Holy Cross College (Autonomous),

Nagercoil Nationally Re-Accredited with A+ by NAAC

(CGPA 3.35)Nagercoil, Kanyakumari District, Tamil Nadu, India.

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

Department of Physics

UG Syllabus

Semesters I, II, III, IV, V &VI

(With effect from the academic year 2020 onwards)

DEPARTMENT OF PHYSICS

Vision

Imbibing the spirit of the Holy Cross, the institution envisions a harmonious society by empowering women for global competency and ecological sustainability through holistic approach with innovative skills.

Mission

- To provide quality education and to promote scholarly activities catering to global competencies
- To nurture participatory leadership to enhance social consciousness and social responsibility
- To uphold ethical values of honesty, personal accountability and transparency through professional commitment
- To create global professionals and entrepreneurs with innovative spirit and zeal
- To create empowered women of competence, commitment and compassion.
- To instill in students the awareness of interconnectedness between man and nature

Programme Educational Objectivities (PEOs)

PEO - 1	The graduates will apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.
PEO - 2	The graduates pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.
PEO - 3	The graduates will be equipped with technical and analytical skills in the field of physics developing innovative solutions to real life necessities and pursue diverse career path using novel technology.

Programme Outcomes (POs)

POs	Upon completion of B.Sc. Degree Programme, the graduates will be able to:
PO - 1	apply the acquired scientific knowledge to face day to day needs.
PO - 2	create innovative ideas through laboratory experiments.
PO - 3	carry out field works and projects in collaboration with other institution.
PO - 4	reflect upon green initiatives and take responsible steps to build a sustainable environment.
PO - 5	face challenging competitive examinations that offer rewarding careers in science and education.
PO - 6	impart communicative skills and ethical values.
PO - 7	equip students with hands on training through various courses to enhance entrepreneurship skills.

Programme Specific Outcomes (PSOs)

PSOs	Upon completion of B.Sc. Degree Programme, the graduates of Physics will be able to:
PSO - 1	understand the core theories and principles of physics which include mechanics, thermodynamics, electronics, material science etc.
PSO - 2	develop extensive comprehension of fundamental and diverse applications of Physics.
PSO - 3	apply knowledge of principles, concepts in Physics and analyze their local, national and global impact.
PSO - 4	apply the critical reasoning and computing skills to analyze and solve problems in physics.
PSO - 5	analyze the observed experimental data and relate the results with theoretical expectations.
PSO - 6	communicate appropriately and effectively, in a scientific context using present technology.
PSO - 7	develop entrepreneurial skills, empowered according to the professional requirement and become self-dependent.
PSO - 8	understand the professional, ethical, legal, security, social issues and responsibilities.

1. Eligibility: 10 + 2 pattern

(i) For Admission: A pass in the Higher Secondary Examination (10+2) (Academic / Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereto by the syndicate of Manonmaniam Sundaranar University, Tirunelveli, is eligible for admission.

SCIENCE

Sl. No.	Name of the Programme	Eligibility	Medium of Instruction
1.	B. Sc. Mathematics (Aided & Self-Financed)	A pass in 10 + 2 with Mathematics as one of the core subjects	English
2.	B. Sc. Physics	A pass in 10 + 2 with Physics and Mathematics as Core Subjects	English
3.	B. Sc. Chemistry	A pass in 10 + 2 with Chemistry as one of the core subjects	English
4.	B. Sc. Botany	A pass in 10 + 2 with Botany or Biology as one of the core subjects	English
5.	B. Sc. Zoology	A pass in 10 + 2 with Zoology or Biology as one of the core subjects	English
6.	B. Sc. Computer Science (Self-Financed)	A pass in 10 + 2 with Computer Science or Mathematics as one of the core subjects	English

(ii) Degree:

The candidates shall have subsequently undergone the prescribed course of study in Holy Cross College affiliated to the Manonmaniam Sundaranar University for a period of not less than three academic years (six semesters), passed the prescribed examinations and fulfilled such conditions as have been prescribed thereof.

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2. Duration

The Programme is for a period of three years. Each academic year shall comprise of two Semesters viz. Odd and Even semesters. Odd Semester shall be from June to October November and Even Semester shall be from November / December to April. There shall be not less than 90 working days which shall comprise 450 teaching clock hours for each Semester (excluding the days for the conduct of end-semester examinations).

3. CBCS System

The main feature of the CBCS is to make undergraduate education student-centric allowing students to choose inter- disciplinary, intra-disciplinary and skill-oriented courses (even from other disciplines according to their learning needs, interests and attitude) with optimal flexibility for students on par with global standards.

Components of the B.Sc. Physics Programme

Part III (Major and Allied)

Major	Core-Theory papers	10x100	1000
	Practical (Core Applied)	5 x 100	500
	Elective-Theory Papers/ Project	4x 100	400
	Total Marks		**1900**
Allied (I &II)	Theory	4x 100	400
	Practical	1x 100	100
	Total Marks		**500**
	Total Marks		**2400**

- **Major and Allied Practical carry 100 marks each.**
- **Practical examination will be conducted at the end of even semester for Major and Allied**

Course Structure

Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI	Total	
							Hours	Credits
Part I - Language	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
Part II-English	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
Part-III								
Major Core	6(4)	6(4)	6(4)	6(4)	6 (5) + 6 (5) + 6 (5) + 6 (5)	6 (6) + 6 (6) + 6 (5) + 6 (5)	72	58
Major Elective	-	-	4(3)	4(3)	-	4 (4)	12	10
Major Project	-	-	-	-	4 (4)	-	4	4
Allied	6 (4)	6(4)	6(4)	6(4)	-	-	24	16
Part IV								
Add-on Course (Professional English)	2 (2)	2 (2)	2 (2)	2 (2)	-	-	8	8
NME (Non-Major Elective)	2 (2)	2 (2)	-	-	-	-	4	4
SEC (Skill Enhancement Course)	2 (2)	2 (2)	-	-	-	2 (2)	6	6
AEC (Ability Enhancement Course)	-	-	-	-	2 (2)	-	2	2
Total	**30 (22)**	**30 (22)**	**30 (21)**	**30 (21)**	**30 (26)**	**30 (28)**	**180**	**140**
Non-Academic Course								
Part V								
FC – I (Values for Life)	-	(1)	-	-	-	-	-	1
FC – II (Personality Development)	-	-	-	(1)	-	-	-	1
FC–III (Human Rights Education)	-	-	-	-	(1)	-	-	1
FC –IV (Gender Equity	-	-	-	-	-	(1)	-	1

Studies)								
SLP-Community Engagement Course	-	(1)	(1)	-	-	-	-	2
SLP-Extension activity (RUN)	-	-	(1)	(1)	-	-	-	2
STP - Clubs & Committees / NSS	-	(1)	-	(1)	-	-	-	2

Courses Offered

Semester	Course	Subject code	Paper	Hours /week	Credit
I	**Part I**	TL2011/ FL2011	Language: Tamil/French	6	4
	Part II	GE2011	General English	6	4
	Part III	PC2011	Major Core I - Mechanics	4	4
		PC20P1	Major Practical I - Physics Lab I	2	-
		AP2011	Allied I- Allied Physics I for Mathematics	4	3
		AP20P1	Allied Practical – General Physics Lab	2	-
	Part IV	APS201	Add on Course - Professional English for Physical Sciences-I	2	2
		PNM201	Non Major Elective (NME) – Physics in Everyday Life I	2	2
		SEC201/ SEC202	SEC (Skill Enhancement Course) – Meditation and Exercise / Computer Literacy	2	2
	Part V	FCV201	Foundation Course I – Values for Life	-	-
		STP201	Student Training Programme (STP) – Clubs and Committees/NSS	-	-
II	**Part I**	TL2021/ FL2021	Language: Tamil/French	6	4
	Part II	GE2021	General English	6	4
	Part III	PC2021	Major Core II –Properties of matter and Sound	4	4
		PC20P1	Major Practical I - Physics Lab I	2	2
		AP2021	Allied II – Allied Physics II for Mathematics	4	3
		AP20P1	Allied Practical – General Physics Lab	2	2
	Part IV	APS202	Addon Course- Professional English for Physical Sciences-II	2	2
		PNM202	Non Major Elective (NME)– Physics in Every Day Life II	2	2
		SEC201/ SEC202	SEC (Skill Enhancement Course) – Meditation and Exercise / Computer Literacy	2	2
		FCV201	Foundation Course I – Values for Life	-	1

	Part V	SLP201	SLP(Service Learning Programme) - Community Engagement Course	-	-
		STP201	STP (Student Training Programme) – Clubs and Committees/NSS	-	-
III	**Part I**	TL2031/ FL2031	Language: Tamil/French	6	4
	Part II	GE2031	General English	6	4
	Part III	PC2031	Major Core III – Heat and Thermodynamics	4	4
		PC2032 PC2033	Major – Elective - I (a) Non Conventional Energy Sources (b) Fundamentals of Physics - I	4	4
		PC2034	(c) Microprocessor Fundamentals		
		PC20P2	Major Practical II - Physics Lab II	2	-
		AP2031	Allied I – Allied Physics I for Chemistry	4	3
		AP20P1	Allied Practical – General Physics Lab	2	-
	Part IV	APS203	Addon Course- Professional English forPhysical Sciences-III	2	2
	Part V	FCV202	Foundation Course II – PersonalityDevelopment	-	-
		SLP201	SLP(Service Learning Programme) -Community Engagement Course	-	2
		SLP202	SLP Extension Activity (RUN)	-	-
		STP201	STP (Student Training Programme) – Clubsand Committees / NSS	-	-
IV	**Part I**	TL2041/ FL2041	Language: Tamil/French	6	4
	Part II	GE2041	General English	6	4
	Part III	PC2041	Major Core IV – Optics and Spectroscopy	4	4
		PC2042 PC2043 PC2044	Major – Elective - II (a) Computer Programming in C++ (b) Medical Physics (c) Optoelectronics	4	4
		PC20P2	Major Practical II - Physics Lab II	2	2
		AP2041	Allied II – Allied Physics II for Chemistry	4	3
		AP20P1	Allied Practical – General Physics Lab	2	2
	Part IV	APS204	Addon Course- Professional English for Physical Sciences-IV	2	2
	Part V	FCV202	Foundation Course II – PersonalityDevelopment	-	1
		SLP202	SLP Extension Activity (RUN)	-	2
		STP201	STP (Student Training Programme) - Clubs and Committees/NSS	-	2
V		PC2051	Major Core V – Classical and Statistical Mechanics	6	5

	Part III	PC2052	Major Core VI - Analog Electronics	6	5
		PC2053	Major Core VII - Solid State Physics	5	5
		PC20PR	Project	5	4
		PC20P3	Major Practical III - Physics Lab III	2	-
		PC20P4	Major Practical IV - Physics Lab IV	2	-
		PC20P5	Major Practical V - Physics Lab V	2	-
	Part IV	AEC201	AEC(Ability Enhancement Compulsorycourse): Environmental Studies	2	2
	Part V	FCV203	Foundation Course III - Human Rights Education (HRE)	-	1
	Part	PC2061	Major Core VIII – Relativity and Quantum	6	5
VI	**III**		Mechanics		
		PC2062	Major Core IX – Digital and CommunicationElectronics	6	5
		PC2063	Major Core X - Nuclear Physics	5	5
		PC 2064 PC 2065 PC 2066	Major – Elective – III (a) Mathematical Physics (b) Nanophysics (c) Astrophysics	5	4
		PC20P3	Major Practical III - Physics Lab III	2	2
		PC20P4	Major Practical IV - Physics Lab IV	2	2
		PC20P5	Major Practical V - Physics Lab V	2	2
	Part IV	SEP203	Skill Enhancement Course (*SEC) – BasicElectrical Circuits and Instruments	2	2
		FCV204	Foundation Course IV – Gender Equity studies	-	1
			TOTAL	**180**	**150**

In Part III, the number of courses vary between 16 to 24 for each Department.

Total number of Hours = 180

Total number of Compulsory Credits = 140 +10

Non-academic Courses are mandatory and conducted outside the regular working hours.

Skill Development Programme (Mandatory Certificate Course - 30 hours) is offered to all the I year students.

Courses offered

Self-Learning Courses- Extra Credit Courses

Semester	Course Code	Title of the Course	Credits
III /V	PC20S1	Physics for Competitive Examination – I	2
IV/VI	PC20S2	Physics for Competitive Examination – II	2

Value Added Courses

Semester	Course Code	Title of the Course	Total Hours
III /V	VAP201	Multimedia Training	30
IV/VI	VAP202	Domestic Appliance Service	30

Instruction for Course Transaction Distribution

Theory (Major Course) Paper Hours

Components	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI
Lecture Hours	45	45	45	45	60/75	60/75
Continuous Internal Assessment (2)	5	5	5	5	5	5
Quiz (2)	1	1	1	1	1	1
Class Test (3)	3	3	3	3	3	3
Problem Solving/ Class Assignment / Open Book Test	6	6	6	6	6	6
Total Hours	60	60	60	60	75/90	75/90

Distribution of total hours for Theory (Elective / Allied)

Components	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI
Lecture Hours	45	45	45	45	60/75	60/75
Continuous InternalAssessment (2)	5	5	5	5	5	5
Quiz (2)	1	1	1	1	1	1
Class Test (3)	3	3	3	3	3	3
Problem Solving /Class Assignment/ Open Book Test	6	6	6	6	6	6
Total Hours /Semester	60	60	60	60	75/90	75/90

Distribution of total hours for Practical

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

Examination Pattern

Each paper carries an internal component.

There is a passing minimum for external component.

A minimum of 40% in the external examination and an aggregate of 40% is required.

i) a. Part I - Tamil

Ratio of Internal and External= 30:70

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Components	**Marks**
Internal test (2)	15
Quiz (2)	4
Class Test (2)	6
Class assignment/ Home assignment/ Field assignment/ Article review/ Group discussion/ Problem solving	5
Total	**30**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 4 x 1	4	Part A 10 x 1 (No choice)	10
Part B 3 x 4	12	Part B 5 x 4 (Internal choice)	20
Part C 3 x 8	24	Part C 5 x 8 (Internal choice)	40
Total	**40**	**Total**	**70**

b. Part I -French

Ratio of Internal and External= 30:70

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Components	Marks
Internal test (2)	15
Quiz (2)	4
Class Test (2)	6
Class assignment/ Home assignment/ Field assignment/ Article review/ Group discussion/ Problem solving	5
Total	**30**

Question Pattern for I & II Semesters

Internal Test	Marks	External Exam	Marks
Part A (Translation)	5	Part A (Translation) 4x5	20
Part B (Grammar) 5x5	25	Part B (Grammar) 6x5 (Paragraph Writing) 15x1	30
Part C (Paragraph Writing)10x1	10	Part C (Translation, Comprehension) 2x5	10
		Part D 5x2	10
Total	**40**	**Total**	**70**

Question Pattern for III & IV Semesters

Internal Test	Marks	External Exam	Marks
Part A (Translation)	5	Part A (Translation)10x1	10
Part B (Grammar) 5x5	25	Part B (Comprehension) 10 x1 (Paragraph Writing) 15 x1	25
Part C (Paragraph Writing)10x1	10	Part C (Grammar) 7 x 5	35
Total	**40**	**Total**	**70**

ii. Part II - General English

Ratio of Internal and External= 30:70

Continuous Internal Assessment(CIA)

Internal Components and Distribution of Marks

Components	Marks
Internal test (2)	15
Quiz (2)	4
Class Test (3)	6
GD/Open Book Test/Role Play/Assignment/Article Review/Seminar	5
Total	**30**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A (ObjectiveType)	4 x 1 = 4	Part A (Objective Type	10 x 1= 10
Part B	3 x 4 =	Part B	5 x 4 =20
Part C	3 x 8 =24	Part C	5 x 8 =40

ii) Part III (Major/ Elective/ Allied)

Ratio of Internal and External= 30:70

Continuous Internal Assessment(CIA)

Internal Components and Distribution of Marks

Components	Marks
Internal test (2)	15
Quiz (2)	4
Class Test (3)	6
Class assignment/ Home assignment/ Field assignment/ Article review/ Group discussion/ Problem solving	5
Total	**30**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 4 x 1	4	Part A 10 x 1 (No choice)	10
Part B 3 x 4	12	Part B 5 x 4 (Internal choice)	20
Part C 3 x 8	24	Part C 5 x 8 (Internal choice)	40
Total	**40**	**Total**	**70**

Practicals : Major Core & Allied papers

Ratio of Internal and External= 40:60

Total: 100 marks

Internal Components and Distribution of Marks

Internal Components	Marks
Performance of the Experiments	10
Regularity in attending practical and submission of records	10
Record	5
Model exam	15
Total	**40**

Question pattern

External Exam	Marks
Major Practical	60
Minor Practical / Spotters /Record	
Total	**60**

ii) Part IV

Ratio of Internal and External = **50: 50**

a) Add-on Course: Professional English for Physical Sciences

Internal Components and Distribution of Marks

Internal Components	Marks
Listening and speaking	25
Reading and Writing	25
Total	**50**

Question pattern

External Exam	Marks
Written Test : Open choice – 5 out of 7 questions (5 x 10)	50
Total	**50**

b) Non – Major Elective (NME)

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Internal Components	Marks
Internal test (2)	20
Quiz (2)	15
Class assignment/ Home assignment/ Project report	15
Total	**50**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 4 x 1 (No Choice)	4	Part A 5 x 1 (No Choice)	5
Part B 3 x 4 (Internal Choice)	12	Part B 5 x 3 (Internal Choice)	15
Part C 3 x 8 (Internal Choice)	24	Part C 5 x 6 (Internal Choice)	30
Total	**40**	**Total**	**50**

c) Skill Enhancement Course (SEC) - Computer Literacy

Internal Components

Component	Marks
Objective type questions (30x1)	30
Exercise (Book) compulsory (2x10)	20
Total	**50**

External Components

Component	Marks
Exercise 1	20
Exercise 2	10
Procedures for both Exercises	20
Total	**50**

d) Skill Enhancement Course (SEC) - Meditation and Exercise

Internal Components

Component	Marks
Objective type questions (20x1)	20
Exercise (2x10)	20
Assignment	10
Total	**50**

External Components

Component	Marks
Quiz	20
Written test :Open choice – 10 out of15 questions (10x3)	30
Total	**50**

e) Ability Enhancement Course (AEC) - Environmental Studies

Internal Component

Component	Marks
Project Report	30
Viva voce	20
Total	**50**

External Component

Component	Marks
Quiz	20
Written Test :Open choice – 10 out of15 questions (10x3)	30
Total	**50**

iii. Part V

i) Foundation course (Values for life, Personality development, Human rights education and Gender equity studies)

Ratio of Internal and External = 50: 50

a) Foundation Course I: Values for Life

Internal Components

Component	Marks
Song, Mime, Skit	20
Book Activities	20
A Kind Action	10
Total	**50**

External Components

Component	Marks
Quiz	20
Written Test : Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

b) Foundation Course II: Personality Development

Internal Components

Component	Marks
Exercise from book	20
Skit	10
Group Album	20
Total	**50**

External Components

Component	Marks
Quiz	20
Written Test : Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

c) Foundation Course III: Human Rights Education

Internal Components

Component	Marks
Album on current issues	20
Group Song/ Mime/ Skit	10
Open book test (Objective type questions)	20
Total	**50**

External Components

Component	Marks
Quiz	20
Written Test : Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

d) Foundation Course IV: Gender Equity Studies

Internal Components

Component	Marks
Album on current issues	20
Group Song/ Mime/ Skit	10
Open book test (Objective type questions)	20
Total	**50**

External Components

Component	Marks
Quiz	20
Written Test : Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

e) SLP -Community Engagement Course (CEC)

(Field Work – 15 hrs; Class Hours – 15 hrs)

Internal Components

Component	Marks
Assignment	10
Group Discussion	10
Attendance (Field work)	30
Total	**50**

External Components

Component	Marks
Project Report / Case Study(10-15 pages in print) Group project	50
Total	**50**

f) SLP –Service Learning Programme: Reaching the Unreached Neighbourhood (RUN)

- 60 Hours mandatory programme included in the curriculum (2 credits).

g) STP – Student Training Programme

- Compulsory for all I &II year students (2 credits).
- Clubs and Committees – Eco Club, YRC, Rotaract Club, NSS/ RRC, AICUF, Consumer Club, Sports, Legal Literacy and Women's Cell.
- Each student can opt for one club/ committee.

