optical switches – Graphene electronics – Biosensors – Biomarkers and Bioimaging – Targeted drug delivery – Nanorobots.

Text Book:

1. Dr. Sr. Gerardin Jayam (2009). *Nano Physics*, (1st ed.). Nagercoil: Department of Physics, Holy Cross College.
   UNIT : I to IV
2. Mohankumar G., (2016) *Nanotechnology-Nanomaterials and Devices* , (1st ed.).New Delhi: Narosa publishing house.
   UNIT: V: 4.1,4.3, 4.7, 5.4, 5.6, 5.7, 5.9, 7.2, 7.3, 7.5, 7.7

Reference Books:

1. Charles P. Poole Jr, Frank J. Owens, (2008). *Introduction to Nanotechnology*, (1st ed.). Germany: Wiley publications.
2. K. Goser, P. Glosekotter and J. Dienstuhl, (2005).*Nanoelectronics and nanosystems*, (1st ed.). Germany: Springer Verlag publications.
3. W.R. Fahrner , (2008). *Nanotechnology and nanoelectronics*, (1st ed.). Germany: Springer Verlag publications.
4. Manasi Karkare, (2008). *Nanotechnology – Fundamentals and applications*, (1st ed.). Mumbai:I.K. International publications.

Semester IV

Elective IV (b) : Quantum Field Theory

Subject Code: PP1745

No of hours per eek	No of credits	Total no of hours	Marks
6	5	90	100

Objectives: 1. To demonstrate an understanding of field quantisation and the expansion of the scattering matrix.

2.To understand and be able to do simple calculations in the standard model of elementary particle physics.

Unit : I Classical fields theory

The dynamics of fields – The Klein – Gordon equation – First order Lagrangians – Maxwell's equations – Locality – Lorentz Invariance – Symmetries – Noether's theorem – Internal symmetries – Hamiltonian formalism

Unit : II Free fields

Canonical quantization – The simple harmonic oscillator – The free scalar field – Relativistic normalization - Complex scalar fiedls. – The Heisenberg picture – Causality – Propagators: The Feynman propagator – Green's functions.

Unit : III Interacting fields

The interaction picture – Dyson's formula – Wick's theorem – Nucleon scattering – Feynman diagrams – Feynman rules – Examples of scattering amplitudes – Mandelstam variables – The Yukawa potential - Φ^4 theory.

Unit IV : The Dirac equation

Spinor representation - Spinors – The dirac equation – Symmetries and conserved currents – Plane wave solutions - Fermionic quantization – Fermi – dirac statistics – Dirac's hole interpretation – Yukawa theory – Nucleon scattering..

Unit V : Quantum electrodynamics

Maxwell' s equations – Gauge symmetry – The quantization of the electromagnetic field – Coulomb Gauge – Lorentz Gauge – QED – Naïve Feynman rules – Feynman rules - Charged scalars – Scattering in QED – The coulomb potential.

Text Book:

Dr. David Tong, (2007). Quantum field theory (lecture notes) (part –III). Universtiy of Cambridge, Mathematical Tripos. Available at : http:// www/damtp.cam.ac.uk/user/tong/qft.html

Reference Book :

1. Peskin,M.E. and and Schroeder, D.V. (1995). An Introduction to Quantum Field Theory, Addison – Wesley Publication.
2. Srednicki, M. (2007). Quantum Field Theory, Cambridge University Press.

Practical – I
Advanced Physics Lab – I (General Physics)
Subject Code: PP17P1

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives:1. To acquire knowledge about basic concepts of physics and to calculated the related physical parameters.

2.ToProvide the students with different practical, intellectual and transferable skills.

Any twelve

1. Ultrasonic diffraction
2. Spectrophotometer Kit: Determination of Rydberg's Constant – Hydrogen and solar Spectrum – Mirror and telescope method
3. LASER Experiment: Thickness of insulation of a wire by Diffraction method
4. Guoy's Method: Magnetic Susceptibility measurement
5. Spectrophotometer Kit: Absorption and Transmission coefficients of solutions.
6. Magneto resistance Kit: Determination of Magnetic resistance.
7. Ultrasonic Interferometer Kit: Determination of velocity
8. Quincke's method: Determination of Susceptibility
9. Band Gap measurement
10. Hall effect Kit: Measurement of Hall voltage, current & Hall Coefficient.
11. LCR circuit: Determination of Dielectric constant of Liquids.
12. Four probe Kit: Conductivity measurements
13. Michelson Interferometer: Determination of wave length and thickness of the given mica sheet.
14. Electrolytic tank.Equi-potential plot.
15. Fibre Optical communication.
16. Indexing an X- ray Powder diffraction pattern and lattice parameter determination
17. Debye – Waller factor determination using X – Ray intensity data.
18. Conductivity – Two probe method – dielectric crystals (Kit)
19. Dielectric constant of crystals – Parallel plate capacitor method
20. B.G. Variation of coefficient of mutual induction with distance and angle.

Practical – II

Advanced Physics Lab - II (Programming with Computer – C++)

Subject Code: PP17P2

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives:1. To enable the students to solve problems in C++ using different numerical methods.

2.To make the mathematical calculations simpler.

Any twelve experiments:

1. Curve fitting to straight line and data interpolation (Cauchy's constants)
2. Currents in a Wheatstone's bridge – Gauss elimination method
3. Solution of radioactive decay problem – RungeKutta method
4. Computer simulation (frequency response of a series LCR resonance circuit)
5. Inverse and determinant of a matrix
6. Matrix multiplication (application – rotation matrices)
7. Solution of a physical problem – Newton Raphson method
8. Newton's forward/backward interpolation for table of points
9. Numerical differentiation – Compute the value of derivative for the function y = f(x) (whose tabular values are given) at a given value of x using Newton's forward/backward difference formula
10. Numerical integration – Simpson's 1/3 and $3/8^{th}$ rule

11. a) Pseudo random number generation b) Monte Carlo method of estimating the value of π
12. Monte Carlo integration – estimating the area of an ellipse or a simple integral
13. Differential equation – Newton's law of cooling by Euler's method
14. Boundary value problem – solution to Poisson's equation

Practical – III
Advanced Physics Lab – III (Electronics)
Subject Code: PP17P3

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objectives:1. To understand and analyze the working of electronic devices.
2.To acquire skills in designing electronic circuits.

Any fourteen

1. Code converters – BCD to Gray, Gray to BCD
2. Darlington pair amplifier
3. FET: Characteristics
4. FET : Amplifier
5. Push – Pull Amplifier
6. Amplitude modulated circuits
7. UJT - Characteristics and saw toothwave generator
8. Phototransistor – Comparison of illumination
9. Schmidt trigger usingIC 555 and IC 741
10. Counters: up, down ring and mod counters
11. Operational Amplifier – A/D converter
12. Operational Amplifer – sine, square, triangular and pulse wave generators
13. Binary adder and subtractor.
14. Operational Amplifier – analog computation
15. Modulus counter – IC7490
16. Multiplexer, Demultiplexer, karnaugh map
17. SCR – Characteristics.
18. BCD to excess 3, excess 3 adder

Practical – IV
Advanced Physics Lab – IV (Microprocessor and Micro controller)
Subject Code: PP17P4

No of hours per week	No of credits	Total no of hours	Marks
6	5	90	100

Objectives:1. To become familiar with the instruction set of Intel 8085 microprocessor and microcontroller.
2.To provide practical hands on experience with Assembly Language Programming and interfacing with 8085 microprocessor.

Any fourteen

1. Assembly language program for Block move and logical operations
2. Assembly language program for Addition, Subtraction, Multiplication, and Division.
3. Arranging an array of datain Ascending and descending orders.
4. Finding the largest, smallest and search for any number of an array using micro processor
5. Factorial of given Number.
6. Sum of series of even numbers and odd numbers from the list of numbers.
7. Fibonaci series.
8. Counters using microprocessor
9. Waveform generation using microprocessor
10. Display of any character (Rolling display)
11. Code conversion using microprocessor
12. AD/DA converters using microprocessor
13. Number of zeros, positive, negative numbers and square of a number using 8085 microprocessor
14. Interfacing – Stepper motor using microprocessor
15. Interfacing – Traffic Control
16. Microcontroller – Logic operations, 1's and 2's compliment
17. Microcontroller - Addition, Subtraction, Multiplication, and Division

Self Learning Course
Semester III

Physics for Lectureship Exam - I (PP17S1)
(CSIR/ JRF/ SLET/ GATE)

No of credits	Marks
2	100

Objectives: 1. To motivate the students for career opportunities and also for research activities.
2.To develop knowledge to face the competitive exams.

Unit I: **Mathematical methods of physics**

Dimensional analysis - Vector algebra and vector calculus - Linear algebra- matrices - Cayley-Hamilton Theorem - Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order,Special functions (Hermite, Bessel, Laguerre and Legendre

functions), Fourier series - Fourier and Laplace transforms. Elements of complex analysis - analytic functions;Taylor & Laurent series; poles - residues and evaluation of integrals - Elementary probability theory - random variables – binomial - Poisson and normal distributions - Central limit theorem - Green's function - Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques: root of functions – interpolation – extrapolation - integration by trapezoid and Simpson's rule - Solution of first order differential equation using Runge-Kutta method. Finite difference methods –Tensors- Introductory group theory: SU(2), O(3).