10. Evaluation

i. The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points.

ii. Evaluation of each course shall be done by Continuous Internal Assessment (CIA) by the course teacher as well as by an end semester examination and will be consolidated at the end of the semester.

iii. There shall be examinations at the end of each semester, for odd semesters in October/November; for even semesters in April/ May.

iv. A candidate who does not pass the examination in any course(s) shall be permitted to reappear in such failed course(s) in the subsequent examinations to be held in October/ November or April/May. However, candidates who have arrears in practical examination shall be permitted to reappear for their areas only along with regular practical examinations in the respective semester.

v. Viva-voce: Each project group shall be required to appear for Viva -voce examination in defence of the project.

vi. The results of all the examinations will be published in the college website.

11. Conferment of Bachelor's Degree

A candidate shall be eligible for the conferment of the Degree of Bachelor of Arts / Science / Commerce only if the minimum required credits for the programme thereof (150 credits) is earned.

12. Grading System

For the Semester Examination:

Calculation of Grade Point Average for End Semester Examination:

$$GPA = \frac{\text{Sum of the multiplication of grade points by the credits of the course}}{\text{Sum of the credits of the courses (passed) in a semester}}$$

For the entire programme:

Cumulative Grade Point Average (CGPA) $\Sigma_n\Sigma_i C_{ni}G_{ni} / \Sigma_{ni}\Sigma_i C_{ni}$

$$CGPA = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

Where

C_i - Credits earned for course i in any semester

G_i - Grade point obtained for course i in any semester

n - semester in which such courses were credited

13. Final Result

Conversion of Marks to Grade Points and Letter Grade

Range of Marks	Grade Points	Letter Grade	Description
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
40-49	4.0-4.9	C	Satisfactory

00-39	0.0	U	Re-appear
ABSENT	0.0	AA	ABSENT

Overall Performance

CGPA	Grade	Classification of Final Result
9.5-10.0	O+	First Class – Exemplary*
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
4.0 and above but below 5.0	C	Third Class
0.0 and above but below 4.0	U	Re-appear

*The candidates who have passed in the first appearance and within the prescribed semester are eligible for the same.

Semester I

Mechanics

Course Code: PC2011

No. of hours per week	Credit	Total no. of hours	Marks
4	4	60	100

Learning Objective

To give the students fundamental ideas on conservation laws, rotational and vibrational motion of rigid bodies, Gravitational fields and some idea about fluid mechanics

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO- 1	Understand and define the laws involved in mechanics	PSO-1	U
CO- 2	Apply conservation laws in collision experiments	PSO-3	Ap
CO- 3	Interpret the principles of gravitation and moment of inertia through theory and experiments	PSO-2	Ap
CO- 4	analyze the fundamentals of center of mass and rocket motion	PSO-4	An
CO-5	apply pressure-velocity relation in fluid flow in the field of fluid dynamics	PSO-2	Ap

Unit I: Laws of Motion **9 hours**

Laws of conservation of energy, linear momentum and angular momentum – work energy theorem – work done by gravitational force – work done by spring force – potential energy – conservative and non-conservative forces – potential energy curve.

Collision – Elastic and inelastic collision(Fundamental laws of impact) – Newton's law of impact – coefficient of restitution – Impact of a smooth sphere on a fixed plane – Direct impact between two smooth spheres – Oblique impact between two smooth spheres – Calculation of final velocities of the spheres – Loss of K.E due to impact.

Unit II: Dynamics of Rigid body 9 hours

Moment of inertia – Theorems of perpendicular and parallel axes – M.I of a circular ring, disc, solid sphere, hollow sphere and cylinder about all axes – Compound pendulum – theory – equivalent simple pendulum – reversibility of centers of oscillation and suspension – determination of g and k.

Unit III: Gravitation 9 hours

Newton's law of gravitation – Kepler's laws of gravitation – G by Boy's method – Mass and density of earth – Acceleration due to gravity – Variation of g with altitude, depth and rotation of earth – Value of g at poles and equator.

Gravitational field – Gravitational potential – Gravitational potential due to spherical shell – Gravitational potential due to a solid sphere (inside and outside).

Unit IV: **Central Force Motion 9 hours**

Angular velocity, angular momentum and K.E of rotation – Torque and angular acceleration – Relation between them – Expression for acceleration of a body rolling down an inclined plane without slipping.

Center of mass – Velocity and acceleration of centre of mass – Determination of motion of individual particle – System of variable mass. Rocket motion – Satellite.

Unit V: **Statics and Hydrodynamics 9 hours**

Friction-laws of friction – Angle of friction – Cone of friction – Centre of gravity – Solid and hollow tetrahedron – solid and hollow hemisphere – Centre of pressure – vertical rectangular lamina – vertical triangular lamina.

Hydrodynamics – Equation of continuity– Pitot's tube and Venturi meter – Euler's equation of unidirectional flow – Torricelli's theorem – Bernoulli's theorem and its applications.

Skill Development

1. Construct a scientific model/demo on conservation of Energy
2. Prepare a chart for streamline and turbulent flow of a liquid
3. Determine the viscosity and surface tension of different liquids through virtual lab

Books for Study

1. Daniel Kleppner and Robert Kolenkow, Cambridge University Press., Second Edition (2014)
2. Mechanics by D. S. Mathur, S. Chand & Co., Revised Edition (2012).
3. Mechanics by P. Duraipandian, Laxmi Duraipandian, Muthamizh Jayapragasam, S. Chand & Co., New Delhi (1995).
4. Properties of Matter by R. Murugeshan, S. Chand & Co., New Delhi., Revised Edition (2005).
5. Mechanics – Part I and II by Narayanamoorthy, National Publishing Company., 6th Edition (2001)

Book for Reference

1. Fundamentals of Physics by D. Halliday, R. Rensick and J. Walker, 6^{th} edition, Wiley, NY (2001).

Semester I

Allied Physics I for Mathematics

Course Code: AP2011

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

Learning Objectives

To understand the concept of strength of materials, viscous properties of liquids, heat transformation from one place to another, converting heat to do mechanical work and basic properties of light such as interference and diffraction.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO Addressed	CL
CO 1	Acquire knowledge on elementary ideas of electricity and magnetism, electronics, optics and nuclear physics.	PSO-1	U
CO 2	Analyze the concepts and study their applications in the field of electricity and magnetism, electronics, optics and nuclear physics.	PSO-2	An
CO 3	Apply their depth knowledge of Physics in day today life.	PSO-3	Ap
CO 4	Develop their knowledge and carry out the practical by applying these concepts	PSO-5	Ap

Unit I: Properties of Matter **9 hours**

Young's modulus – Rigidity modulus – Bulk modulus – Poisson's ratio (definition alone) – Bending of beams – Expression for bending moment – Determination of Young's modulus – uniform and non-uniform bending.

Expression for Couple per unit twist – Work done in twisting a wire – Torsional oscillations of a body– Rigidity modulus of a wire and M.I. of a disc by torsion pendulum.

Unit II: Viscosity 9 hours

Viscosity – Viscous force – Co-efficient of viscosity – Units and dimensions – Poiseuille's formula for co-efficient of viscosity of a liquid – Determination of co- efficient of viscosity using burette and comparison of Viscosities – Bernoulli's theorem – Statement and proof – Venturi meter – Pitot tube.

Unit III: Conduction, Convection and Radiation 9 hours

Specific heat capacity of solids and liquids – Dulong and Petit's law – Newton's law of cooling – Specific heat capacity of a liquid by cooling – Thermal conduction –Coefficient of thermal conductivity by Lee's disc method.

Convention process – Lapse rate – Greenhouse effect – Black body radiation – Planck's radiation law – Rayleigh Jean's law, Wien's displacement law – Stefan's law of radiation. (No derivations).

Unit IV: Thermodynamics 9 hours

Zeroth and First Law of thermodynamics – Second law of thermodynamics – Carnot's engine and Carnot's cycle – Efficiency of a Carnot's engine – Entropy – Change in entropy in reversible and irreversible process – Change in entropy of a perfect gas – Change in entropy when ice is converted into steam.

Unit V: Optics 9 hours

Interference – Conditions for interference maxima and minima – Air wedge – Thickness of a thinwire – Newton's rings – Determination of wavelength using Newton's rings.

Diffraction – Difference between diffraction and interference – Theory of transmission grating – Normal incidence – Optical activity – Biot's laws – Specific rotatory power – Determinationof specific rotatory power using Laurent's half shade polarimeter.

Books for Study

1. Heat and Thermodynamics – Brijlal & Subramanyam, S. Chand & Co, 16th Edition 2005.
2. Heat and Thermodynamics – D. S. Mathur, Sultan Chand & Sons, 5th Edition 2014.
3. Optics and Spectroscopy – R.Murugeshan, S.Chand and co., New Delhi, 6th Edition 2008.
4. A text book of Optics – Subramanyam and Brijlal, S. Chand and co. New Delhi, 22nd Edition 2004.
5. Properties of Matter by R. Murugeshan, S. Chand & Co., New Delhi., Revised Edition (2005).
6. Mechanics by D. S. Mathur, S. Chand & Co., Revised Edition (2012).

Books for Reference

1. Ubald Raj and G. Jose Robin, Mechanics, Waves and Oscillations –1st Edn., Indira Publications, (2006).
2. R. Murugeshan, Allied Physics - Revised Edn., S. Chand & company private limited (2016)

Semester I

Part IV

Add on Course- Professional English for Physical Sciences-I

Course Code: APS201

Hours /week	Credits	Total Hours	Marks
2	2	30	100

Learning Objectives

1. To develop the language skills of students by offering adequate practice in professional contexts
2. To develop strategic competence that will help in efficient communication

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	**PSO - 1**	U
CO - 2	use language for speaking with confidence in an intelligible and acceptable manner	**PSO - 6**	E
CO - 3	understand the importance of reading for life	**PSO - 1**	U
CO - 4	Understand the importance of writing in academic life	**PSO - 1**	U
CO - 5	Write simple sentences without committing error of spelling or grammar	**PSO - 7**	An

Unit I

Communication:

1. Listening to Audio Text & answering Questions
2. Pair Walk
3. Comprehension passage
4. Developing a story with pictures
5. Vocabulary

Unit II :Description:

1. Listening to Process Description – Online shopping
2. Speaking – Role play – sample 1
3. Reading Passages on Products
4. Process Description – Compare & Contrast
5. Vocabulary

Unit III

Negotiation Strategies:

1. Listening to interviews of specialists
2. Brain Storming (Mind mapping)
3. Economic System (Longer Reading Text)
4. Why learn the skill of writing an essay
5. Vocabulary

Unit IV

Presentation Skill:

1. Listening to Lecture – I
2. Short Talks – I
3. Reading comprehension – passage I
4. Writing Recommendations
5. Vocabulary

Unit V

Critical Thinking Skills:

1. Listening Comprehension
2. Speaking – Making Presentation – Task 1 & 2
3. Reading – Comprehension Passages, Note making
4. Writing - Problem & Solution Essays, Creative writing
5. Vocabulary

Reference Book

1. TANSCHE (2020). Professional English for Physical Sciences, *First* edition

Semester I

Non Major Elective Course - I Physics in Everyday Life - I Course Code: PNM201

Hours /week	Credits	Total Hours	Marks
2	2	30	100

Learning Objectives

1. To introduce the basic concepts in physics and their applications in everyday life.
2. To understand the physics concept applied in day to day life situations.

Course Outcome

COs	Upon completion of this course, students will be able to	PSO addressed	CL
CO – 1	Understand their knowledge of basic scientific principles and fundamental concepts in physics.	**PSO - 1**	**U**
CO – 2	Recall the various phenomena of sound waves applied in day today life	**PSO - 3**	**R**
CO – 3	Understand the basic laws of physics and different forces involved in nature.	**PSO - 1**	**Ap**
CO – 4	Explain the physics concepts behind the sports	**PSO - 3**	**E**
CO – 5	Categorize different characteristic nature of light and its properties like refraction, reflection and diffraction.	**PSO - 1**	**C**

Unit I **4 hrs**

Properties of Matter, Heat and Thermodynamics: Introduction - Elasticity - Elastic behaviour of materials - Elastic energy - Elastic and Plastic Deformation - Polymers and elastomers - Application of Elastic behaviour of materials - Surface Tension - Concept behindSurface Tension - Examples of surface Tension, Capillary action - Experiment - Examples of capillary action - Viscosity - definition - Applications of Viscosity.

Unit II **4 hrs**

Sound: Introduction - frequency spectrum of Sound waves - The Human voice - How does the ear hears? - Amazing Abilities of Sound - Basic characteristics of sound - Reflection of Sound - echo- Interference -Application of reflection of sound wave - Ultra sound: Properties and applications of ultrasound - Applications of sound in human life.

Unit III **4 hrs**

Mechanics: Introduction - terms used in mechanics - Centripetal and centrifugal forces - Contact and non-contact forces - Friction and its types - Newton's laws of motion – gravity - mass and weight - mechanics in everyday life

Unit IV **4 hrs**

Biomechanics in Sports: Introduction – Forces and torques in Bio Mechanics – Centre of gravity - Biomechanics of gait - Physics of walking – Physics of cycling – Physics of long jump, swimming, volleyball, and basketball

Unit V **4 hrs**

Renewable energy: Introduction - solar power – Applications - Wind power and applications - hydroelectric power and uses - Biogas plant and its advantages - Advantages and disadvantages of renewable energy sources.

Text Book

1. Gerardin Jayam. (2019). Physics in Everyday Life.Published by the Department of Physics, Holy Cross College (Autonomous), Nagercoil.

Semester II

Properties of matter and Sound

Course Code: PC2021

No. of hours per week	Credit	Total no. of hours	Marks
4	4	60	100

Learning Objectives

To expose students to the fundamentals of properties of matter and sound.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO- 1	identify the materials suitable for construction of buildings, based on the moduli of elasticity.	PSO-4	Ap
CO- 2	paraphrase the properties of liquids and its determination.	PSO-1	U
CO- 3	analyze the physics of sound and its applications	PSO-2	An
CO- 4	integrate the concepts of acoustic comfort and better understanding of the theories used in building acoustics	PSO-3	Ap

Unit I: 9 hours

Elasticity : Elasticity –- Hooke's law – Elastic moduli – Poisson's ratio – Beams – Bending of beams – Expression for bending moment – Cantilever- Theory of uniform and non – Uniform bending - Determination of Young's modulus - Koenig's method – Torsion of a body – Expression for couple per unit twist – Work done in twisting a wire – Torsional oscillations of a body - Rigidity modulus by dynamic torsion method (Torsional pendulum) and static torsion method.

Unit II 9 hours

Surface Tension : Surface tension – definition – Molecular forces – Explanation of surface tension on kinetic theory – Surface energy – Work done in increasing the area of a surface – Excess pressure inside a curved liquid surface – Excess pressure inside a spherical and cylindrical drops and bubbles - Drop weight method - Angle of contact - Quincke's method- variation of surface tension with temperature - Experimental determination - Jaegar's method.

Unit III: **9 hours**

Viscosity : Viscosity – Co efficient of viscosity – Streamlined and turbulent motion – Critical velocity – Rate of flow of liquid in a capillary tube – Poiseuille's formula – Viscosity of highly viscous liquid-terminal velocity - Stoke's method - Ostwald Viscometer - Viscosity of gas - Mayer's formula - Rankine 's method

Unit IV: **9 hours**

Sound : 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, damped and forced vibration – Frequency of vibrating string- Melde's experiment and verification of the laws of transverse vibration of a string- Sonometer – Loudness level- Sound Intensity measurement.

Unit V: **9 hours**

Ultrasonics and Acoustics : Ultrasonics – Production – Piezoelectric crystal method – Magnetostriction method – Properties and Applications.

Acoustics of building – Reverberation - Sabine's Reverberation formula (No derivation) - Factors affecting acoustics of building - Sound distribution in an auditorium - Requisites for good acoustics.

Skill development

1. Experimentally determine the elasticity of different materials (fibre, wood, glass).
2. Display a model / demo for proving surface tension of liquids.
3. Exhibit science models for simple harmonic motion.
4. Make a chart showing the factors affecting architectural acoustics.