Unit II: **Classical mechanics**

Newton's laws - Dynamical systems- Phase space dynamics- stability analysis. Central force motions- Two body collision - Scattering in laboratory and Centre of mass frames - Rigid body dynamics- Moment of inertia tensor - Non-inertial frames and pseudoforces - Variational principle - Generalized coordinates - Lagrangian and Hamiltonian formalism and equations of motion - Conservation laws and cyclic coordinates - Periodic motion: Small oscillations - Normal modes - Special theory of relativity- Lorentz transformations - relativistic kinematics and mass–energy equivalence - Dynamical systems - Phase space dynamics - Stability analysis - Poisson brackets and canonical transformations – Symmetry - Invariance and Noether's theorem - Hamilton-Jacobi theory.

Unit III: **Electromagnetic theory**

Electrostatics: Gauss's law and its applications - Laplace and Poisson equations - boundary value problems - Magnetostatics: Biot-Savart law - Ampere's theorem - Electromagnetic induction - Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces - Scalar and vector potentials - Gauge invariance - Electromagnetic waves in free space - Dielectrics and conductors - Reflection and refraction – Polarization - Fresnel's law – Interference –Coherence – Diffraction - Dynamics of charged particles in static and uniform electromagnetic fields -Dispersion relations in plasma - Lorentz invariance of Maxwell's equation - Transmission lines and wave guides - Radiation- From moving charges and dipoles and retarded potentials.

Unit IV: **Quantum mechanics**

Wave-particle duality - Schrödinger equation (time-dependent and time-independent) - Eigenvalue problems (particle in a box, harmonic oscillator, etc.) - Tunneling through a barrier - Wave-function in coordinate and momentum representations - Commutators and Heisenberg uncertainty principle - Dirac notation for state vectors - Motion in a central potential: Orbital angular momentum - Angular momentum algebra – Spin -Addition of angular momenta - Hydrogen atom - Stern-Gerlach experiment - Time-independent perturbation theory and applications - Variational method - Time dependent perturbation theory and Fermi's golden rule - selection rules - Identical particles - Pauli exclusion principle - Spin-statistics connection.

Unit V: **Thermodynamics and statistical physics**

Laws of thermodynamics and their consequences - Thermodynamic potentials- Maxwell relations - Chemical potential - Phase equilibria - Phase space - Micro- and macro-states - Micro-canonical -Canonical and grand-canonical ensembles and partition functions - Free energy and its connection with thermodynamic quantities - Classical and quantum statistics - Ideal Bose and Fermi gases - Principle of detailed balance - Blackbody radiation and Planck's distribution law.

Reference Book:

Malemnganba, W. & Chenglei, (2012). Study Materials UGC CSIR NET/SET (JRF & LS) Physical Sciences.Arihant Publications Ltd.

Question pattern (Answer all the questions)

Part A : 25 questions x 1 marks = 25 marks

Part B : 20 questions x 2.5 marks = 50 marks

Self Learning Course
Semester IV
Physics for Lectureship Exam II (CSIR/ JRF/ SLET/ GATE) - PP17S2

No of credits	Marks
2	100

Objectives:1. To build confidence to face competitive exams.

2.To face the challenges in society and come out successfully in life.

Unit I: **Electronics and experimental methods**

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices) - Device structure - Device characteristics - Frequency dependence and applications - Opto-electronic devices (solar cells, phot -detectors, LEDs) - Operational amplifiers and their applications - Digital techniques and applications (registers, counters, comparators and similar circuits) - A/D and D/A converters - Microprocessor and microcontroller basics - Data interpretation and analysis - Precision and accuracy - Error analysis - propagation of errors - Least squares fitting - Linear and nonlinear curve fitting - Chi-square test - Transducers (temperature, pressure/vacuum, magnetic fields, vibration, optical, and particle detectors) - Measurement and control - Signal conditioning and recovery - Impedance matching -amplification (Op-amp based, instrumentation amp, feedback) - Filtering and noise reduction – Shielding and grounding - Fourier transforms - Lock-in detector - Box-car integrator - Modulation techniques - High frequency devices (including generators and detectors).

Unit II: **Atomic & molecular physics**

Quantum states of an electron in an atom - Electron spin - Spectrum of helium and alkali atom - Relativistic corrections for energy levels of hydrogen atom - Hyperfine structure and isotopic shift - Width of spectrum lines - LS & JJ couplings – Zeeman - Paschen-Bach & Stark effects - Electron spin resonance - Nuclear magnetic resonance - chemical shift - Frank-Condon principle - Born-Oppenheimer approximation – Electronic – Rotational - Vibrational and Raman spectra of diatomic molecules - selection rules - Lasers: Spontaneous and stimulated emission - Einstein A & B coefficients - Optical pumping - Population inversion - Rate equation - Modes of resonators and coherence length.

Unit III: **Condensed matter physics**

Bravais lattices - Reciprocal lattice - Diffraction and the structure factor - Bonding of solids - Elastic properties – Phonons - Lattice specific heat - Free electron theory and electronic specific heat - Response and relaxation phenomena - Drude model of electrical and thermal conductivity - Hall effect and thermoelectric power - Electron motion in a periodic potential - Band theory of solids: Metals - Insulators and semiconductors - Superconductivity: Type-I and type-II superconductors - Josephson junctions - Super fluidity - Defects and dislocations - Ordered phases of matter: Translational and orientational order - Kinds of liquid crystalline order - Quasi crystals.