Books for Study

1. Elements of properties of matter – D. S. Mathur – S. Chand & Co., 2004.
2. Ghosh, M., Bhattacharya, D. A text book of Oscillations, Waves and Acoustics. (3rd Ed.) New Delhi: S.Chand &Company Ltd. 2006.
3. Palanisamy, P.K. Engineering Physics. India: Schitech Publications Pvt. Ltd. 2012.

Books for reference

1. Properties of matter – R. Murugesan – S. Chand & Co., 2004.
2. Properties of matter – Brijlal and Subramanian S. Chand & Co., 2006.
3. Fundamental of Physics, D. Hallidary , Resnick and J Walker, 6th Edition, Wiley, New York 2001.

Semester I

Major Practical I – Physics Lab – I

Course Code: PC20P1

No. of hours per week	Credit	Total no. of hours	Marks
2	2	30	50

Learning Objectives

- To understand the concepts in Mechanics and Properties of matter through simple experiments.

Any twelve 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. Determination of 'g' – Compound Pendulum
6. Verification of perpendicular axes theorem – Bifilar Pendulum
7. Viscosity – Variable pressure head
8. Viscosity – Stoke's method
9. A.C. frequency – Sonometer
10. Melde's string – Determination of frequency of the vibrator
11. Thermal conductivity of bad conductor Lee's Disc method
12. Specific heat capacity of liquid
13. q, n, σ Searle's Method
14. Latent heat of ice
15. Newton's Law of Cooling – verification
16. Surface tension and interfacial surface tension

Books for Reference

Lab Manual – Edited by Dr.M.Mary Freeda, Dr.M.Priya Dhrashini & Ms.P.Aji Udhaya, Department of Physics, Holy Cross College (Autonomous), Nagercoil.

Semester II

Allied Physics II for Mathematics

Course Code: AP2021

Hours /Week	Credit	Total no. of hours	Marks
4	3	60	100

Learning Objectives

To understand the concepts of resistance of materials, capacity of conductors, effect of magnetic field due to passage of current, idea about the atom models and energy released in breaking of atom, basic semi-conductor diodes, transistor and basic logic gates.

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO 1	Acquire knowledge on elementary ideas of electricity and magnetism, electronics, optics and nuclear physics.	PSO-1	U
CO 2	Analyze the concepts and study their applications in the field of electricity and magnetism, electronics, optics and nuclear physics.	PSO-2	An
CO 3	Apply their depth knowledge of Physics in day today life.	PSO-3	Ap
CO 4	Develop their knowledge and carry out the practical by applying these concepts	PSO-5	Ap

Unit I: Current Electricity **9 hours**

Ohm's law – Law of resistance in series and parallel – Specific resistance – Capacitors – capacitors in serial and parallel – Kirchoff's laws – Wheatstone's network – Condition for balance

Carey - Foster's bridge – Measurement of resistance – Measurement of specific resistance – determination of temperature coefficient of resistance – Potentiometer – Calibration of Voltmeter.

Unit II: Electromagnetism **9 hours**

Electromagnetic Induction – Faraday's laws – Lenz law – Self Inductance – Mutual Inductance – Coefficient of Coupling

A.C. Circuits – Mean value – RMS value – Peak value – LCR in series circuit – impedance – resonant frequency – sharpness of resonance.

Unit III: Atomic and Nuclear Physics **9 hours**

Bohr's atom model – radius energy – Atomic excitation – Ionization potential – Frank and Hertz Method – Nucleus – Nuclear properties – Mass defect – Binding energy.

Radio isotopes – Uses of radio isotopes – Nuclear fusion and nuclear fission – X-rays – Production – properties –Derivation of Bragg's law – uses in industrial and medical fields.

Unit IV: Analog Electronics **9 hours**

Semiconductor – PN junction diode – Bridge rectifier – Zener diode – Regulated power supply. Transistor – Working of a transistor – CE Configuration – current gain relationship between transistor α and β – Transistor Characteristics (CE Configuration only) – CE amplifier – feedback – Hartley oscillator – Colpitt's oscillator.

Unit V: Digital Electronics **9 hours**

Number system – Decimal – Binary – Octal and Hexadecimal system – Double Dabble method – Binary addition, subtraction and multiplication – conversion of one number system to another number system.

Logic gates – OR, AND, NOT, XOR, NAND and NOR gates – truth tables – Half adder and Full adder – Laws and theorems of Boolean's algebra – De Morgan's theorems.

Books for Study

1. Electricity and Magnetism – R. Murugesan, S. Chand & Co,2017.
2. Modern Physics – R. Murugesan & Kiruthiga Sivaprasath, S. Chand & Co,2016.
3. Basic Electronics – B. L. Theraja, S. Chand & Co,2003.

Books for Reference

1. A. Ubald Raj and G. Jose Robin, Mechanics, Waves and Oscillations –1st Edn., Indira Publications, (2006).
2. R. Murugeshan, Allied Physics - Revised Edn., S. Chand & company private limited (2016).

Allied Practical – General Physics Lab

Course Code: AP20P1

No. of hours per week	Credit	Total no. of hours	Marks
2	2	60	100

Learning Objectives

To elucidate theory through simple experiments in physics.

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
9. Surface tension and Interfacial surface tension –Drop weight method
10. Newton's Rings – R and n
11. Air wedge – thickness of a wire
12. Carey Foster Bridge – Specific resistance
13. Calibration of voltmeter – Potentiometer
14. LCR Series Resonance Circuit
15. Logic gates – AND, OR and NOT

Books for Reference

Lab Manual – Edited by M.Abila Jeba Queen, Ms. P.Aji Udhaya, & R. Krishna Priya, Department of Physics, Holy Cross College (Autonomous), Nagercoil.

Semester II

Part IV

Add on Course- Professional English for Physical Sciences-II

Course Code: APS202

Hours /Week	Credits	Total Hours	Marks
2	2	30	100

Learning Objectives

1. To develop the language skills of students by offering adequate practice in professional contexts
2. To develop strategic competence that will help in efficient communication

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	**PSO - 1**	U
CO - 2	use language for speaking with confidence in an intelligible and acceptable manner	**PSO - 6**	Ap
CO - 3	understand the importance of reading for life	**PSO - 1**	U
CO - 4	Understand the importance of writing in academic life	**PSO - 1**	U
CO - 5	Write simple sentences without committing error of spelling or grammar	**PSO - 7**	An

Unit I

Communication:

1. Listening to instruction
2. Small Group Work
3. Comprehension- Difference between facts & opinions
4. Developing a short poem with pictures
5. Vocabulary

Unit II

Description:

1. Listening to Process Description - Cartographic Process
2. Speaking – Role play – sample 2
3. Reading Passages on Equipments & gadgets
4. Paragraph: Sentence Definition & Extended Definition, Free writing
5. Vocabulary

Unit III

Negotiation Strategies:

1. Listening to interviews of inventors in fields
2. Small Group Discussion – Specific
3. Longer reading text –The Art of Loving
4. Essay Writing – Solidarity
5. Vocabulary

Unit IV Presentation

Skill:

1. Listening to Lecture – 2
2. Short Talks – Poverty and the need to alleviate it
3. Reading comprehension – passage 2
4. Interpreting Visual Inputs
5. Vocabulary

Unit V

Critical Thinking Skills:

1. Listening for Information
2. Making Presentation task 3& 4
3. Motivational Articles on Professional Competence, Professional Ethics & Life Skill
4. Problem & Solution Essays, Summary Writing
5. Vocabulary

Reference Book

1. TANSCHE (2020).Professional English for Physical Sciences, *First* edition

Semester II

Non Major Elective Course - II Physics in Everyday life – II Course Code: PNM202

Hours /week	Credits	Total Hours	Marks
2	2	30	100

Learning Objectives

1. To provide basic knowledge on the concepts of light, Electromagnetism and Electronics along with some applications.
2. To explain the wonders in universe using the principles of physics.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	understand the principle and working of simple devices used in day to day life.	**PSO - 1**	**U**
CO – 2	identify the symbols used for various electronic components and infer the electronic tools.	**PSO - 3**	**R**
CO – 3	distinguish different heavenly bodies (star, planet, comets, galaxies)	**PSO - 3**	**R**
CO - 4	recall various applications of physics concepts in everyday life	**PSO - 3**	**K**

Unit I **4 hrs**

Light: Introduction - Nature and properties of light - Reflection - Colours of light - Colours of objects- Reflection in everyday life - Refraction - Dispersion - Rainbow formation - Refraction in everyday life - Laser: principle and applications - Fiber optics and its applications - Applications of light in day to day life.

Unit II **4 hrs**

Electromagnetic Radiation: Introduction- Properties of Electromagnetic waves - EM Spectrum- Radio sub spectrum - Cell phones, Microwaves - Microwave oven and sensor, Terahertz radiation and its applications - Infra red rays in everyday life - InfraRed and microwaves - comparison - visible light waves - UV rays and its applications

Unit III **4 hrs**

Electromagnetism: Introduction - Magnetic materials - Magnetic Field in and around a bar Magnet, Magnetic Fields in and around Horseshoe magnet, Magnetic lines of force - Electric charge - Ohm's Law - Practical Applications of Ohm's Law in Daily Life - Electromagnetism - Applications of electricity and magnetism: Credit card machine, Use of electromagnetism in daily life.

Unit IV **4 hrs**

Basic Electronics: Introduction - Electronic components - Electronic tools - Semiconductors and integrated circuits - Application of electronic devices - Smart phones - Digital - Glucose meter - Sphygmomanometer.

Unit V **4 hrs**

Space Physics: Introduction - The big bang theory - Stars-Star system, multiple stars, supernova, black hole - solar system - Terrestrial and Jovian planets - Asteroids- Meteoroids - Meteors - Comets: parts of a comet, Galaxy - Eclipse: solar and lunar - seasons

Text Book

1. GerardinJayam.(2019). *Physics in Everyday Life.*Published by the Department of Physics, Holy Cross College (Autonomous), Nagercoil.

Semester III

Major Core III - Heat and Thermodynamics

Course Code: PC2031

Hours /Week	Credits	Total Hours	Marks
4	**4**	**60**	**100**

Learning Objectives

1. To understand the phenomena connected with various units of measurement of temperature, knowing the concept of specific heat capacities of matter and transmission of heat.
2. To introduce the concept of lowering the temperature, liquefying gases and process of making heat to do mechanical work.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO-1	understand experimental methods to determine the transmission of heat.	**PSO - 4**	**U**
CO-2	analyze the work and heat interactions associated with a prescribed process path and to perform a analysis of a flow system	**PSO - 1**	**An**
CO-3	understand the basic concepts of thermodynamics like system, properties, equilibrium, pressure, specific volume, temperature and the laws of thermodynamics	**PSO - 4**	**U**
CO-4	evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.	**PSO - 3**	**An**
CO-5	analyze Maxwell's thermo dynamical relations and their applications	**PSO - 5**	**E**

Unit I **9 hrs**

Thermometry and Calorimetry: Platinum resistance thermometer - Calendar and Griffith's bridge - Thermoelectric effect – Seebeck effect - Thermoelectric thermometers- International temperature scale – Thermistor- Specific heat capacity of solids – Regnault's method of mixtures(solid) – specific heat capacity of liquids – Callendar and Barnes method – Specific heat capacity of gases – Cp and Cv – Meyer's relation – Cv by Joly's differential steam calorimeter method – Cp by Regnault's method.

Unit II **9 hrs**

Low Temperature Physics: Joule - Kelvin effect - Liquefaction of Air-Linde's Process – liquefaction of hydrogen - liquefaction of helium-Kammerling - Onne's method - Helium I and II - Lambda point - production of low temperatures - adiabatic demagnetization - practical applications of low temperature - refrigerators and air-conditioning machines - super fluidity - application of super fluidity.

Unit III **9 hrs**

Transmission of Heat: Conduction – coefficient of thermal conductivity – Rectilinear flow of heat along a bar – convection – lapse rate – Stability of the atmosphere – Newton's law of cooling – determination of specific heat capacity of liquid - Radiation - black body – Kirchhoff's law – Stefan – Boltzmann law - energy distribution in black body spectrum - Wien's law – Rayleigh Jean's law– Planck's law - solar constant – water flow pyroheliometer.

Unit IV **9 hrs**

Kinetic Theory of Gases: Kinetic Theory of gases- assumptions - Molecular collisions – mean free path – expression for mean free path – Transport phenomenon – Brownian motion and its features - expression for viscosity, Diffusion and thermal conductivity of gas. Experimental verification -Vander walls equation of state - Determination of Vander walls constant - Relation between Vander Wall's constant and critical constants.

Unit V **9 hrs**

Thermodynamics : Zeroth and first law of thermodynamics – reversible and irreversible processes – isothermal process-adiabatic process-gas equation during adiabatic process - work done during adiabatic and isothermal process - second law of thermodynamics – Carnot'sengine – its efficiency. Entropy – change of entropy in reversible and irreversible processes – temperature – entropy diagrams – physical significance of entropy - change of entropy when ice converted into steam - third law of thermodynamics – Extensive and Intensive thermodynamic variables – distinction between them – Maxwell thermodynamical relations – derivation and application - Clausius - Clapeyron equation and specific heat relation

Text Books

1. Brijlal, Subrahmanyam, Hemne, P.S. (2014). *Heat, Thermodynamics and Statistical Physics.* New Delhi: S. Chand & Company Ltd.

2. Mathur D.S. (2014). *Heat and Thermodynamics*. 5th Edition. New Delhi: Sultan Chand & Sons.

3. Gupta, A.B. (2014). *Thermal Physics*. H.P. Roy Books and Allied (P) Ltd.

4. Murughesan. R and Kiruthiga Sivaprasath. (2008). *Thermal Physics.* II Edition. New Delhi: S.Chand& Co.

Reference Books

1. Rajan.J.B. (1985). *Heat & Thermodynamics*. New Delhi: SC Publisher.

2. Varma.H.C. (2015). *Concepts of Physics* Volume I and II. New Delhi: Bharati Bhawan Publishers.

3. Narayanamoorthy.M and Nagarathinam.N. (1987).*Heat.* Eight edition. Chennai: National publishing Co.

Semester IV

Non-Conventional Energy Sources - Elective I (a)

Course Code: PC2032

Hours /Week	Credits	Total Hours	Marks
4	**4**	**60**	**100**

Learning Objectives

1. To provide an understanding of the present energy crisis and various available energy sources.
2. To make the students to understand the present-day crisis of need for conserving energy and theiralternatives.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO- 1	Apply the solar energy in various sectors. (Industry, agriculture and domestic purposes)	**PSO-3**	**Ap**
CO- 2	Explain the basic principles of wind energy conversion, various Biomass conversion Processes and its classification.	**PSO- 1**	**U**
CO- 3	Discuss the geothermal energy resources and chemical energy resources. (fuel cells)	**PSO-2**	**An**
CO- 4	Solve the present and future energy crisis.	**PSO- 8**	**C**

Unit I **9 hrs**

Introduction to Energy Sources: World's reserve of Commercial energy sources and their availability-India's production and reserves-Conventional and non-conventional sources of energy, comparison – Coal- Oil and natural gas –applications - merits and demerits.

Unit II **9 hrs**

Solar Thermal Energy : Solar constant -Solar Spectrum-Solar radiations outside earth's atmosphere –at the earth surface- on tilted surfaces -Solar Radiation Geometry-Basic Principles of Liquid flat plate collector –Materials for flat plate collector -Construction and working-Solar distillation- Solar Drying-Solar cooker (box type)-Solar water heating systems – Swimming pool heating.

Unit III **9 hrs**

Photovoltaic Systems: Introduction-Photovoltaic Principle-Basic Silicon Solar cell- Power output and conversion efficiency-Limitation to photovoltaic efficiency-Basic photovoltaic system for power generation-Advantages and disadvantages-Types of solar cells- Application of solar photovoltaic systems - PV Powered fan – PV powered area - lighting system – A Hybrid System.

Unit IV **9 hrs**

Biomass Energy: Introduction-Biomass classification- Photosynthesis - Biomass conversiontechnologies-Bio-gas generation-Factors affecting bio-digestion -Working of biogas plant-source floating and fixed dome type plant -advantages and disadvantage-Bio-gas from plant wastes-Methods for obtaining energy from biomass. Advantage & disadvantages of biomass as energy

Unit V **9 hrs**

Wind Energy and Other Energy Sources : Wind Energy Conversion-Classification anddescription of wind machines, wind energy collectors-Energy storage-- Energy from Oceans energy storage- Hydrogen as alternative fuel for motor vehicles. and Chemical energy resources-Ocean thermal energy conversion-tidal power, advantages and limitations of tidal power generation-Energy and power from waves- wave energy conversion devices- Fuel cells- and application of fuel cells- batteries- advantages of battery for bulk

Text Books

1. .D.P. Kothari, K.C. Singal& Rakesh Ranjan, (2008). *Renewable energy sources andemerging Technologies*, New Delhi :Prentice Hall of India Pvt. Ltd.
2. Rai G. D, (2010). *Non-conventional Energy sources*, 4th Edition, Khanna Publishers.
3. Suhas P Sukhatme,(2012). *Solar energy -- Principles of thermal collection and storage*, Second edition, New Delhi: Tata McGraw-Hill Publishing company.
4. Reference Books
5. Chetan Singh Solanki, (2011). *Solar Photovoltaics Fundamentals, Technologies and Applications*, 2nd Edition, New Delhi:PHI Learning Private Limited.
6. Jeffrey M. Gordon,(2013). *Solar Energy*: The State of the Art, Earthscan.
7. Kalogirou S.A, (2013). *Solar Energy Engineering: Processes and Systems*, 2nd Edition,Academic Press.

8.ZobaaA.F.and Ramesh Bansal, (2011). *Handbook of Renewable Energy Technology, WorldScientific.* S.A. Abbasiand Nasema Abbasi, (2008).*Renewable Energy sources and their environmentalimpact*, New Delhi:PHI Learning Pvt. Ltd.

Semester III

Fundamental of Physics- I -Elective I (b)

Course Code: PC2033

Hours /Week	Credits	Total Hours	Marks
4	**4**	**60**	**100**

Learning Objective

- To introduce the basic concepts of Physics like measurement of physical quantities, states of matter, kinds of energies and energy sources to students studying other than Physics.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO-1	Understand the fundamentals of dynamics.	**PSO – 1**	**U**
CO-2	Determine the behavior of a ray at any optical surface (lenses, Prisms).	**PSO – 6**	**E**
CO-3	Outline the extraction of useful energy from Earth, Ocean, Wind and Sun.	**PSO- 3**	**Ap**
CO-4	Determine the significance of steady current and alternating current.	**PSO-2**	**E**
CO-5	Apply Kirchoff's laws to simple electrical circuits.	**PSO - 5**	**A**

Unit I **9 hrs**

S.I. Units: Measurements of length, mass, time and other physical quantities – Dimensional formula for area, volume, density and force – Uses of dimension. Matter – Solid, Liquid, Gas and Plasma – Application of Plasma – change of state – specific heat capacity – specific latent heat of ice and steam.

Unit II **9 hrs**

Kinds of energy: Mechanical energy, Thermal energy, Optical energy, Sound energy, Electrical energy, atomic and nuclear energy, (Examples) – Conservation of energy. Renewable and non – renewable energy – Fossil fuel – coal Oil – Solar – Wind – Biomass – OTEC.

Unit III **9 hrs**

Light: Mirror – Laws of reflection – Image formation (Concave and Convex mirror) Lens – Law's of refraction – Image formation (Concave and Convex lens) – Defects of eye and rectification. Prism -Determination of refractive index of the prism.

Unit IV **9 hrs**

Current: Electric current- voltage and resistance- Ohm's law- Kirchhoff's law- Resistances in series and in parallel. DC Source – Primary cells – Leclanche and Daniel cell – Secondary cells – Lead Acid Accumulator – DC generator. Alternating current generation by hydro, thermal and atomic power stations– RMS value – Peak value (Quantitative) – AC generator – no derivation.

Unit V **9 hrs**

Measurement: Measurement of Electric power by Wattmeter- simple calculations- Induction coil- Wattless current- Power factor. Simple electrical circuits – resistor, capacitor and inductor connected to AC source (independently) – Relationship between emf and current in each case- Diode – Bridge Rectifier.

Text Books

1.Narayan Rao,B,V. (1998) *Physics B. Sc 1* –New Age International (P) Lt,

Reference Books

1. Mathur, D, S.(2002). *Mechanics.* S.Chand& Co

2. Mathur, D, S. (2002). *Properties of matter.* S. Chand & Co

3. Brijlal Subramanian. (2006). *Properties of matter.* S. Chand & Co

4. Murugesan, R. (2004). *Electricity and Magnetism*. S. Chand & Co

Semester- III

Elective I: Microprocessor Fundamentals (c)

Subject code: PC2034

Hours /week	Credits	Total Hours	Marks
4	**4**	**60**	**100**

Learning Objectives

1. To provide an extensive knowledge about basic concepts of microprocessor, programming instructions and interfacing concepts.
2. To attain hands on experience to perform simple programs using microprocessor.

Course Outcome

COs	Upon completion of this course students will be able to:	PSO addressed	CL
CO-1	know the basic ideas on microprocessor, memory and I/O devices	**PSO-1**	**U**
CO-2	be familiar with the basic concepts of microprocessor architecture and interfacing	**PSO-1**	**U**
CO-3	acquire skills in the programming instruction sets of microprocessors	**PSO-2**	**A**
CO-4	apply the programming instructions to perform simple programs using microprocessor	**PSO-2**	**C**

Unit I **9 hrs**

Architecture: Architecture of 8085 – registers, flags, ALU, address and data bus, demultiplexing address/data bus – control and status signals – control bus, Programmer's model of 8085 –Pin out diagram – Functions of different pins.

Unit II **9 hrs**

Programming Techniques: Instruction set of 8085 – data transfer, arithmetic, logic, branching and machine control group of instructions – addressing modes – register indirect, direct, immediate and implied addressing modes. Assembly language & machine language – programming techniques: addition, subtraction, multiplication, division, ascending, descending order, largest and smallest(single byte)

UNIT III **9 hrs**

Interfacing memory to 8085: Memory interfacing – Interfacing 2kx8 ROM and RAM, Timing diagram of 8085 (MOVRd, Rs – MVI Rd,data(8)) .

Unit IV **9 hrs**

Interfacing I/O Ports to 8085: Interfacing input port and output port to 8085 – Programmable peripheral interface 8255– flashing LEDs.

Unit V **9 hrs**

Interrupts: Interrupts in 8085 - hardware and software interrupts – RIM, SIM instructions –priorities – simple polled and interrupt controlled data transfer.

Text Books

1. Gaonkar R.S. (1992)*Microprocessor Architecture programming and application with 8085 / 8080A*. Wiley Eastern Ltd.
2. Vijayendran,V. (2003).*Fundamental of microprocessor 8085*. Chennai: S. Viswanathan Publishers.
3. Ram,B. (2013).*Fundamentals of Microprocessors and microcomputers*. Dhanpat RAI publication.

Reference Books

1. Aditya Mathur.(1987).*Introduction to microprocessor*. Tata Mc.Graw Hill Publishing Company Ltd.
2. Dougles V. Hall.(1983).*Microprocessor and digital system- 2nd Edition*, McGraw Hill Company.

Semester: III

Allied Physics I for Chemistry

Course code: AP2031

Hours /Week	Credits	Total Hours	Marks
4	**3**	**60**	**100**

Learning Objectives

1. To understand the concept of strength of materials, viscous properties of Liquids, heat transformation from one place to another, converting heat to do mechanical work.
2. To understand basic properties of light such as interference and diffraction.

Course Outcome

COs	Upon completion of this course students will be able to:	PSO addressed	CL
CO- 1	Understand to know, various modulus involved in the materials, flow of liquids due to viscous forces, transmission of heat due to process of conduction, convection and radiation and various laws involved in heat transformation, various thermodynamic laws and.	**PSO-1**	**U**
CO -2	Analyze the concepts and study the concept of entropy, and the phenomenon like interference and diffraction, optical activity of liquids and its uses.	**PSO -3**	**An**
CO- 3	Apply their depth knowledge of Physics in day today life.	**PSO -2**	**Ap**
CO- 4	Develop their knowledge and carry out the practical by applying these concepts	**PSO -4**	**R**

Unit I **9 hrs**

Properties of Matter: Young's modulus – Rigidity modulus – Bulk modulus – Poisson's ratio (definition alone) – Bending of beams – Expression for bending moment – determination of young's modulus – uniform and non-uniform bending. Expression for Couple per unit twist – work done in twisting a wire – Torsional oscillations of a body– Rigidity modulus of a wire and M.I. of a disc by torsion pendulum.

Unit II **9 hrs**

Conduction in solids: Thermal conductivity – Lee's disc method – Relation between thermal and electrical conductivities - Widemann – 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 III **9 hrs**

Viscosity: Viscosity – Viscous force – Co-efficient of viscosity – units and dimensions – Poiseuille's formula for co-efficient of viscosity of a liquid – determination of coefficient of viscosity using burette and comparison of Viscosities - Bernoulli's theorem – Statement and proof – Venturimeter – Pitot tube.

Unit IV **9 hrs**

Thermodynamics: Zeroth and I Law of thermodynamics – II law of thermodynamics – Carnot's engine and Carnot's cycle – Efficiency of a Carnot's engine – Entropy – Change in entropy in reversible and irreversible process – change in entropy of a perfect gas – change in entropy when ice is converted into steam.

Unit V **9 hrs**

Optics: Interference – conditions for interference maxima and minima – Air wedge – thickness of a thin wire – Newton's rings – determination of wavelength using Newton's rings. Diffraction – Difference between diffraction and interference – Theory of transmission grating – normal incidence – optical activity – Biot's laws – Specific rotatory power – determination of specific rotatory power using Laurent's half shade polarimeter.

Text Books

1. Brijlal and Subramanyam. (1983).*Properties of matter*.III Edition.New Delhi: Eurasia Publishing co.

2. Mathur,D.S. (1976).*Element of properties of matter*.10th Edition.New Delhi:S.Chand& Company Ltd.

3. Brijlal& Subramanyam. (2005).*Heat and Thermodynamics*.16th Edition. New Delhi:S.Chand& Co.

4. Mathur,D.S. (2014).*Heat and Thermodynamics*.5th Edition. New Delhi:SultanChand& Sons.

5. Murugeshan,R. (2008).*Optics and Spectroscopy*.6th Edition. New Delhi:S.Chand and co.

6. Subramanyam and Brijlal. (2004).*A text book of Optics*.22nd Edition.New Delhi:S.Chand and co.

7. Sathyaprakash, Ratan PrakashanMandhir. (1990).*Optics*.VII Edition. New Delhi.

8. Ubald Raj,A. and Jose Robin,G. (2006).*Mechanics, Waves and Oscillations*. 1stEdn. Indira Publications.

Reference Books

1. AjoyGhatak. (2009).*Optics*. Fourth edition . New Delhi: TMH publishing co.

2. Halliday,D. Resnick,R. and Walker,J. (2001).*Fundamentals of Physics*, 6thEdition,New York: Wiley.

Semester III
Part IV
Add on Course- Professional English for Physical Sciences-III
Course Code: APS203

Hours /Week	Credits	Total Hours	Marks
2	2	30	100

Learning Objectives

1. To develop the language skills of students by offering adequate practice in professional contexts
2. To develop strategic competence that will help in efficient communication

Course Outcome

CO	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	**PSO - 1**	U
CO - 2	use language for speaking with confidence in an intelligible and acceptable manner	**PSO - 6**	Ap
CO - 3	understand the importance of reading for life	**PSO - 1**	U
CO - 4	Understand the importance of writing in academic life	**PSO - 1**	U
CO - 5	Write simple sentences without committing error of spelling or grammar	**PSO - 7**	An

Unit I

Listening – Answering comprehension exercises

Speaking – Reading passages – open ended questions

Reading – One subject based reading of text followed by comprehension activities / exercises

Writing – Summary writing based on the reading passages (semi-guided)

Unit II

Listening – Announcement

Speaking – Just a minute activities

Reading – Analyzing Ads

Writing –Dialogue writing

Unit III

Listening – Listening to interviews (subject based)

Speaking – Interview with subject teachers / professionals

(Using video conferencing skills)

Reading – Selected sample of web page

Writing – Creating web pages

Reading Comprehension – Essay on Digital competence for academic and professional life

Unit IV

Listening – General videos (lifestyle and values)

Speaking –Movie review, book review

Writing – Poster making – writing slogans / captions (subject based)

Reading –Essay on creativity and imagination

Unit V

Speaking – Presentation using Power Point

Reading / Writing – Circulars, minutes of meeting, paraphrasing

Reference Book

1. TANSCHE (2020). Professional English for Physical Sciences, *First* edition

Semester IV

Major Core IV: Optics and Spectroscopy

Course Code: PC2041

Hours /week	Credits	Total Hours	Marks
4	4	60	100

Learning Objectives

1. To provide knowledge on the concept of aberrations in lenses, prisms and Spectroscopy.
2. To understand the phenomenon like interference, diffraction, polarization through wave nature of light and its applications.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO – 1	The knowledge of geometric optics is helps in the practical design of many optical systems and instruments including aberrations in lens system.	**PSO - 2**	**U**
CO – 2	determine the behavior of a ray and wave at any optical surface.	**PSO - 1**	**R**
CO - 3	analyze the intensity variation of light due to polarization, interference and diffraction.	**PSO - 4**	**An**
CO - 4	The study of phenomena interference, diffraction, and polarization lays the foundation for an understanding of concepts such as holograms, interferometers.	**PSO -5**	**E**
CO - 5	The knowledge of Spectroscopy helps to extract the dynamic information about the molecule .	**PSO - 3**	**Ap**

Unit I **9 hrs**

Geometrical optics: Lens – Spherical aberration in lenses – Methods of minimizing spherical aberration —Dispersion – Angular and Chromatic dispersion – combination of prisms to produce i) dispersion without deviation ii) deviation without dispersion –Direct vision

spectroscope –Eyepieces – Ramsden's and Huygens's eyepieces – simple microscope (magnifying glass)– compound microscope.

Unit II **9 hrs**

Interference: Conditions for interference – Theory of interference fringes – interference due to reflected light (thin films) -colours of thin films – wedge shaped thin film – theory – determination of diameter of a thin wire by Air wedge – test for optical flatness – Newton's rings by reflected light – Determination of wavelength of light - Michelson's Interferometer – theory and its Application (Measurement of wavelength)

Unit III **9 hrs**

Diffraction: Fresnel's diffraction –Rectilinear propagation of light – zone plate – action of zone plate - Fraunhofer diffraction at single slit – Double slit – Plane diffraction grating – theory of plane transmission grating - experiment to determine wavelength(Normal incidence method) –resolving power– Rayleigh's criterion for resolution – resolving power of a telescope – resolving power of a microscope – resolving power of a prism - resolving power of grating.

Unit IV **9 hrs**

Polarization: Double refraction –Nicol Prism – Nicol Prism as polarizer and analyzer – Huygens's explanation of double refraction in uniaxial crystals– Plane, elliptically and circularly polarized light– Quarter wave plates and Half wave plates – Production and detection of plane, circularly and elliptically polarized light- Optical activity– Fresnel's explanation of optical activity

Unit V **9 hrs**

Spectroscopy: Infrared spectroscopy – sources and detector – uses – ultraviolet spectroscopy – sources – quartz spectrograph - applications - Raman Spectroscopy– Nuclear magnetic resonance –Nuclear quadrupole resonance –– Electron spin resonance spectroscopies- (Qualitative study)

Text Books

1. Subramanyam, Brijlal. (2004). *A text book of Optics*.25th Edition. New Delhi: S. Chand and co.

2. Murugeshan, R. (2008). *Optics and Spectroscopy*. 6th Edition. New Delhi: S. Chand and co.

3. Gupta,S.L., Kumar, V. and Sharma Pragati Prakashan, R.C. (1997). *Elements of Spectroscopy.*13th Edition, Meerut.

4. Aruldhass, G. (2007). *Molecular structure and spectroscopy.*II Edition. New Delhi: PHI Pvt Ltd.

Reference Books

1. Sathyaprakash, Ratan Prakashan Mandhir. (1990). *Optics*. VII Edition, New Delhi.

2. Banewell, C.N. (2006). *Introduction to Molecular Spectroscopy.* IV Edition. New Delhi: TMH publishing co.

3. Ajoy Ghatak. (2009).*Optics*. Fourth edition . New Delhi: TMH publishing co.

4. Singh & Agarwal, Pragati Prakashan, R.C. (2002).*Optics and Atomic Physics*. Nineth edition. Pragati Prakashan Meerut.

5. Halliday, D. Resnick, R. and Walker, J. (2001).*Fundamentals of Physics*, 6th Edition, New York: Wiley.

Semester IV

Elective II - Computer Programming in C++

Course Code: PC2042

Hours /Week	Credits	Total Hours	Marks
4	4	60	100

Learning Objectives

1. To provide knowledge about the basics of Computer programming in C++ and to solve problems by writing programs.
2. To enable the students developing their own applications using C++.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO-1	understand the different types of operators and expressions in C++ language.	PSO - 4	U
CO-2	implement different operation an arrays and use function to solve the given problem	PSO - 4	Ap
CO-3	understand member functions and constructors	PSO - 4	U
CO-4	analyze pointers, operator overloading and inheritance.	PSO - 4	An
CO-5	analyze input/output operations	PSO- 4	An

Unit I **9 hrs**

C++ - An Introduction: Introduction - tokens - keywords - identifiers and constants - declaration of variables - basic data types - user defined data types-derived data types - symbolic constants - operators in C++ -expressions and their type-hierarchy of arithmetic operators- scope resolution operator – declaring, initializing and modifying variables-special assignment operators - all control structures structure of a simple C ++ program

Unit II **9 hrs**

Arrays and Functions in C++: Introduction - one dimensional and two dimensional arrays-initialization of arrays-array of strings -Functions-introduction-function with no argument and no return values -function with no argument but return value - function with argument and no return values- function with argument and return values- call by reference return by reference-function prototyping - inline functions - local, -global and static variables--function overloading - virtual functions-main function-math library functions.

Unit III **9 hrs**

Classes and Objects: Introduction - specifying a class - defining member functions-C++ program with class - nesting of member functions - private member functions - objects as function arguments - arrays within a class-array of objects-static class members-friend functions-constructors - parameterized constructors-multiple constructors - constructors with default arguments - copy constructor.

Unit IV **9 hrs**

Operator Overloading, Inheritance and Pointers: Introduction -defining operator overloading - overloading unary operators -binary operators Inheritance - single inheritance - multiple inheritance - multilevel inheritance -hybrid inheritance - hierarchical inheritance-virtual base class-abstract class -Pointers- definition-declaration- arithmetic operations

Unit V **9 hrs**

Managing Console, I/O Operations: Introduction - C++ stream - C++ stream classes - unformatted I/O Operations -formatted console I/O operations - working with files - classes for file steam operations - opening and closing a file - file pointers and their manipulations.

Text Book

1. Balagurusamy, E. (2015*). Object Oriented Programming with C++*. 6th edition. New Delhi: McGraw Hill Education (India) Private Limited.

Reference Books

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

2. Byron S. Gottfried. (2007). Schaum'sOutlines : *Programming with C*.New Delhi:Tata McGraw Hill Pub. Co Ltd.

3. YashvantKanetkar. (1998). *Programming with C*. 2nd edition.New Delhi: Tata McGraw Hill.

Semester IV

Medical Physics- Elective I (b)

Course Code: PC2043

Hours /Week	Credits	Total Hours	Marks
4	**4**	**60**	**100**

Learning Objectives

1. To understand the basics about the biological systems in our body, their Behaviour, and the diagnostic devices. To impart the physics principles involved in the living body and the functioning of medical instruments.
2. To develop the skills in medical diagnostic systems.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	Understand the Anatomical terms of the body.	**PSO - 2**	**U**
CO - 2	Explain the physical dynamics of the body.	**PSO - 2**	**Ap**
CO - 3	Analyse the heat and pressure system of the body.	**PSO - 5**	**An**
CO - 4	Discuss the optical and electrical behavior of the human body.	**PSO - 3**	**An**
CO - 5	Gain knowledge and application ideas regarding diagnostic systems.	**PSO - 2**	**Ap**

Unit I **9 hrs**

Anatomical terms of the Human body: Basic Anatomical Terminology: Standard anatomical position, Planes, Familiarity with terms like - Superior, Inferior, Anterior, Posterior, Medial, Lateral, Proximal, 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. Forces on and in the Body - Physics of the Skeleton - Heat and Cold in Medicine- Energy work and Power of the Body.