Unit IV: **Nuclear and particle physics**

Basic nuclear properties: Size - Shape and charge distribution - Spin and parity - Binding energy - Semi-empirical mass formula - Liquid drop model - Nature of the nuclear force -Form of nucleon-nucleon potential - Charge-independence and charge-symmetry of nuclear forces - Deuteron problem - Evidence of shell structure - single-particle shell model - Its validity and limitations - Rotational spectra - Elementary ideas of alpha -Beta and gamma decays and their selection rules - Fission and fusion - Nuclear reactions - Reaction mechanism - Compound nuclei and direct reactions - Classification of fundamental forces - Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.) - Gellmann-Nishijima formula - Quark model - Baryons and mesons - C, P, and T invariance - Application of symmetry arguments to particle reactions - Parity non-conservation in weak interaction - Relativistic kinematics.

Unit V: **Quantum mechanics and statistical physics**

Spin-orbit coupling - Fine structure - WKB approximation - Elementary theory of scattering: Phase shifts - Partial waves - Born approximation - Relativistic quantum mechanics: Klein-Gordon and Dirac equations - Semi-classical theory of radiation - Bose-Einstein condensation - . Diffusion equation - Random walk and Brownian motion - Introduction to non equilibrium processes.

Reference Book:

W. Malemnganba Chenglei, (2012). UGC CSIR NET/SET (JRF & LS) Physical Sciences. (1st ed.). Arihant Publications Ltd.

Question pattern (Answer all the questions)

Part A :	25 questions x 1 marks	=	25 marks
Part B :	20 questions x 2.5 marks	=	50 marks

Professional Ethics

Indian Knowledge System

Environment and Sustainability

DEPARTMENT OF PHYSICS
with effect from the academic year 2017 - 2018

Aim:

To enhance creative thinking and development skills that lead to quality research.

Objectives:

1. To acquire deep knowledge in advanced areas of physics.
2. To motivate the students towards quality research.

Eligibility Norms for admission:

A candidate who has passed the M.Sc. in Physics with a minimum of 55% marks in the qualifying examination of Manonmaniam Sundaranar University or possess qualification accepted by the syndicate of Manonmaniam Sundaranar University as equivalent examination. For SC/ST candidates there will be 5% relaxation in marks.

Procedure for Admission

An entrance test is conducted for the candidates. It shall be followed by an interview. Only the predetermined number of students may be admitted to M.Phil. programme.

Duration of the course: 1 year

The M.Phil. degree course will consist of two semesters covering one academic year. The scholars will have summative examinations for all the three theory papers at the end of the semester I and the Dissertation and viva, at the end of the II semester.

Passing minimum

A minimum of 50% in the external examination and an aggregate of 50% is required. There is no minimum pass mark for the continuous internal assessment.

Eligibility condition for submission of the dissertation

A candidate is eligible to submit the dissertation only if she completes the three theory papers of the I semester successfully.

M.Phil. – Courses offered

Semester	Subject code	Title of the paper	Hours/week	Credits
I	MPP171	Advanced Physics – I	6	6
	MPP172	Advanced Physics – II	6	6
	MPP173	**Optional** (In-depth study paper): (a) Principles and Methods of Crystal Growth	6	6
	MPP174	(b) Research Trends in Nanoscience and Technology		
	MPP175	(c) Electronic Structure Calculations For Solids		
II	MPP17D	Project	20	12
		TOTAL		**30**

Note:

1. During I semester, 12 hours / week are utilized for Reference work in the library / Participating in seminars & workshops / Self study etc.
2. During II semester, 10 hours / week are utilized for reference work / Data collection / Presentation of project work done (monthly review) / Participating in seminars & workshops and presentation of research findings / Report writing etc.

SemesterI

C1: Professional Skills for Teaching –
LearningSubCode:MPP191

No.ofhours perweek			Credit	Totalno. ofhours	Marks
T	**P**	**Library**	3 +1	75	100
3	2	2			

Objectives

1. Toempower scholarswith softskills.
2. To introducethe teachingand dynamics of teaching – learning
3. Tofacilitatee-learning/ e-teachingwiththe ICTtools
4. Toacquirepracticalskills(insubject)aimingatgainingconfidencetohandlepracticalclasses
5. Todevelopteachingskillsand gainconfidenceinteaching.

UnitI:Soft Skills

IntroductiontoSoftSkills,SoftSkillsVsHardSkills,typesofSoftSkills.

CommunicationSkills:Basicsincommunication,structureofwrittenandoralsentences,Verbal, non-

verbal, body language, Intrapersonal and Interpersonal Communications, ActivitiesinEffectiveCommunication.
BehavioralSkills:Leadershipskills,TimeManagement,Creativityand Lateralthinking.
InterviewSkills:ResumeWriting,Differenttypesofinterviews,Etiquettesininterviews,Mockinterviews.
TeamBuildingandGroupDiscussion:ProgressivestagesofTeamBuilding,ParametersofGD(special referencetoattending, listening, respondingskills).
Languageskills(LSRW):StrategiestoacquireLSRWskills.
UnitII:Techniquesand Dynamicsof Teaching-Learning
EmergingtrendsinEducationalPsychology:Meaning,ScopeandMethods
Learning:DifferentTheoriesoflearning,Approachestolearning(ClassicalConditioning-IvanPavlov;Operantconditioning-B.F.Skinner);kindsof learning,factorsaffectinglearning.
Motivation: Intrinsicandextrinsicmotivation,Development ofmemoryandintelligence.
UnitIII:Incorporating TeachingandLearningviaModern Gadgets:
AnOverviewofMicrosoftOffice-2007:MSWORDS-2007-MSExcel-2007-MSPowerpoint-2007.Concepts in e-Resources :Makinguseof Web Resources .
ICTforResearch:On-linejournals,e-books,Courseware,Tutorials,Technicalreports,ThesesandDissertations.
UnitIV:InstructionalTechnology:
Definition,ObjectivesandTypes–DifferencebetweenTeachingandInstruction–Lecture Technique: Steps, Planning of a Lecture, Delivery of a Lecture – Narration in tune withthe nature of different disciplines – Lecture with power point presentation –LCD Projector- AVaids – Smart class room. Teaching – learning Techniques: Team Teaching, Group discussion,Seminar, Workshop, Symposium and Panel Discussion– Modes of teaching: CAI, CMI andWBI
UnitV:Learning,TeachingandEvaluationPractice
Teacher assisted class room teaching- assignment – (5 classes) and Teacher evaluationand suggestions.-Teacher assisted laboratory practice –assignment – (5 lab sessions) and teacherevaluationsand suggestions

ReferenceBooks

Don Skinner (2005), Teaching Training,Edinburgh University Press Ltd, EdinburghSharma,R.A.(2006)FundamentalsofEducationalTechnology, SuryaPublications,Meerut
Vanaja, M. and Rajasekar, S (2006), Computer Education, Neelkamal Publications, HyderabadBelaRaniSharma(2007),CurriculumReformsandTeachingMethods,Sarupandsons,New Delhi

SemesterI
C2:ResearchMethodology
Sub.Code:MPP182

No.ofhours perweek		Credit	Totalno. ofhours	Marks
Contact	Library	4	75	100
5	3			

Objective

1. Tounderstandtheessentialknowledgeandskillsneededfor Physicsresearch.
2. Toapplytheir skills todevelop newmaterials and devices.

UnitI:Research Methodology

Researchanditsimportance–Researchmethodsandresearchmethodology–Typesofresearch–Identificationofaresearchproblem–Literaturesurvey–Reference collection.

Mode of approach : research design – Possible approaches – Actual investigation – Results andconclusions – Presenting a scientific seminar – oral report – The art of writing a research

paperand thesis – Outline of a report – Layout of a report – Writing a research paper for publication inajournal.

UnitII:MathematicalPhysics

Specialfunctions–LaguerreDifferentialequationandLaguerrePolynomials-Generating function, Rodrigue's formula - Recurrence relations. Green's function – Green'sfunction for Poisson's equation - Quantum mechanical scattering problem – Numerical Analysis:Finitedifferences–Interpolationandextrapolation –Numericaldifferentiation–Integration

UnitIII:Photonics

Postulates of ray optics and wave optics - Holography- Principles of electro optics– Photonic Crystals Basics concepts - Features of photonic crystals - Methods of fabrication - Nonlinearphotoniccrystals-Photoniccrystalfibers-Photoniccrystalsandopticalcommunications-Photoniccrystal sensors.

UnitIV:Astrophysics

Spectral classification of stars - Boltzmann's formula– Saha 's equation of thermalionization– Harvard system of spectral classification – Theory of sunspots – Solar flares –Stellartemperatures-Classificationofvariablestars–eruptingandexplodingstars–Distribution of novae in our galaxy – Cosmology – red shift and the expansion of universe – Bigbang – Dark matter and dark energy – Elementary particles and their interactions – Van AllenBelt–Evolution of stars.

UnitV:RecentTrendsin ThinFilmTechnology

Thin Film optics – theory – optical constants of thin films – filters – Anti reflectioncoatings.Thinfilmsolarcells:Roleandprogressandproductionofthinfilmsolarcells-photovoltaic parameters. Thin film silicon (Polycrystalline) solar cells. Current status of bulksilicon solar cells – fabrication technology photovoltaic performance – Emerging solar cells:GaAsand CuInSe.