Unit II **9 hrs**

Dynamics of the Human body: Pressure system of the body: Physics of breathing, Physics of Cardiovascular system- Electricity within the Body - Applications of Electricity and Magnetism in Medicine. Sound in medicine- Physics of the Ear and Hearing- Light in medicine- Physics of eyes and vision.

Energy household of the body: Energy balance in the body - Energy consumption of the body - Heat losses of the body - Thermal Regulation. 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 **9 hrs**

Basic Principles in Human body: Transducers- performance of characteristics of transducer- static and dynamic - active transducers - (a) magnetic induction type (b) piezoelectric type (c) photovoltaic type (d) thermoelectric type. Passive transducer- (a) resistive type - effect and sensitivity of the bridge (b) capacitive transducer (c) linear variable differential transducer (LVDT)

Unit IV **9 hrs**

Electrical behaviour of the human body: 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 – V **9 hrs**

Diagnostic systems: Electro Cardio Graph (ECG) - Block diagram- ECG Leads- Unipolar and bipolar-ECG recording set up. Electro Encephalo Graph (EEG) - origin- Block diagram- Electro Myogragh (EMG) - Block diagram- EMG recorder- Computer Tomography (CT) principle- Block diagram of CT scanner. 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.

Text Books

1.John R. Cameron and James G.Skofronick, (1978), *Medical Physics* –John Willy & Sons.

2.Arumugam, M. (1997). *Bio medical instrumentation*, Edi. II, Chennai: Anuradha Agencies.

3.Thayalan, K. (2009). *Basic Radiological Physics ,2nd ed*, New Delhi: Jaypee Brothers Medical Publishing Pvt. Ltd.

4. Irving P. Herman. (2007). *Physics of the human body*, 1sted, Atlanta, NewYork: Springer.

Reference Books

1. Muhammad Maqbool, (2017).*Introduction to Medical Physics*, Springer International Publishing.

2. 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.

3. Cameron. J,R. Skofronick J,G. (1978). *Medical Physics, 1st ed*, New York: Wiley.

4. Curry T,S. Dowdey J,E. Murry R,C. (1990). *Christensen's Physics of Diagnostic Radiology, 4 thed*, Philadelphia, USA: Lippincot Williams & Wilkins.

5. Khan F,M. (2003). *Physics of Radiation Therapy, 3rd ed*, USA: Lippincot Williams & Wilkins.

6. Livingstone R,S. (2007) *Handbook of Physics in Diagnostic Imaging. 1sted*, Chennai: B.I. Publication Pvt Ltd.

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

Semester IV

Optoelectronics- Elective I (c)

Course Code: PC2044

Hours /week	Credits	Total Hours	Marks
4	**4**	**60**	**100**

Learning Objectives

1. To give an introductory account of the basic principles of Optoelectronic devices
2. To gain information about fibre optic communication system and thereby impart the basic knowledge of optical fibres and its application in communication

Course Outcome

COs	**Upon completion of this course the students will be able to:**	**PSO addressed**	**CL**
CO-1	Explain the various methods of propagation of light waves through various types of fibres.	**PSO-4**	**U**
CO - 2	Understand the basic concepts of fiber optics and types of fibers	**PSO-4**	**U**
CO-2	Explain the structure and performance of LEDS and Lasers.	**PSO-2**	**U**
CO-3	Classify the optical sources and detectors and to discuss their principle.	**PSO-1**	**U**
CO-4	Discuss the channel impairments such as losses and dispersion.	**PSO-5**	**C**
CO-5	Analyse various coupling losses.	**PSO-5**	**An**

Unit I **9 hrs**

Optical Fibers: What are optical fibres - importance of optical fibres - principle of optical fibre - 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 - comparison of step and graded index fibres - application of fibres – Classification of fibre - stepped index fibre, stepped index monomode fibre – disadvantage- Graded Index multimode fibre, plastic fibres.

Unit II **9 hrs**

Light Sources: Introduction - LED - The processes involved in LED - LED materials- Advantages- LCD - Characteristics and action of LCD - Advantages- LASER - Laser operation -characteristics of Laser - Spontaneous and Stimulated emission - Einstein coefficients- condition for population inversion -Types of Lasers - semiconductor laser diode

Unit III **9 hrs**

Photodetectors: Photo Detectors - Characteristics of Photo detectors -Photo Emissive - Photo - detectors, PN junction photo detector- PIN photodiode, Avalanche photo diode (APD), Photo transistor, Bit-Error rate.

Unit IV **9 hrs**

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 - Dispersion in optical fibres - intermodal dispersion - material chromatic dispersion - wave guide dispersion.

Unit V **9 hrs**

Optical couplers, splicing techniques and Fibre optic communication system: 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- Fibre optic communication system (block diagram)

Text Books

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

2. Palanisamy, P, K (2002).*Semiconductor physics and Optoelectronics*, Chennai: SCITECH Publication.

Reference Books

1. Wilson & Hawker, (2004).*Opto Electronics*. New Delhi: Prentice Hall of India.

2. Wilson, Hawker. (2005). *An Introduction to Optoelectronics*. New Delhi: Prentice Hall of India.

3. Battacharya, P. (2002). *Semiconductor Optoelectronics*. New Delhi: PHI.

Semester: IV

Allied Physics II for Chemistry

Course code : AP2041

Hours /week	Credits	Total Hours	Marks
4	**3**	**60**	**100**

Learning Objectives

1. To understand the concepts of resistance of materials, capacity of conductors, effect of magnetic field due to passage of current, idea about the atom models and energy released in breaking of atom.
2. To make an awareness in physical concepts behind electricity , electronics, basic semiconductor diodes, transistor and basic logic gates.

Course Outcome

COs	Upon completion of this course students will be able to:	PSO addressed	CL
CO -1	Acquire knowledge on elementary ideas of electricity and magnetism, electronics, atomic and nuclear physics.	**PSO-1**	**U**
CO- 2	Analyze the concepts and study their applications in the field of electricity and magnetism, electronics and nuclear physics.	**PSO -3**	**An**
CO- 3	Apply their depth knowledge of Physics in day today life.	**PSO -2**	**Ap**
CO- 4	Develop their knowledge and carry out the practical by applying the concepts of a rectifier, amplifiers and oscillator, basic digital electronics principles through logic gates and the laws governing them.	**PSO -4**	**R**

Unit I **9 hrs**

Current Electricity: Ohm's law – Law of resistance in series and parallel – Specific resistance – capacitors – capacitors in serial and parallel – Kirchoff's laws – Wheatstone's network – condition for balance Carey-Foster's bridge – measurement of resistance – measurement of specific resistance –determination of temperature coefficient of resistance – Potentiometer – calibration of Voltmeter.

Unit II **9 hrs**

Electromagnetism: Electromagnetic Induction – Faraday's laws – Lenz law – Self Inductance – Mutual Inductance – Coefficient of Coupling A.C. Circuits – Mean value – RMS value – Peak value – LCR in series circuit – impedance – resonant frequency – sharpness of resonance.

Unit III **9 hrs**

Atomic and Nuclear Physics: Bohr's atom model – radius energy – Atomic excitation – Ionization potential – Frank and Hertz Method – Nucleus – Nuclear properties – Mass defect – Binding energy. Radio isotopes – Uses of radio isotopes – Nuclear fusion and Nuclear fission – X-rays – Production – properties –Derivation of Bragg's law – uses in industrial and medical fields.

Unit IV **9 hrs**

Analog Electronics: Semiconductor – PN junction diode – Bridge rectifier – Zener diode – Regulated power supply. Transistor – Working of a transistor – CE Configuration – current gain – Transistor Characteristics – CE Configurationβ and αrelationship between only – CE amplifier – feedback – Hartley oscillator.

Unit V **9 hrs**

Digital Electronics: Number system – Decimal – Binary – Double Dabble method – Binary addition, subtraction and multiplication – conversion of one number system to another number system- Logic gates – OR, AND, NOT, XOR, NAND and NOR gates – truth tables – Laws and theorems of Boolean's algebra – De Morgan's theorems.

Text Books

1. Murugesan,R. (2017).*Electricity and Magnetism.* New Delhi*:*S. chand& co.

2. Murugesan,R. (1998). *Modern Physics.* New Delhi*:*S. chand& co.

3. Theraja,B.L.(2003). *Basic Electronics.* New Delhi*:*S. chand& co.

Reference Books

1. Murugesan,R. Kiruthiga Sivaprasath. (2016). *Modern Physics.* New Delhi*:*S. chand& co. 2. Ubald Raj,A. and Jose Robin,G. (2006). *Mechanics, Waves and Oscillations*. 1st Edn. Indira Publications.

3. Murugeshan,R.(2016).*Allied Physics.* Revised Edn.New Delhi*:* S. Chand & company private limited

Semester IV

Part IV

Add on Course- Professional English for Physical Sciences-IV

Course Code: APS204

Hours /Week	Credits	Total Hours	Marks
2	2	30	100

Learning Objectives

1. To develop the language skills of students by offering adequate practice in professional contexts
2. To develop strategic competence that will help in efficient communication

Course Outcome

COs	Upon completion of this course, students will be able to:	PSOs addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	**PSO - 1**	U
CO - 2	use language for speaking with confidence in an intelligible and acceptable manner	**PSO - 6**	Ap
CO - 3	understand the importance of reading for life	**PSO - 1**	U
CO - 4	Understand the importance of writing in academic life	**PSO - 1**	U
CO - 5	Write simple sentences without committing error of spelling or grammar	**PSO - 7**	An

Unit I

Listening – Listening to two talks / Lectures by specialists on selected subjects

Speaking – Small Group Discussions

Reading – One Subject Based Reading text followed by comprehension activities / exercises

Writing – Summary writing based on the reading passages (Free Writing)

Unit II

Listening – Product Launch

Speaking – Debates

Reading – Reading Texts on advertisements (On products relevant to the subject areas) and answering inferential questions

Writing – Writing an argumentative / persuasive essay

Unit III

Listening – Interview by a famous celebrity

Speaking –Interviewing any professional / Creating Vlogs (How to become vloger and use vloging to nurture interest – subject related)

Reading – Blog

Writing – Blog Creation

Unit IV

Listening – Listening academic videos (Prepared by EMRC Other MOOC videos on Indian academic sites)

Speaking – Making oral presentations through short films – subject based

Reading – How is creativity possible in Science (Continuation of essay in semester III)

Writing – Creating flyers and Brochures (Subject Based)

Unit V

Speaking – Presentation (Without Aids)

Reading & Writing – Product Profiles / Writing an Introduction.

Reference Book

1. TANSCHE (2020). Professional English for Physical Sciences, *First* edition

Semester III and IV

Major Practical II- Physics Lab II Course

Code: PC20P2

Hours /Week	Credits	Total Hours	Marks
2	**2**	**30**	**100**

Learning Objectives

1. To demonstrate the working of deflection magnetometer, BG, Desauty's and Owen's bridge.
2. To enhance the understanding of the principles of electricity, magnetism, electronics and light through some basic experiments.
3. To enable the students to understand the principle and working of analog electronic circuits like Zener diode and op-amp through some basic experiments.

Learning Outcome

LOs	Upon completion of this course, students will be able to:	PSOs addressed	CL
LO - 1	understand the scientific method and an ability to apply the scientific method in practice.	**PSO - 1**	**U**
LO - 2	recall the basic experiments; improve the basic skills and attitude which help them to apply these skills in their field of physics	**PSO - 3**	**R**
LO - 3	rstand the practical knowledge of various bridges (Desauty's and Owen's bridge) by demonstration of experiments	**PSO - 1**	**U**
LO - 4	verify the Thevenins and Nortons theorem.	**PSO - 2**	**Ev**
LO - 5	compile a record of an experiment in a clear and logical written form (e.g., lab manual report, Record) augmented with figures and graphs where appropriate.	**PSO - 5**	**C**
LO - 6	analyze the physical principle involved in the various instruments and design simple circuits	**PSO - 5**	**An**

Any fourteen experiments

1. Spectrometer – Determination of A and μ
2. Spectrometer – Dispersive power of prism
3. Spectrometer Grating- Normal Incidence
4. Air wedge- Thickness of the thin wire
5. Newton's rings- R and μ
6. Measurement of absolute capacitance – B.G.
7. Figure of merit – B.G.
8. Deflection and vibration magnetometer
9. Potentiometer – Calibration of Ammeter
10. Potentiometer – Calibration of Voltmeter (low range)
11. De Sauty's bridge – Capacitance in series and parallel
12. Owen's bridge – Inductance in series and parallel
13. LCR-Series resonance circuit
14. Field along the axis of a coil – Dipole moment
15. V-I Characteristics of Zener diode
16. Zener – Voltage regulator
17. Bridge rectifier- with and without filter
18. Verification of Thevinins and Nortons theorem.
19. Addition of two DC voltages using Op-amp in inverting and non-inverting modes

Reference: Material prepared by the department.

Allied Practical

Semester: IV

Name of the Course : General Physics Lab

Course code : AP20P1

Hours /Week	Credits	Total Hours	Marks
2	2	60	100

Learning Objectives

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

Course Outcome

LOs	Upon completion of this course students will be able to:	PSO addressed	CL
LO - 1	understand the basic principles of Physics through experiments.	**PSO - 1**	**U**
LO - 2	measure and determine the various physical parameters.	**PSO - 5**	**An**
LO - 3	develop an idea about the handling of various instruments.	**PSO - 7**	**C**
LO - 4	get an idea about basic Scientific knowledge and implications of its broad working principle.	**PSO - 3**	**Ap**
LO - 5	analyzing, interpreting and evaluating data.	**PSO - 5**	**E**
LO - 6	build a foundation in Scientific Career.	**PSO - 2**	**Ap**

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
15. 17. Logic gates – AND, OR, NOT18. AC frequency – Sonometer
16. 19. LCR – Parallel Resonance circuit.20. Characteristics of Zener diode

Semester V
Major Core V- Classical and Statistical Mechanics
Course Code: PC2051

Hours/Week	Credits	Total Hours	Marks
6	**5**	**90**	**100**

Learning Objectives

1. To understand the mechanics of systems of particles and their equations of motion
2. To study the concept of statistics of molecules.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO- 1	understand the basic mechanical concepts related to system of particles	**PSO-1**	**U**
CO-2	apply various mechanical principles to find solution for physical problem	**PSO-4**	**Ap**
CO- 3	solve the equations of motion using Hamiltonian formalism	**PSO-6**	**C**
CO- 4	explain the fundamental postulates of statistical mechanics and Maxwell Boltzmann statistics	**PSO-1**	**R**
CO- 5	understand and develop a scientific knowledge in quantum statistics	**PSO-7**	**U**

Unit I **15 hrs**

Mechanics of a System of Particles: External and internal forces, center of mass- Conservation of linear momentum- Conservation of angular momentum- Conservation of energy- work- energy theorem- Conservative forces- examples- Constraints-Types of constraints- Examples- Degree of freedom- Generalized coordinates (transformation equations) – Generalized Velocities-Generalized Momentum.

Unit II **15hrs**

Lagrangian Formulations: Principle of virtual work, D'Alembert's principle, Lagrange's equation of motion for conservative and nonconservative systems-Simple applications- simple pendulum- Atwood's machine- compound pendulum-Hamilton's principle- Deduction of Lagrange's equation of motion from Hamilton's principle- Deduction of Hamilton's principle from D'Alembert's principle.

Unit III **15 hrs**

Hamiltonian Formulations: Phase space- The Hamiltonian function H- Hamilton's Canonical equation of motion- Physical significance of H-Deduction of Canonical equation from a variational principle- Applications- Harmonic Oscillator-Planetary motion-Compound pendulum

Unit IV **15hrs**

Classical Statistics: Micro and macro states- The mu-space and gamma space- fundamental postulates of statistical mechanics- Ensembles- different types- Thermodynamical probability - entropy and probability- Boltzmann's theorem- Maxwell- Boltzmann statistics-Maxwell- Boltzmann energy distributive law- Maxwell- Boltzmann velocity distributive law.

Unit V **15hrs**

Quantum Statistics: Development of Quantum statistics- Bose- Einstein and Fermi-Diracstatistics- Derivation of Planck's radiation formula from Bose– Einstein statistics - Free electrons in metal- Fermi Gas-Difference between classical and quantum statistics

Textbooks

1. Upadhyaya,J.C. (2005). *Classical Mechanics*, Mumbai: Himalya Publishing House
2. Brijlal& Subramaniam (1998). *Heat& Thermodynamics*, New Delhi:S.Chand & CompanyLtd
3. Agarwal (1 9 9 6) . *Statistical Physics***,** New Delhi: S.Chand & CompanyLtd

Reference Books

1. Herbert Goldstein. (1980). *Classical Mechanics*, 2nd edition, Addison-wesley publications.
2. Aruldhas, G. (2008). *Classical Mechanics*, PHI learning publications.
3. Gupta,B.D. Satyaprakash.(1991).*Classical Mechanics*, 9th Edition,Meerut: KadernathRamnathPublications.
4. Gupta, Kumar &Sharma. (2005). *Classical Mechanics*, Meerut: Pragati Prakashan Publications.
5. MurraySpiegal, R.(1981). *Theoretical Mechanics*, New Delhi:McGrawHillPublications.

Semester: V

Core VI- Analog Electronics

Course Code: PC2052

Hours / Week	Credits	Total Hours	Marks
6	**5**	**90**	**100**

Learning Objectives

1. To impart in depth knowledge about Semiconductors, diodes, Transistors, Operational Amplifiers, oscillators etc
2. To enable the students to understand the aspects of analog electronics in a lucid and comprehensive manner.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO-1	understand the fundamental principles of semiconductorsincluding P-N junctions and zener diode	**PSO-1**	**U**
CO-2	illustrate network theorems like Thevenin's theorem, Norton's theorem etc.,	**PSO-2**	**U**
CO-3	analyze the operation of transistor, amplifier, oscillator and multivibrator	**PSO-3**	**E**
CO-4	demonstrate practical skills in the simulation, construction and testing of simple electrical and electronic circuits.	**PSO-6**	**Ap**

Unit I **15 hrs**

Linear circuit analysis and semiconductor diodes: Constant voltage source - constant current source - Maximum power transfer theorem - Thevenin's theorem - procedure for finding Thevenin Equivalent circuit - PN junction theory - V-I characteristics of a PN junction diode - Half wave rectifier - Bridge rectifier - Efficiency - filters - Shunt capacitor filter – pi filter - Zener diode - equivalent circuit - voltage regulator - LED - V-I characteristics – advantages - applications - photo diode - characteristics applications.