ReferenceBooks

i. Rajasekar,S.&Philominathan.P.ChinnathambiV.(2003).*ResearchMethodology*.
ii. **(**1st ed.)New Delhi:Prentice-HallofIndiaprivateLtd.
iii. SatyaPrakash.(2005).*MathematicalPhysics*.(4th ed).NewDelhi:S.Chand&Company Pvt.Ltd.
iv. Sastry,S.S.(2009).*IntroductoryMethodsofNumericalAnalysis*.(3rd ed).India:Prentice HallPvt.Ltd.
v. Bahaa,E.A&Saleh.(2003).*Fundamentalsofphotonics*.(2nd ed).Germany:JohnWiley &Sonspublications.
vi. SalehB.E.A&Teich,M.C.(1991).*FundamentalsofPhotonics*.(1st ed).Germany:John Wiley&Sons publications.
vii. Prasad,P.N. (2003). *Nanophotonics*.(1 st ed). Germany: Wiley&Sons publications.
viii. BaidyanathBasu.(1997).*AnIntroductiontoAstrophysics.*(5th ed).NewDelhi:Prentice HallofIndia.
ix. ArtherBeiser&ShobhitMahajan.,RaiChoudhury.S.(2012).*ConceptsofMordernPhysics.*(6th ed.)New Delhi: TataMcGraw Hill PvtLtd.
x. MiltonOhring.(1992).*TheMaterialsScienceofThinFilms.*(2nd ed).NewDelhi:Academic Press.
xi. Chopra.K.L.(1979).*ThinFilmPhenomena* .(2nd ed).NewDelhi:TataMcGrawHillPvtLtd.ChopraK. L.&Das. S.R. (1983).*ThinFilmSolar Cells.* (1st ed).London:Plenum press

Semester I
C3:AdvancedPhysics
Sub.Code:MPP183

No.of hours perweek		Credit	Totalno. ofhours	Marks
Contact	Library	5	75	100
5	3			

Objectives

1. Tohighlightavarietyoftopicssuchassolidstatetheory,hightemperaturesuperconductivity,crystalgrowth studies.
2. Toanalyzethematerialpropertiesandvarioussensingmechanisms.

UnitI:SolidStateTheory

Fermi surfaces – Construction of Fermi surfaces – Electrons in an uniform magneticfield - Anomalous skin effect- Cyclotron resonance – Closed orbits and open orbits – De HAAS-van ALPHEN effect - Nearly Free electron approximation - The density of states in the Bandmodel– band structureof metals – band structureofsemiconductors andinsulators.

UnitII:HighTemperatureSuperconductivity

High temperature superconductors: Cuprates – charge carriers – Structure and doping of$La_{2-x}Ba_xCuO_4$–PreparationandstructureofY$Ba_2Cu_3O_{7-x}$–Morelayer-likecupratesuperconductors($Bi_2CaSr_2Cu_2O_8$)–Applicationsofhightemperaturesuperconductorsinmicrowavetechnology–superconductingaerials.

UnitIII:ModernCrystalgrowthTechniques

Vapourgrowth(physicalandchemical)–Crystalgrowthbyhydrothermalmethod–Introduction – Growth apparatus – Determination of growth parameter – Growth techniques.Electrocrystallization:Introduction–Electrochemicalpotential–Diffusion–Crystallizationmechanism–Doublelayer–FaradaicandNon-Faradaicsystem–Equilibriumexchangecurrentdensityi_0–Non–equilibriumcurrentdensity–Overpotential–Multinuclearmultilayerdeposition-Gel growth– Technologyof Epitaxy.

UnitIV:Sensor MaterialsandApplications

Sensor,signalsandsystems–Sensorsclassification–Radarsensors–ultrasonicsensors –Halleffectsensors –Thinfilmsensors–liquidlevelsensors–Conceptsofpressure–Optoelectric sensors – Basic flow dynamics – Microflow sensors – Fibre optic – Micro phone –Concept of Humidity – Optical hygrometer – semiconductor pn junction sensor – Acoustictemperature sensors – Chemical sensors characteristics – Specific Difficulties – Classification ofChemical sensing mechanism – EnchancedCatalystic gas sensor – Smart chemical sensors.Materials-Surfaceprocessing.

UnitV:CharacterizationofMaterials

X-ray diffraction - Scanning electron microscopy - Transmission electron microscopy – Scanning probe microscopy- Thermo gravimetric Analysis – Differential Thermal Analysis - Differential Scanning Calorimetry – Microthermal Analysis - Spectroscopy of semiconductors;excitons-Infrared surfacespectroscopy-Raman spectroscopy-Electron spectroscopy.