Unit II **15 hrs**

Transistor Amplifier: Transistor - Different modes of operations-CB mode &CE mode - Two port representation of a transistor- h parameter - AC equivalent circuit using h parameters- analysis of amplifiers using h parameters (CE only) - RC coupled amplifier - transformer coupled amplifier - power amplifier -classification of amplifiers - Class A, ClassB and Class C - Push pull amplifier – Emitter follower.

Unit III **15 hrs**

Oscillators and Multivibrator: Feedback principle -effect negative feedback-and Barkhaussen criterion - Phase shift and Wien Bridge oscillators using transistors –Expression for frequency- Multivibrators-Astable, Monostable and Bistable multi vibrators using transistors - Schmitt trigger.

Unit IV **15 hrs**

Special Semiconductor Devices: Clipping and clamping circuits - Differentiating circuit - Integrating circuit- -Field effect Transistor FET-MOSFET- UJT-SCR -characteristics - FET as a VVR-UJT relaxation oscillator-SCR as a switch and rectifier.

Unit V **15 hrs**

Operational Amplifier: Operational Amplifier- characteristics-parameters-applications-Inverting amplifier - Non inverting amplifier - Voltage follower- Adder -Subtractor - Integrator – Differentiator- Solving simultaneous equations-comparator -square wavegenerator -Wien bridge oscillator -Schmitt trigger

Text Books

1. Gupta and Kumar, (2002). *Hand Book of Electronics*, Meerut: Pragati Prakashan publications.
2. Mehta, V.K, RohitMehta,(2006). *Principles of Electronics*,New Delhi: S Chand & Co.
3. M. Arul Thalapathi,M (2005). *Electronics*, Comptek Publishers.
4. Bagde, M.K and Singh S.P.(1990). *Elements of Electronics*, New Delhi: S Chand & Co..
5. Subramanyam ,A (1997).*Applied Electronics*, National Publishing Co.
6. Ramakant A. Gayakwad, (1994).*OP - AMPs and Linear Integrated Circuits* , Prentice Hall ofIndia
7. 7.Malvino Leach, (1992). *Digital Principles and Application*, Tata McGraw Hill, 4th Edition.

Reference Books

1. Mittal .G.K,(1993). *Electronic Devices*, G.K. Publishers Pvt. Ltd.
2. Theraja ,B.L (2008). *Basic Electronics*, S. Chand & Co.
3. Sedha, R.S (1990), *Applied Electronics*, S. Chand & Co.

Semester V

Major Core VII: Solid State Physics

Course Code: PC2053

Hours/Week	Credits	Total hours	Marks
5	5	75	100

Learning 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

Course Outcomes

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	illustrate various types of bonding present in solids with example.	**PSO - 1**	**U**
CO - 2	explain the various crystal parameters and structures.	**PSO - 3**	**E**
CO - 3	discuss the various theories involved in magnetic materials. (dia, para, ferro, ferri and antiferro magnetism)	**PSO - 3**	**C**
CO - 4	describe polarization processes and analyze the information contained in the temperature and frequency dependence of dielectric materials.	**PSO - 1**	**C**
CO - 5	analyze the structure and physical properties of semiconductors.	**PSO - 5**	**An**
CO - 6	describe and discuss the theory of superconductivity and superconducting materials.	**PSO - 2**	**C**

Unit I **12hrs**

Bonding in Solids: Types of bonds in crystals - Ionic, covalent, Metallic, Vander waal's and Hydrogen Bonding - Bond energy of sodium chloride molecule - variation of inter atomic force with inter atomic spacing -cohesive energy - cohesive energy of ionic solids - application to sodium chloride crystal - evaluation of Madelung constant for sodium chloride.

Unit II **12hrs**

Crystal Structure and Crystal Diffraction: Crystal Lattice -Primitive and unit cell- seven classes of crystal-Bravais Lattice- Miller Indices-Structure of crystals-- Simple cubic, Face centered cubic, Body centered cubic and Hexagonal close packed structure -Sodium Chloride, Zinc Blende and Diamond Structures. Crystal Diffraction
Bragg's Law-Experimental methods-Laue method, powder method and rotating crystal method- Reciprocal lattice- Intensity and structure factor.

Unit III **12hrs**

Magnetic Properties: Spontaneous Magnetization – Weiss Theory – Temperature dependence of Magnetization -classical Theory of Diamagnetism – Weiss theory of Para magnetism – Ferromagnetic domains – Bloch wall – Basic ideas of anti- ferromagnetism
Ferri magnetisms – Ferrites in computer Memories.

Unit IV **12hrs**

Dielectric Properties: Band theory of solids –classified Of insulators, Semiconductors, conductors – intrinsic and extrinsic semiconductor – Carrier concentration for electron - Barrier Potential Calculation – Rectifier Equation Dielectrics - Polarization – frequency and temperature effects on polarization-dielectric loss-Clausius Mosotti relation- determination of dielectric constants.

Unit V **12hrs**

Super Conductivity: Introduction - General Properties of Superconductors - effect of magnetic field - Meissnereffect-effectofcurrent-thermalproperties-entropy-specificheat
-energy gap - isotope effect - London equations - AC & DC Josephson effects - applications - Type–I and Type–II Superconductors - Explanation for the Occurrence of Super Conductivity
- BCS theory - Application of Superconductors - High TCsuperconductors.

Text Books

1. Arumugam,M. (2002). *Materials Science,* Anuradha Agencies Publishers.
2. Singhal,R.L. (2003). *Solid State Physics*, Kedarnath Ram Nath& Co., Meerut.
3. Kittel. (2003). *Introduction to Solid State Physics*, Willey EasternLtd.
4. Raghavan,V. (2004). *Materials Science and Engineering,* Prentice Hall of India Private Limited, NewDelhi.

Reference Books

1. Pillai,S.O. (2002). *Solid State Physics*, New Age International (P)Ltd.
2. Dekker,A. J. (1985). *Solid State Physics*, MacmillanIndia.
3. Gupta,H.C. (2001). *Solid State Physics,* Vikas Publishing House Pvt. Ltd., New Delhi.

Semester V

Project

Course code: PC20PR

Hours/Week	Credits	Total Hours	Marks
5	4	75	100

Learning Objectives

1. To enable students to design experiment, analyze data and interpret results.
2. To develop skills to identify subject related problems in the neighborhood and report to the scientific community.

Course Outcome

COs	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	Explore new areas of research in physics	PSO - 7	Ap
CO - 2	Analyze a research problem and construct tools for data collection.	PSO - 5	An
CO - 3	Write research reports and present results in the scientific community.	PSO - 8	Ap
CO - 4	Develop skills to serve in science related industries and agencies.	PSO - 2	Ap

Guidelines

- All the students must undertake Project work at the final year (V semester) as a group (4 to 5 students per group)

Project Report framework

1. The Report format should be in:
   - Font - Times New Roman
   - Heading - Font size 14 (Bold) - Uppercase

     Sub headings - Font size 12 (Bold) — Lowercase; should be numbered. (Eg: Introduction 1;Subheading 1.1; 1.2)
   - Text, the content of the dissertation — Font size -12 (Normal).
   - Line space - 1.5
   - Margin - 2" on the left and 1" on the right, Gutter -0.5.

- Page Numbering — Bottom middle alignment; excluding initial pages and reference
- **Total number of pages - Minimum 30 - Maximum 40** (excluding initial pages and reference).
- The Tables and Figures should be included subsequently after referring them in the text of the report.

The report will have two main parts:

I. Initial Pages - in the following sequence

i. Title Page
ii. Certificate from the Supervisor
iii. Declaration by the candidate endorsed by the Supervisor and HOD.
iv. Acknowledgement (within one page - signed by the candidate).
v. Table of Contents
vi. List of abbreviations

II. Main body of the report

i. Introduction and Objectives
ii. Methodology
iii. Results
iv. Discussion
v. Summary
vi. References

The guidelines for reference

Journal Article : with Single Author

Waldron, S 2008, "Generalized Welch bound equality sequences are tight frames", IEEE Transactions on Information Theory, vol. 49, no. 9, pp. 2307-2309.

Journal Article : with Two Authors

Conley, TG &Galeson, DW 1998, "Nativity and wealth in mid-nineteenth century cities", Journal of Economic History, vol. 58, no. 2, pp. 468-493.

Journal Article : with more than two Authors

Alishahi, K, Marvasti, F, Aref, VA & Pad, P 2009, "Bounds on the sum capacity of synchronous binary CDMA channels", Journal of Chemical Education, vol. 55, no. 8, pp. 3577-3593.

Books

Holt, DH 1997, Management Principles and Practices, Prentice-Hall, Sydney.

Semester: V &VI

Major Practical III-Physics Lab III (Non-Electronics)

Course code: PC20P3

Hours/Week	Credits	Total Hours	Marks
2	**-**	**30**	**100**

Learning Objectives

1. To acquire knowledge about basic concepts of physics and to calculated the related physical parameters.
2. To demonstrate the fundamental principle of optics, potentiometer and B.G.

Course Outcome

LOs	Upon completion of this course, students will be able to:	PSO addressed	CL
LO - 1	demonstrate the experimental techniques and develop competence in handling optical instruments.	PSO - 1	U
LO - 2	analyze the diffraction and dispersion phenomena in optical elements (grating or prism) using spectrometer.	PSO - 4	An
LO - 3	develop practical hands-on experience applying widely used techniques to investigate optical phenomena. (Oblique incidence, i – d curve)	PSO - 2	Ap
LO - 4	record, analyze, interpret and critically evaluate Cauchy's constant and Hartmann's interpolation formula experimentally.	PSO - 6	C
LO - 5	Evaluate thermal parameters using M.G, B.G and potentiometer.	PSO - 7	Ap

Any fourteen experiments

1. Spectrometer-Cauchy's constant.
2. Spectrometer- Hartmann's interpolation formula.
3. High Resistance by leakage using B.G
4. Potentiometer- Calibration of high range Voltmeter
5. Potentiometer-Emf of thermocouple
6. Potentiometer- Temperature Coefficient of Resistance
7. Determination of wavelength of Laser source by diffraction grating
8. Diameter of a thin wire by diffraction method (using Laser).
9. Wavelength determination of different sources
10. Spectrometer- Hollow prism.
11. Carey Foster's Bridge-Temperature coefficient of Resistance
12. Spectrometer-i – d curve.
13. Spectrometer-i – i' curve.
14. Spectrometer-Wavelength of spectral lines of Mercury light with grating in oblique incidence.
15. Thermoemf using M.G
16. Comparison of Mutual inductance of the two pair of coils using B.G
17. Thermoemf of Thermocouple-B.G
18. Characteristics of solar cell
19. Study of Power versus load characteristics of Solar Photovoltaic panel.

Semester: V &VI

Major Practical IV- Physics Lab IV (Electronics)

Course code: PC20P4

Hours/Week	Credits	Total Hours	Marks
2	**-**	**30**	**100**

Learning Objectives

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

Course Outcome

LOs	Upon completion of this course, students will be able to:	PSO addressed	CL
LO - 1	develop knowledge and skills relating to electricity and electronics through hands-on learning experience.	PSO - 4	Ap
LO - 2	understand the fundamental concepts and mechanisms used in Digital Electronics. (Logic gates and Flip – Flops)	PSO - 2	U
LO - 3	design and analyse digital systems / logical circuits. (De Morgans theorems using IC)	PSO - 1	An
LO - 4	analyse and design various combinational and sequential circuits. (Flip flop, Encoder, Decoder, Op-amp etc.)	PSO - 5	An/E
LO - 5	infer the operation of basic logic gates, understand Boolean algebra and simplify simple Boolean functions by using basic Boolean properties.	PSO - 6	Ap

Any fourteen experiments

1. IC – 555 – A stable multivibrator
2. IC – 555 – Monostablemultivibrator
3. Half Adder& Full Adder
4. Half Subtractor& Full Subtractor
5. Universality of NOR
6. Universality of NAND
7. Flip – Flop (RS)
8. Flip – Flop (JK)
9. Verification of Boolean expressions and DeMorgan's Laws.
10. Decoder
11. Encoder
12. Regulated Power Supply Using IC's
13. Hartley Oscillator
14. Colpitt's Oscillator
15. Emitter Follower
16. Single Stage Amplifier-With and Without Feedback
17. Op-amp-Inverting and Non inverting amplifier
18. Op-amp-adder and Subtractor
19. Op-amp-Differentiator and Integrator

Semester: V &VI

Major Practical V- Physics Lab V (Computer)

Course code: PC20P5

Hours/Week	Credits	Total Hours	Marks
2	**-**	**30**	**100**

Learning Objectives

1. To apply object-oriented programming techniques to solve physics problems.
2. To develop programs using functions and classes (objects, array of objects, friend functions, passing and returning objects).

Course Outcome

LOs	Upon completion of this course, students will be able to:	PSO addressed	CL
LO - 1	understand the principles of object-oriented program to construct computer programs and modeling of experimental data for the solution of problems in physics. (period of a pendulum and Young's modulus of a material).	PSO - 1	**U**
LO - 2	apply object oriented programming techniques to solve computing problems. (addition, subtraction, multiplication and division)	PSO - 3	Ap
LO - 3	develop programs using functions and classes. (objects, array of objects, friend functions, passing and returning objects, function declaration with/without using the return statement).	PSO - 2	Ap/C
LO - 4	formulate the applications of pointers and virtual functions. Distinguish formatted and unformatted I/O operations.	PSO - 6	E
LO - 5	develop programs using constructor, destructor, operator overloading and inheritance. (generate a series of Fibonacci numbers using constructor in the scope of class definition / out of the class definition using the scope resolution operator).	PSO - 4	C
LO - 6	analyze the concepts trained in the computer lab activities and provide an understanding of data acquisition and analysis.	PSO - 5	An

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 member:

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.

17. Write a program to find the smallest and biggest element in an array.

18. Write a simple C++ program to find the path travelled by a body.

Semester VI

Major Core VIII: Relativity and Quantum Mechanics

Course Code: PC2061

Hours/Week	Credits	Total Hours	Marks
6	5	90	100

Learning Objective

1. To acquire sufficient knowledge in the concept of Relativity, dual nature of matter waves,
2. To apply the Quantum mechanics principles, Operator formalisms and derive Schrodinger equation and its applications.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	gain knowledge in the concepts of special and theory of relativity	PSO - 1	**U**
CO - 2	evolve ideas about dual nature of matter	PSO - 2	**E**
CO - 3	recognize basic terms in Quantum Mechanics and different operator mechanism	PSO - 3	**C**
CO - 4	apply of Schrödinger's equation to micro system	PSO - 4	**Ap**

Unit I **15 hrs**

Relativity: Frames of reference - Galilean transformation - Michelson - Morley experiment - Postulates of special theory of relativity - Lorentz transformation - length Contraction – time dilation - Relativity of simultaneity - addition of velocities - variation of mass with velocity– Mass energy relation - Elementary ideas of general relativity.

Unit II **15 hrs**

Wave Theory: Wave Nature of Matter Phase and group velocity - wave packet - expression of De Brogile's wave length -Davisson and Germer's experiment - G.P.Thomson's experiment - Heisenberg's uncertainty principle and its consequences.

Unit III **15 hrs**

Fundamentals of quantum mechanics: Schrodinger Equation Inadequacy of classical mechanics - Basic postulates of quantum mechanics - Schrodinger equation - Properties of wave function - Probability interpretation of wavefunction - linear operators - self adjoint operators - expectation value - eigenvalues and eigenfunctions - commutativity and compatibility.

Unit IV **15 hrs**

Operators: Angular Momentum in Quantum Mechanics Orbital angular momentum operators and their commutation relations - separation of three-dimensional Schrodinger equation into radial and angular parts - Elementary ideas of spin angular momentum of an electron - Pauli matrices.

Unit V **15 hrs**

Applications of Schrodinger Equation: Solutions of Schrodinger Equation – Time dependent and time independent Schrodinger equation - Free particle solution - Particle in a box - Potential well of finite depth (one dimension) - linear harmonic oscillator - rigid rotator and hydrogen atom.

Text Books

1. P.M.Mathews and S.Venkatesan, (2005). *A Text book of Quantum mechanics,*TataMcGraw - Hill, New Delhi.

2. V.K.Thankappan, (2003). *Quantum Mechanics,* New Age International (P) Ltd. Publishers, New Delhi.

3. K.K.Chopra and G.C. Agrawal, (1998). *Quantum mechanics,* Krishna PrakasamMedia(P) Ltd., Meerut First Edition.

4. R. Murugeshan and KiruthigaSivaprasath, (2008).*Modern Physics,* S. Chand &Co.

Reference Books

1. BrijlalSubramanyam, (1990). *Mechanics and Relativity,*S.Chand& Co., New Delhi.

2. A.Beiser, (1997). *Concepts of modern physics*, Tata McGraw - Hill, 5th edition, NewDelhi.

3. Pauling and Wilson, (2000) *Introduction to quantum mechanics*, McGraw – Hill.

4. A.Ghatak and Loganathan, (2012)*Quantum mechanics,* Macmillan India Pvt. Ltd.

Semester: VI

Core IX - Digital and Communication Electronics

Course code: PC2062

Hours/Week	Credits	Total Hours	Marks
6	**5**	**90**	**100**

Learning Objectives

1. To understand the structure of various number system and basic Logic gates.
2. To design and solve the Boolean Algebra simplification and Karnaugh Maps.
3. To construct sequential circuits and to design counte

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO -1	Understand the basic operation, and features related to Logic gates and interprets their applications.	**PSO-1**	**U**
CO -2	Acquire knowledge on number system, arithmetic building blocks, and memories.	**PSO-3**	**E**
CO -3	Understand the fundamental concepts of logic gates, counters, registers, fiber optics, etc.	**PSO-1**	**U**
CO -4	Develop skill to build and troubleshoot combinational digital circuits.	**PSO-7**	**Ap**
CO-5	Understand AM, FM and PM modulation and demodulation techniques.	**PSO-1**	**U**
CO-6	Assess the basic concepts of fiber optics and types of fiber diodes, transistor, op-amps and converters.	**PSO-2**	**E**
CO-7	Learn the working principle of satellite communication system.	**PSO-6**	**C**

Unit I **15hrs**

Digital Fundamentals: Number Systems and Conversions - Binary-Coded Decimal (BCD) Code - Gray code - 1's and 2's complements - Basic logic gates - NAND, NOR and EX-OR gates - NAND and NOR as Universal Building blocks - Laws and theorems of Boolean algebra - NAND-NAND circuits - Karnaugh's map- Sum of Product (SOP) and Product of Sum (POS) - applications.