ReferenceBooks

1. Otfriedmadelung.(1996). Introduction to Solid State theory.(3rd Ed.) Springer services printing.Ford,P.J., Saunders,G.A. (2005). TheRise ofthe Superconductors. CRCPress, USA.
2. Kakani,S.L.,ShubhraKakani.(2007).Superconductivity.New AgeInternational(P) Ltd.,NewDelhi.
3. KeshraSangwal. (1994). Elementary Crystal Growth. Saan

PublishersSanthanaragavan,P.,Ramasamy,P.(2000).Crystalgrowth processandMethods.Brice,J.C. (1986).Crystalgrowthprocess. Newyork: JohnWileyand sons.
4. Jacob Fraden. (2003).Handbook of Modern Sensors Springer. (3rd Ed.)ParagDiwan,AshishBharadwaj.(2006).NanoMedicines. PentagonPress.
5. Guozhong Cao. (2004).Nanostructures and Nanomaterials - Synthesis Properties & applications.ImperialCollegePress.
6. Skoog,Holler,Crouch.(2007).InstrumentalAnalysis.
7. Fensler,J.H.F.(1998). Nanoparticles andnano structuredfilmsPreparationcharacterizationandapplications. John Wiley&Sons.
8. CharlesP.Poole,Jr.,FrankJ.Owens.(2008). IntroductiontoNanotechnology.WileyandSons.

SemesterI

C4: Principles and Methods of Crystal Growth (In-depth paper)Sub.Code:MPP184

No.ofhours perweek		Credit	Totalno. ofhours	Marks
Contact	**Library**	5	45	100
3	4			

Objectives

1. Tounderstandthebasicconceptsandtheoriesofcrystalgrowth.

2. Todeveloptheabilityto preparingcrystalswithpreferred orientation.

UnitI:Fundamentalsof CrystalGrowth

Importance of crystal growth – Classification of crystal growth methods – Basic steps:Generation, transport and adsorption of growth reactants – Nucleation: Kinds of nucleation –Classical theory of nucleation: Gibbs Thomson equations for vapour and solution – Kinetictheory of nucleation – Becker and Doring concept on nucleation rate – Energy of formation of aspherical nucleus – Statistical theory on nucleation: Equilibrium concentration of critical nuclei,Freeenergyof formation.

UnitII:Theories of CrystalGrowth

An introductory note to Surface energy theory, Diffusion theory and Adsorption layertheory –Concepts of Volmer theory, Bravais theory, Kossel theory and Stranski's treatment –Two-dimensional nucleation theory:Free energy of formation, Possible shapesand Rate ofnucleation – Mononuclear, Polynuclear and Birth and Spread models – Modified Birth andSpread model – Crystal growth by mass transfer processes: Burton, Cabrera and Frank (BCF)bulkdiffusion model, Surfacediffusiongrowth theory.

UnitIII:ExperimentalCrystalGrowth-Part-I: MeltGrowthTechniques

Basicsofmeltgrowth–Heatandmasstransfer–Conservativegrowthprocesses:Bridgman-Stockbargermethod–Czochralskipullingmethod–Kyropolousmethod–Non-conservative processes:Zone-refining – Vertical and horizontal float zone methods– Skullmeltingmethod – Vernueil flamefusion method.

UnitIV:SolutionGrowthTechniques

Growth from low temperature solutions: Selection of solvents and solubility – Meir'ssolubility diagram–Saturationandsupersaturation–Metastablezonewidth– Growthbyrestricted evaporation of solvent, slow cooling of solution and temperature gradient

methods–Crystal growth in Gel media: Chemical reaction and solubility reduction methods – Growth fromhigh temperature solutions: Flux growth Principles of flux method – Choice of flux – Growth byslowevaporation and slow coolingmethods– Hydrothermalgrowthmethod.

UnitV:VapourGrowthTechniques

Basic principles – Physical VapourDoposition (PVD): Vapour phase crystallization in aclosed system – Gas flow crystallization – Chemical Vapour Deposition (CVD): Advantageousanddisadvantageous–Growthby chemicalvapourtransportreaction:Transportingagents,Sealedcapsulemethod,Openflowsystems– Temperaturevariationmethod:Stationarytemperatureprofile,Linearlytimevaryingtemperatureprofileandoscillatorytemperatureprofile.

ReferenceBooks

Brice, J.C. (1986). Crystal Growth Processes,New York : John Wiley and Sons.2Mullin,J.W.(2004).Crystallization. London:ElsevierButterworth-Heinemann.

Vere, A.W.(1987).CrystalGrowth:PrinciplesandProgressNew York:PlenumPress.

IchiroSunagawa.(2005).Crystals:Growth,MorphologyandPerfection.Cambridge:CambridgeUniversityPress.

Pamplin,B.R.(1975).CrystalGrowth.Oxford:PergamonPress.

SemesterI
C4: Research Trends in Nanoscience and Technology (In-depth paper)Sub.Code:MPP185

No.ofhours perweek		Credit	Totalno. ofhours	Marks
Contact	Library	5	45	100
3	4			

Objectives

1. Tounderstandthebasic properties, structureandbehaviorofnanoparticles.
2. To studythe variousnanostructures andtheir properties.