Unit II **15hrs**

Sequential Logic: RS-Flip flop, Clocked RS Flip flop, D-Flip flop, J-K and J-K Master- Slave Flip-flop - Shift registers and Counters - Multiplexers and Demultiplexers - Decoders and Encoders - Memory Circuits - D/A and A/D converters - applications.

Unit III **15hrs**

Modulation and Demodulation: Amplitude modulation - Frequency modulation, Phase Modulation and Pulse Width Modulation - Detectors of Amplitude Modulation (AM), Frequency Modulation (FM), Phase modulation (PM) and Pulse width modulation (PWM), Phase locked loop (PLL) - Noise in Communication Systems.

Unit IV **15hrs**

Digital and Satellite Communication: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK) Modulation and Demodulation, Advantages and disadvantages of digital communication. Communication Satellite Systems - Telemetry - Tracking and Command System-Satellite Links - Commonly Used frequency in Satellite Communication - Multiple access - Error Detection.

Unit V **15hrs**

Fibre Optic Communication: Basic Fibre Optic System - Advantages of Fibre Optic System - Propagation of light through fibre - Numerical aperture - Acceptance angle - Losses and distortion in optical fibres - Basic fibre Optical communication and links - Special applications.

Text Books

1. Jain, R. P. (2007). *Modern Digital Electronics*. New Delhi: Tata McGraw Hill.2.
2. Malvino Leach, (1992). *Digital Principles and Application*, Tata McGraw Hill, 4th Edition.
3. Thomas L. Floyd, (1998). *Digital Fundamentals,* Universal Book Stall, New Delhi.
4. Vijayendran. V, Viswanathan. S, (2005). *Introduction to Integrated Electronics,* Printer sand Publishers Pvt. Ltd., Chennai.
5. Gerd Keiser, (2003). *Optical communications Essentials*,Tata McGraw Hill, 5th Edition.

Reference Books

1. Mehta V. K., Rohit Mehta. (2016). *Principles of Electronics*. New Delhi: S. Chand and Company.
2. Vijayendran. V. Viswanathan. S. (2011). *Introduction to Integrated Electronics Digital and Analog*. (1st Ed.). Chennai: (printers and Publishers) Pvt. Ltd.
3. Thomas L. Floyd. (1999). *Digital Fundamentals*. (3rded.). New Delhi: UBS-Publishers Distributers LTD.
4. Albert Malvino, David J Bates. (2007). *Electronic Principles*, 7th Edition, New Delhi: McGraw Hill.
5. Mehta, V.K. (2001). *Principles of Electronics.* 6th Revised Edition, S. Chand and Company.

Semester: VI

Core X –Nuclear Physics

Coursecode:PC2063

Hours/Week	Credits	Total Hours	Marks
5	5	75	100

Learning Objectives

1. To acquire knowledge on static properties of nuclei and its stability.
2. To understand the background of various nuclear models.
3. To know about different modes of decay and interaction of nuclear radiations with matter

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO 1	understanding on the basics of nuclear physics that treats atomic nuclei as self-bound many-body quantum systems	PSO-1	U
CO2	ledge about particle- antiparticle, decay processes and their outcomes.	PSO-2	U
CO 3	basic interaction between fundamental particles.	PSO-4	An

Unit I **12 hrs**

Properties and structure of Nuclei: General properties of nucleus- binding energy – BE/A curve - significance - proton electron theory- proton neutron theory -nuclear forces – characteristics –Meson theory of nuclear forces – Yukava Potential- Nuclear models.

Unit II **12 hrs**

Radio Activity: Fundamental laws of radio activity –theory of α ,β and ϒ decay- properties of alpha, beta and gamma rays - neutrino and its properties-electron capture. - nuclear isomers- Mossabauer effect - applications- Radio carbon dating- radio isotopes – uses.

Unit III: **12 hrs**

Nuclear Reactions: Kinematics of nuclear reaction-nuclear fission –Nuclear fusion – Nuclear reactor-uses - atom bomb - hydrogen bomb-fusion reactor –plasma confinement – artificial transmutation-Q value of nuclear reaction-types of nuclear reaction

Unit IV **12 hrs**

Nuclear Detectors and Particle Accelerators: Neutron sources and properties- Detectors- G.M.Counter-scintillation counter- bubble chamber-Wilson cloud chamber- Accelerators- cyclotron- synchrocyclotron-betatron-synchrotrons

Unit V **12 hrs**

Cosmic Rays and Elementary Particles: Cosmic rays-introduction-discovery-latitude, altitude and azimuth effects- longitudinal effect-north –south effect-seasonal and diurnal changes-primary and secondary cosmic rays-nature of cosmic rays- cosmic ray showers-Van Allen belt- origin of cosmic radiation. Elementary particles-introduction-particles and antiparticles-antimatter-the fundamental interaction-elementary particle quantum numbers-conservation laws and symmetry-the quark model

Text Books

1. N.Subrahmanyam and Brijlal. (1996) *Atomic and Nuclear Physics*,1st Edition, New Delhi: S Chand & Co.

2. Tayal D.C. (2006).*Nuclear Physics*, Mumbai: Himalaya Publishing House.

3. R.C.Sharma. (2000).*Nuclear Physics*, Meerut: Nath& Co

4. Irving Kaplan.(2002).*Nuclear Physics*, 2nd Edition New Delhi: Narosa Publishing house.

Reference Books

1. R.R.Roy and B.P.Nigam. (1997).*Nuclear Physics*, 1st Edition, NewDelhi: New Age International (P) Ltd.

2. Longo. (1973). *Fundamentals of Elementary ParticlePhysic*s, 1st Edition, US: McGraw-Hill.

3. W.A. Benjamin. (1997).*Nuclei and Particles*,1st Edition, USA

Semester: VI

Major – Elective- III (a)- Mathematical Physics

Course code: PC2064

Hours/Week	Credits	Total Hours	Marks
5	4	75	100

Learning Objectives

1. To understand the various mathematical methods used in Physics.
2. To employ mathematical tools to solve various problems in Physics.

Course Outcome

COs	Upon completion of this course, students will be ableto:	PSO addressed	CL
CO-1	Illustrate linear dependence and combination of vectors as quantities in Physics.	PSO-4	U
CO-2	Solve ordinary and partial differential equations related to Physical Science.	PSO-2	C
CO-3	Evaluate problems in matrices.	PSO-4	E
CO-4	Adapt Laplace transform technique to obtain the Laplace series of periodic functions of Physics.	PSO-5	C
CO-5	Understand and manipulate random variables using the theory of probability including tools of probability transformation and characteristic functions.	PSO-6	U

UnitI **12 hrs**

Vectors: Vectors and scalars-Vector algebra-The scalar product-The vector (cross or outer) product-The triple scalar product-The triple vector product-The linear vector space Vn- Vector differentiation -Space curves - Motion in a plane - A vector treatment of classical orbit theory - Vector differential of a scalar field and the gradient - Conservative vector field - The vectordifferential operator - Vector differentiation of a vector field - The divergence of a vector - The operator A^2, the Laplacian - The curl of a vector.

Unit II **12 hrs**

Differential Equation: First-order differential equations - Separable variables -Exact Equations-Integrating factors -Bernoulli's equation- Second-order equations with constant coefficients - Nature of the solution of linear equations - General solutions of the second-order equations - Finding the complementary function - Finding the particular integral - Rules for D operators - The Euler linear equation - Solutions in power series.

matrix - Orthogonal matrix (real) - Unitary matrix - Rotation matrices - Trace of a matrix.

Unit III **12 hrs**

Matrix: Definition of a matrix - Four basic algebra operations for matrices - Equality of matrices - Addition of matrices - Multiplication of a matrix by a number - Matrix multiplication - The commutator - Powers of a matrix - Functions of matrices - transpose of a matrix - Symmetric and skew-symmetric matrices - The matrix representation of a vector product - The inverse of a matrix - A method for finding A-1 - Systems of linear equations and the inverse of a matrix - Complex conjugate of a matrix - Hermitian conjugation - Hermitian/anti-Hermitian

Unit IV **12 hrs**

Laplace Transformation: Definition of the Laplace transform - Existence of Laplace transforms - Laplace transforms of some elementary functions - Shifting (or translation) theorems - The first shifting theorem - The second shifting theorem - The unit step function - Laplace transform of a periodic function - Laplace transforms of derivatives - Laplace transforms of functions defined by integrals - A note on integral transformations.

Unit V **12 hrs**

Partial Differential Equations: Linear second-order partial differential equations - Solutions of Laplace's equation: separation of variables - Solutions of the wave equation: separation of variables - Solution of Poisson's equation. Green's functions - Laplace transform solutions of boundary-value problems

Text Books

1. Tai L. Chow. (2000). *Mathematical Methods for Physicists: A concise introduction*. Cambridge University Press.

2. R.Murugesan. (2014). *Mechanics and Mathematical Physics*. Sultan Chand & Co.

Reference Books

1. Piyoosh Kumar Tyagi. (2018). *Mathematical Physics*.RBSA Publishers.

2. SatyaPrakash. (2021). *Mathematical Physics*. Sultan Chand & Co.

3. Gupta. (2009). *Mathematical Physics*. Sultan Chand & Co.

4. James Nearing. (2010). *Mathematical Tools for Physics*. New York. Dover Publications.

Semester VI

Major – Elective- III (b)-Nanophysics

Course Code: PC2065

Hours /Week	Credits	Total hours	Marks
5	**4**	**75**	**100**

Learning Objectives

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

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	infer the history of nanotechnology and explain thesynthesis of nanomaterials.	**PSO - 1**	**U**
CO - 2	Interpret quantum well, quantum wires and quantum dots.	**PSO - 5**	**E**
CO - 3	explain the carbon nanotubes and its applications.	**PSO - 6**	**E**
CO - 4	discuss the applications of nanotechnology in various fields.	**PSO - 4**	**C**

Unit I: **12 hrs**

Nanomaterials: History of Nanotechnology- Background - Conceptual origins - Experimental advances - Nanostructures-Nanomaterials -Synthesis of oxide nanoparticles-Sol-gel processing - Synthesis of semiconductor nanoparticles-Arrested precipitation - Synthesis of metallic nanoparticles -Sonochemical reduction process - Electrochemical deposition method - Biosynthesis of nanoparticles.

Unit II: **12 hrs**

Quantum Hetero structure: Super lattice - Preparation of Quantum nanostructure - Quantum well lasers - Quantum cascade laser - Application -Quantum wire - production of nanowires - Structure of nanowires - Use of nanowires - Quantum dot - Application of Quantum dots - Quantum dot information storage - Quantum dot infrared photo detectors - Quantum dot lasers.

Unit III: **12 hrs**

Carbon Nanotubes: Discovery of Nanotubes - Carbon Allotropes - Diamond - Graphite - Carbon Nanotubes - Types of carbon Nanotubes- Single walled carbon nanotubes - Multiwalled carbon nanotube - Fullerite - Torus - Nanobuds - Graphene sheet to a single walled nanotube - Electronic structure of Carbon Nanotubes - Synthesis of Carbon Nanotube - Electric Arc Discharge method - Laser method.

Unit IV: **12 hrs**

Magneto Electronics: Nanocrystalline soft material - Permanent magnet material - Theoretical background - Super paramagnetism - Coulomb blockade - Quantum cellular Automata - Spintronics - Giant magneto resistance (GMR) - Types of GMR.

Unit V: **12 hrs**

Application of Nanotechnology: Chemistry and Environment - Energy applications of nanotechnology - Information and Communication - Heavy Industry – Consumer goods - Nanomedicine - Medical application of Nanotechnology- Biomarkers and Bioimaging - Targeted drug delivery - Nanorobots.

Text Books

1. Sr. Gerardin Jayam (2019), *Nanophysics,* Department of Physics.

2. Ramachandra Rao, M.S, Shubra Singh. (2013). *Nanomaterials,* New Delhi: Wiley Indiapvt. Ltd.

Reference Books

1. T. Pradeep, (2007),*Nano the Essentials,* Tata Mc. Graw Hill Company. Ltd.
2. Rao C. N. R, Muller. A,Cheetham A.K, (2004). *The Chemistry of Nanomaterials: Synthesis, Properties and Applications*, Germany.
3. Charles P. Poole, Frank J. Owens. (2008). *Introduction to Nanotechnology,* (1st ed.), Germany: Wiley publications
4. Mohankumar, G. (2016). *Nanotechnology- Nanomaterials and Devices*,(1sted.).New Delhi:Narosa publishing House

Semester VI
Major – Elective- III (c)-Astrophysics
Course Code: PC2066

Hours / Week	Credits	Total Hours	Marks
5	4	75	100

Learning Objectives

1. To enable the students to understand and realize the historical evolution of Universe and principles involved in Astrophysics
2. To provide knowledge on Solar system, History of Earth, Earth atmosphere, Astronomical telescopes, Classification of Stars, galaxy nomenclature which play a key role in the future employability and global progress of students.

Course Outcome

COs	Upon completion of this course, the students will be able to :	PSO addressed	CL
CO- 1	**Perceive** the historical evolution of solar system and planets	PSO-2	E
CO- 2	**Describe** the principles of physics in the formation of astronomical objects like planets-Satellites - Asteroids and Comets	PSO-3	U
CO- 3	**Examine** the requirements and limitations of instrumentation for modern astrophysical observations (Optical telescopes and Radio telescopes)	PSO-5	An
CO- 4	**Analyse**the formation of stars, pulsars, Neutron stars and Black holes	PSO-5	An
CO -5	**Interpret** the observations of Galaxies, star clusters, Galactic clusters.	PSO-2	E
CO -6	Distinguish between some cosmological models of the universe and its observational tests.	PSO-6	Ap

Unit I **12 hrs**

Birth of Modern Astronomy: Geocentric and Heliocentric theories —– Kepler's laws of planetary motion – Newtonian gravitation – Celestial sphere – Planets – Terrestrial and Jovian planets (Planets individual description is not required in detail) - Asteroids- Meteorites – Comets.

Unit II **12 hrs**

Telescopes: Elements of telescope – Properties of images – Types of Optical telescopes – Refracting and Reflecting telescopes- Radio telescope – Spectrograph – Limitations – Photographic photometry – Photoelectric photometry – Spectrophotometry – Detectors and image processing.

Unit III **12 hrs**

Sun : Physical properties – Composition – Core – Nuclear Reactions – Photosphere – Chromosphere – Corona – Sunspots – Sunspot cycle – Solar Wind – Auroras – space weather effects – History of the Earth – Temperature of a planet – The atmosphere – Pressure and Temperature distribution – Magnetosphere – Eclipses – Solar and Lunar Eclipses.

Unit IV **12 hrs**

Classification of Stars: The Harvard Classification system – Luminosity of a Star – Hertzprung- Russel Diagram – Stellar evolution using the HR diagram – Theoretical evolution of stars – White Dwarfs – Neutron stars-Black holes – Event horizon – Basic physics of Black Holes.

Unit V **12 hrs**

Galaxy nomenclature: Types of Galaxies – Spiral – Elliptical – irregular galaxies – Milky Way Galaxy and its structure – Rotation and Mass Distribution – Rotation curve and Doppler shift – Star clusters – Galactic clusters – Pulsars – Cosmological Models – Big bang theory – Steady state theory
– Hubble's law – Olber's paradox.

Text Books

1. Niclolas. A. Pananides and Thomas Arny, (1979). *Introductory Astronomy*, Addison Wesley Publ. Co.

2. MujiberRahman.A. (2018).*Concepts to Astrophysics*, Scitech Publications, Chennai.

Reference Books

1. Abell, Morrison and Wolf, (1987). *Exploration of the Universe*, 5th ed., Saunders College Publ.
2. Carrol and Ostlie, (2007). *Introduction to Modern Astrophysics*, 2nd ed., Pearson International.
3. William J. Kaufmann, III, (1977). *Relativity and Cosmology*, Macmillan Publishing company, London.
4. Abhyankar, K.D., (2001). Astrophysics: Stars and Galaxies, Universities Press.

Semester VI
Skill Enhancement Course
Basic Electrical Circuits and Instruments
Course code: SEP203

Hours/Week	Credits	Total hours	Marks
2	2	30	100

Learning Objectives

1. To acquire knowledge on the basic electrical parameters, circuits and wiring.
2. To understand the concept of electronic devices and to develop basic trouble shooting skills.

Course Outcome

COs	Upon completion of this course, students will be able to	PSO Addressed	Cognitive Level
CO-1	Recall the basic definitions and units of electrical quantities	PSO-1	R
CO-2	Analyze the circuit elements and their connections	PSO-2	An
CO-3	Develop their own circuits using electrical wiring	PSO-5	Ap
CO-4	Compare the Physics concepts behind various electrical instruments and appliances (Voltmeter, Ammeter, Incandescent lamp, fluorescent bulb, Choke and Starter)	PSO-3	Ev
CO-5	Demonstrate uses of tester &Multimeter, LDR, Microphone, loudspeaker, etc.,	PSO-6	U
CO-6	Test for the working of electrical circuits and appliances (music bell, lamp controlled by switch, etc.,)	PSO-5	An

Unit I **15 hrs**

Electrical quantities: Introduction to Electricity - Current - Voltage - Resistance - Ohm's Law - DC Circuit - Series Circuits - Parallel Circuits- AC Voltage – Alternating Current (AC) - Sine Waves - AC vs. DC - Electric Power- Units of Power.

Unit II **I5 hrs**

Basic Electrical Circuits and Components: Symbols of electrical elements - Resistors - Conductors - Inductor – Capacitor and transformer - Single phase and three phase - Star and delta connections - Rules of electric connections - Study of motors and Generators.