UnitI:BasicPropertiesandMeasuringMethodsofNanoparticles

Size effect and properties of Nanoparticles- Particle size - Particle shape - Particledensity - Melting point, surface tension, wettability - Specific surface area and pore - Compositestructure -Crystalstructure-Surfacecharacteristics-Mechanicalproperty- Electricalproperties -Magneticproperties -Optical propertyof nanoparticle

UnitII:StructuralControlof Nanoparticles

Structure construction and function adaptation of Nanoparticles - Particle size - Particleshape-Compositestructure -Porestructure-Nanoparticledesign forDDS-Nanotubes (CNT).

UnitIII:Characteristicsand BehaviorofNanoparticlesanditsDispersion Systems

Introduction of nanoparticle dispersion and aggregation behavior - Single nanoparticlemotion in fluid – Brownian diffusion - Adsorption properties and wettability of nanoparticlesurface-Interactionsbetweenparticles-Aggregationanddispersion,characterizationandcontrol -Rheologyofslurry-Simulation of colloidal dispersion system.

UnitIV:ControlofNanostructureof Materials

Assembly of nanoparticles and functionalization - Nanoparticles arranged structures - Nanopore structure - Nanocomposite structure - Structure control of nanoparticle collectives bysinteringand bonding-Self-assembly.

UnitV:Evaluation MethodsforPropertiesof Nanostructured Materials

Functionalityofnanostructuresandtheircharacteristicevaluation-Mechanicalproperties-Thermophysicalproperties-Electricproperties-Electrochemicalproperties-Magnetic properties - Optical properties - Catalytic property - Properties of gas permeation andseparationmembranes

Reprints

TextBook

MasuoHosokawa.,KiyoshiNogi.,MakioNaito.,ToyokazuYokoyama.(2007).NanoparticleTechnologyHandbook.Elsevier Publishers.

ReferencesBooks

William, A.,GoddardIll.,Donald, W., Brenner, Sergey, E.,Lyshevski,Gerald, J., Iafrate.(2007) .HandbookofNanoscience.EngineeringandTechnology.CRCPress.

Robert,W.,Kelsall,IanW.Hamley,MarkGeoghegan.(2005).NanoscaleScienceandTechnology.John Wiley&SonsLtd.

SemesterI

C4: Electronic Structure Calculations for Solids (In-depth paper)Sub.Code:MPP186

No.ofhours perweek		Credit	Totalno. ofhours	Marks
Contact	Library	5	45	100
3	4			

Objective

1. To emphasize the use of first principles in the theoretical calculations of electronic structure inthe understanding of structural, cohesive, optical and vibrational properties of solids underhighpressure.
2. To improve the computational skill and the theoretical calculations for providing scientificadvances and discoveries which play a key role in the future employability and worldwideprogressof students.

UnitI:BasicTheoriesof ElectronicStructure

Zeroth Born-Oppenheimer approximation – Density functional theory – Self interactioncorrectionandoptimizedeffectivepotentials–Gradientcorrections–Localdensity approximation-Atomicsphereapproximation-Hartreeapproximation-Hartree-Fockapproximation.

UnitII:TheFP-LMTO Method

The energy band problem - Partial waves for a single muffin-tin- The muffin-tin orbitals - Energy independent muffin-tin orbitals- One center expansion and structure constants- Korringa-Kohn-Rostoker(KKR)condition-Totalenergyandenthalpydetermination-McMillan'sformula-Superconductingtransition temperature calculation.

UnitIII:Reprints

Fiverecent reprintsof electronicstructurecalculations

UnitIV:PressureInducedStructuralChanges

Murnaghan's equation of state (EOS) – NaCl structure to CsCl structure pressure inducedtransitions – ZnS to NaClandNaCl to CsCl transitions – BCC to FCC transitions – HCP to BCCtransitions – Transitions in and from Wurtzite structures – Force theorem and elastic constants ofsolids.

UnitV:MetallizationandFermiSurface

Metallization in alkali halides – silver halides –Group III-V compounds – Group II-VIcompounds –Measurement of Fermi surface –Bohr-Somerfield quantization rule – Oscillationof the Density of statesat the Fermi energy –Determination of Fermi surface – electronic andopticalproperties of Alkali metals and noble metals.

TextBooks

O.K.Andersen,O.JebsenandM.Sob,Electronicbandstructureanditsapplications,Editors.M.Yussouff ,SpringerVerlagLectureNotes (1987).
H.L.Skriver,'TheFP-LMTOmethod',Springer,Heidelberg(1984).

ReferenceBooks

Andersen, O.K. ,Jebsen,O.,Glotzel, D. (1985).Highlights of condensed matter theory. North-Holland:
Christensen, N. E., Novikov, D. L. , Alonso, R. E., Rodriguez, C. O. (1999).Solids under Pressure-AbInitio Theory.HeidelbergSpringer.

Professional Ethics

Indian Knowledge System

Environment and Sustainability