Unit III **I 5 hrs**

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 –Earthing - Lamp holders, sockets - Fuse base - Distribution box –Trip switches

Hands on training

a. Uses of tester &Multimeter.

b. A lamp controlled by a switch with fuse circuit and lamp controlled by two switches.

c. Calling bell. (demo)

d. Florescent lamp wiring and testing.

e. Music bell.

f. LDR application.

g. Working of a relay.

h. Microphone – amplifier – Loudspeaker setup.

i. Blinking LED

i. Domestic sensors

Text Book

Course material prepared by the Department of Physics, Holy Cross College (Autonomous), Nagercoil.

Reference Books

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

Self – Learning Course

Physics for Competitive Examination - I (PC20S1)

Credits	Marks
2	100

Learning 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.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	recall the principles of mechanics and conservation laws.	**PSO - 1**	**R**
CO - 2	understand the concept of fluid dynamics.	**PSO - 2**	**U**
CO - 3	categorize different kinds of oscillations.	**PSO - 3**	**An**
CO - 4	examine the various aberrations and geometry involved in optics.	**PSO - 7**	**An**
CO - 5	apply the laws of thermodynamics on heat phenomena.	**PSO - 4**	**Ap**

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 andsimple harmonic motion – Lissajous figures – Damped oscillation – Undamped oscillation - Resonance – Beats – Stationary waves – Vibration of strings and air coloumns – Logitudinal waves in soul 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.

Text Books

1. Nayyar, N.K. (2009).*Unique Quintessence of Physics* (For M.Sc. Entrance Examinations (All Universities) &other Competitive Examinations). New Delhi: Unique Publishers.
2. Daniel Gebresselasie. (2015).*Mechanics, Thermodynamics, Oscillations and Waves*, College Physics I.1st Edition. www.bookboon.com.

Self – Learning Course

Physics for Competitive Examination - II (PC20S2)

Credits	Marks
2	100

Learning 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.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	discuss the principles and generation of electric charges.	PSO - 1	R
CO - 2	classify the different types of magnetic materials.	PSO - 2	U
CO - 3	correlate the mechanisms involved between magnetismand electricity.	PSO - 3	An
CO - 4	discuss the principles behind the phenomena of atomic physics and nuclear reactions.	PSO - 2	An
CO - 5	differentiate metals, conductors and insulators.	PSO - 4	Ap
CO - 6	recognize the elements of microprocessors and computers	PSO - 2	U

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 behavior 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 – Quantization 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

Text Books

1. Nayyar, N.K. (2009). *Unique Quintessence of Physics* (For M.Sc. Entrance Examinations (All Universities) & other Competitive Examinations). New Delhi: Unique Publishers.
2. Griffiths, D.(2008). *Introduction to Elementary Particles*. 2nd Ed. Wiley-Vch.

Local

National

Regional

Global

Holy Cross College (Autonomous), Nagercoil

Nationally Re-Accredited with A+ by NAAC (CGPA 3.35)

Nagercoil, Kanyakumari District, Tamil Nadu,

India.

Affiliated to

Manonmaniam Sundaranar University,

Tirunelveli

DEPARTMENT OF PHYSICS

PG Syllabus

Semesters I, II, III and IV

(With effect from the Academic year 2020– 2021)

DEPARTMENT OF PHYSICS

Vision

Imbibing the spirit of the Holy Cross, the institution envisions a harmonious society by empowering women for global competency and ecological sustainability through holistic approach with innovative skills.

Mission

- To provide quality education and to promote scholarly activities catering to global competencies
- To nurture participatory leadership to enhance social consciousness and social Responsibility
- To uphold ethical values of honesty, personal accountability and transparency through professional commitment
- To create global professionals and entrepreneurs with innovative spirit and zeal
- To create empowered women of competence, commitment and compassion.
- To instill in students the awareness of interconnectedness between man and nature

Programme Educational Objectivities (PEOs)

PEO – 1	The graduates use scientific and computational technology to solve socialissues and pursue research.
PEO– 2	The graduates will continue to learn and advance their careers in industry both in public and private sectors, government and academia.
PEO– 3	The graduates adapt to the evolving technical challenges and changing career opportunities and communicate effectively as an individual and as a team member in professional environment.

Programme Outcomes (POs)

PO	**Upon completion of M.Sc Degree Programme, the graduates will be able to :**
PO – 1	Recognize the scientific facts behind natural phenomena.
PO – 2	Relate the theory and practical knowledge to solve the problems of the society.
PO – 3	Prepare successful professionals in industry, government, academia, research, entrepreneurial pursuits and consulting firms.
PO – 4	Face and succeed in high level competitive examinations like NET, GATE and TOFEL.
PO – 5	Carry out internship programme and research projects to develop scientific skills and innovative ideas.
PO – 6	Utilize the obtained scientific knowledge to create eco– friendly environment.
PO – 7	Prepare expressive, ethical and responsible citizens with proven expertise.

Programme Specific Outcomes (PSOs)

PSO	Upon completion of M.Sc. Degree Programme, the graduates of Physics will be able to :
PSO – 1	Have well– defined knowledge on theoretical concepts and experimental methods of advanced physics. (Classical mechanics, Mathematical physics, Quantum Mechanics, Solid state Physics, Molecular Spectroscopy, Integrated electronics, Astrophysics, Nanophysics, Microprocessor etc.)
PSO – 2	Acquire skills in performing advanced physics experiments and projects using modern technology and numerical simulations.
PSO – 3	Develop and communicate analytical skills ranging from nuclear to cosmology to progress in the expanding frontiers of physics.
PSO – 4	Apply and interpret physics principles in various physical observations.
PSO – 5	Use the techniques, skills, and modern technology necessary to communicate effectively with professional and ethical responsibility.
PSO – 6	Demonstrate proficiency in analyzing, applying and solving scientific problems.
PSO – 7	Understand the impact of Physics in a global, economic, environmental, and societal context.

Eligibility Norms for Admission

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

Duration of the Programme: 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.

1. Degree

The candidates shall have subsequently undergone the prescribed Programme of study in Holy Cross College affiliated to the Manonmaniam Sundaranar University for a period of not less than two academic years comprising four semesters, passed the examinations prescribed and fulfilled such conditions as have been prescribed thereof.

2. Duration

The duration of PG Programme is for a period of two years. Each academic year shall comprise of two semesters, viz. Odd and Even semesters. Odd semester shall be from June to October / November and Even Semester shall be from November / December to April. There shall be not less than 90 working days which shall comprise 450 teaching clock hours for each Semester (excluding the days for the conduct of end– semester examinations).

3. Semesters

In each semester, Courses are offered in 15 teaching weeks and the remaining 5 weeks are to be utilized for the conduct of examinations and evaluation purposes. Each week shall have 30 working hours spread over 5 / 6 days a week.

4. CBCS System

The main feature of the CBCS is to make postgraduate education student centric allowing students to choose inter– disciplinary, intra – disciplinary courses, skill– oriented courses (even from other disciplines according to their learning needs, interests and attitude) with optimal flexibility for students on par with global standards.

In keeping with the spirit of CBCS based on the norms of UGC, the curriculum has been restructured once in every three years since the college was conferred with the autonomous status in 2007– 2008.

A PG student may take up an Internship/ Summer Training Programme relevant to her subject in any reputed institution for a month in order to develop knowledge and skills and equip for career. This programme was included within the curriculum with one credit under curriculum restructuring from 2011– 12.

As per the guidelines from UGC, Community Engagement Course is offered to all the I

PG students with 2 credits for 30 hours with at least 50% field experience.

5. Courses

The following are the various categories of courses offered in the PG programmes:

Arts and Commerce – Core Courses, Elective Courses & Project

Science – Core Courses, Core Practical, Elective Courses & Project.

The college provides all information to students regarding Elective Courses so as to enable them to choose the relevant ones.

Project – Each candidate shall be required to take up an individual or group project (2 members) and submit it at the end of the third semester. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the student in the beginning of the final year. A copy of the project report will be submitted to the Department before the date fixed by the Institution. The Project will be evaluated by an internal and an external examiner nominated by the Controller of Examinations. The candidate concerned will have to defend her Project through a Viva– voce.

6. Life Skill Training I & II – Life Skill Training is offered to the PG students to mould them to responsible individuals. External Examination is conducted at the end of the II & IV Semesters (1 credit each).

Service– Learning Programme (SLP)– Community Engagement Course with two credits for 30 hours with at least 50% in the field, is compulsory for all UG students (2 credits).

Summer Training Programme – 30 hours Programme with one credit and mandatory for all I PG students to undertake at the end of semester II.

7. Credits

Credit refers to the weightage given to a course, usually in relation to the instructional hours assigned to it and a quantum of work a student is required to put in for a particular course. The credits of a Course should be less than the hours allotted to it. The total minimum credits, required for awarding PG Degree is 95.

CBCS for PG Programme

Components	**No. of Courses**	**Credit/Course**	**Total**
Core Courses/Practicals/ Projects	**13– 18**	**4– 5**	**70**
Elective	**4**	**5**	**20**
Life Skill Training	**2**	**1**	**2**
Summer Training Programme (STP)	**1**	**1**	**1**
Service Learning Programme(SLP) – Community Engagement Course	**1**	**2**	**2**
		Total	**95**

8. Pedagogy

Each Course is designed with Lectures / Tutorials / Laboratory or Field Work / Seminar / Practical Training / Assignments or Report Writing/ Book review / Group Discussion/ Flipped / Blended/ Open Book test etc. to meet effective teaching, learning and evaluation requirements.

9. Examination Pattern

i) Major Core / Elective

Internal: External – 40:60

Allotment of Marks for PG Programme

Components	**Marks**	
	Internal	**External**
Core & Elective – Theory	40	60
Practicals	40	60
Project	40	60
Life Skill Training (I & II)	60	40

- Each paper carries an internal component.
- There is a passing minimum for external component.

Internal Component

Component	**Marks**
Continuous Internal Assessment (2)	20
Quiz (2)	4
Class test (2)	4
Seminar	4
GD/Open Book test/ Article Review/ Book Review	4
Online Home Assignment	4
Total	**40**

External Component

Component	**Marks**
Part A: 10 x 1 (Two objective type questions from each unit without any choice).	10
Part B: 5 x 3 (One question from each unit with internal choice. Among the five questions one question should be of application type and another will be of analysis type).	15
Part C: 5 x 7 (One question from each unit with internal choice. Question should cover all cognitive levels as per the Course Outcomes).	35
Total	**60**

Life Skill Training

Internal Components		Marks
Life Skill Training– I	Album (20 pages)	40
	Group Song, Mime, Skit(Group of 5 students)	20
	Total	**60**
Life Skill Training– II	Case Study (30 page)	60
	Total	**60**

SLP – Community Engagement Course (CEC)

(Field Work – 15 hrs; Class Hours – 15 hrs)

Internal Component

Component	**Marks**
Assignment	10
Group Discussion	10
Attendance	30
Total	**50**

External Component

Component	**Marks**
Project Report / Case Study(10– 15 pages in print)	50
Total	**50**

10. Evaluation

i. The performance of a student in each Course is evaluated in terms of percentage of marks with a provision for conversion to grade points.

ii. Evaluation for each Course shall be done by a Continuous Internal Assessment (CIA) by the Course teacher as well as by an end semester examination and will be consolidated at the end of the semester.

iii. There shall be examinations at the end of each semester, for odd semesters in October /November; for even semesters in April / May.

iv. A candidate who does not pass the examination in any course(s) shall be permitted to re– appear in such failed course(s) in the subsequent examinations to be held in October / November or April / May. However, candidates who have arrears in Practical Examination(s) shall be permitted to re– appear for their arrears only along with Regular Practical examinations in the respective semester.

v. Viva– voce: Each candidate shall be required to appear for Viva– voce Examination in defence of the Project.

vi. The results of all the examinations will be published in the College website.

11. Passing Minimum

A minimum of 50% in the external examination and an aggregate of 50% are required.

Passing Minimum		
Continuous Internal Assessment (CIA)		**End Semester Examination (ESE)**
Theory	50% out of 40 marks (i.e. 20 marks)	50% out of 60 marks (i.e. 30 marks)
Practical	50% out of 40 marks (i.e. 20 marks)	50% out of 60 marks (i.e. 30 marks)

12. Conferment of the Master's Degree

A candidate shall be eligible for the conferment of the Degree ofMasterof Arts / Science / Commerce only if the minimum required credits for the programme thereof (95 credits) is earned.

13. Grievance Redressal Committee

The College shall form a Grievance Redressal Committee for each Programme in each Department with the Course Teacher and the HOD as the members. This Committee shall solve all grievances relating to the Internal Assessment of the students. For External Examination, HOD, COE, Class Teacher, Principal and Deans shall be the members of the Committee.

14. Grading System

Calculation of Grade Point Average for End Semester Examination:

GPA = $\frac{\text{Sum of the multiplication of grade points by the credits of the course}}{\text{Sum of the credits of the courses (passed) in a semester}}$

For the entire programme:

CGPA =Cumulative Grade Point Average (CGPA) $\Sigma_n\Sigma_i C_{ni}G_{ni} / \Sigma_{ni}\Sigma_i C_{ni}$

CGPA = $\frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$

Where

C_i – Credits earned for course i in any semester

G_i – Grade point obtained for course i in any semester

n – semester in which such courses were credited

15. Final Result

CGPA	**Corresponding Grade**	**Classification of Final Results**
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
4.00 to 4.99	C	Average
Below 4.00	R.A.	Re– appearance

Credit– based weighted Mark System is adopted for individual semesters and cumulative semesters in the column 'Marks Secured' (for 100).

Components of the M.Sc. Programme

Major	Core– Theory papers	11x100	1100
	Practical (Core Applied)	4x 100	400
Elective	Elective– Theory Papers/ Project	5x 100	500
	Total Marks	**20x100**	**2000**

Course Structure Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Total	
					Hours	Credits
Major Core – Theory	6 (5) + 6 (5) + 6 (5)	6 (5) + 6 (5) + 6 (5)	6 (5) + 6 (5)	6 (5) + 6 (5) + 6 (5)	66	55
Major Core – Practical	6	6 (3+3)	6	6 (3+3)	24	12
Major Elective	6 (4)	6 (5)	6 (4)	6 (5)	24	18
Major Project	–	–	6 (5)		6	5
Total	**30(19)**	**30 (26)**	**30 (19)**	**30 (26)**	**120**	**90**
Non Academic Courses						
Life Skill Training – I	**–**	(1)	–	–	**–**	1
Life Skill Training – II	**–**	–	–	(1)	**–**	1
Service– Learning Programme (SLP) – Community Engagement Course		–	(2)	–	**–**	2
Summer Training Programme	**–**	–	–	(1)	–	1
TOTAL		**(1)**	**(2)**	**(2)**	**–**	**5**

- Non-Academic Courses are mandatory and conducted outside the regular workinghours
- **SLP (Service-Learning Programme) – Community Engagement Course is** conducted outside the regular working hours on Saturdays and holidays, during the II and III Semesters for all the PG students. No. of hours allotted for eachof this

programme is 30 and is supervised by the faculty in charge

- **STP (Summer Training Programme)** (Mandatory Course – 30 hours) will be offered in the second year for all the students.

Courses offered

Semester	Course code	Title of the Course	Hours/ Week	Credits
I	PP2011	Core I – Classical Mechanics	6	5
	PP2012	Core II – Mathematical Physics	6	5
	PP2013	Core III – Quantum Mechanics– I	6	5
	PP2014 PP2015 PP2016	Elective I – (a) Advanced Nuclear Physics (b) Molecular Physics (c) Numerical methods	6	4
	PP20P1	Practical I – Advanced Physics Lab – I (General Physics)	3	–
	PP20P2	Practical II – Advanced Physics Lab – II(Programming with C++)	3	–
	LST201	Life Skill Training (LST) – I	–	–
II	PP2021	Core IV – Electromagnetic Theory	6	5
	PP2022	Core V – Quantum Mechanics– II	6	5
	PP2023	Core VI – Condensed MatterPhysics– I	6	5
	PP2024 PP2025 PP2026	Elective II – (a) Experimental design (b)Introductory Astronomy, Astrophysics & Cosmology (c) Laser Physics	6	5
	PP20P1	Practical I – Advanced Physics Lab – I (General Physics)	3	3
	PP20P2	Practical II – Advanced Physics Lab – II (Programming with C++)	3	3
	LST201	Life Skill Training (LST) – I	–	1

	SLP201	SLP (Service- L e a r n i n g Programme) –	–	–
		Community Engagement Course		
III	PP2031	Core VII – Electronics	6	5
	PP2032	Core VIII – Condensed MatterPhysics– II	6	5
	PP20PR	Project	6	5
	PP2033 PP20 34 PP20 35	Elective III – (a) Biophysics (b) Microprocessor andMicrocontroller (c) Solar Energy Utilization	6	4
	PP20P3	Practical III– Advanced Physics Lab – III (Electronics)	3	–
	PP20P4	Practical IV **–** Advanced Physics Lab – IV(Microprocessor and Micro Controller)	3	–
	LST202	Life Skill Training (LST) – II	–	–
	SLP201	SLP (Service Learning Programme) –Community Engagement Course	–	2
	PP2041	Core IX – Nuclear and Elementary Particle Physics	6	5
	PP2042	Core X – Spectroscopy	6	5
	PP2043	Core XI – Thermodynamics a ndStatistical Mechanics	6	5

IV	PP2044 PP2045 PP2046	Elective IV – (a)MaterialsPhysics and Processing Techniques (b) Advanced Nanophysics (c) X– ray Crystallography	6	5
	PP20P3	Practical III– Advanced Physics Lab – III(Electronics)	3	3
	PP20P4	Practical IV – Advanced Physics Lab – IV(Microprocessor and Micro Controller)	3	3
	LST202	Life Skill Training (LST) – II	–	1
	STP201	Summer Training Programme	–	1
		TOTAL	**120**	**90+5**

Self– Learning Courses– Extra Credit Courses

Semester	**Course Code**	**Title of the Course**	**Credits**
III	PP20S1	Physics for Lectureship Examination – I	2
IV	PP20S2	Physics for Lectureship Examination – II	2
II– IV	–	Online courses (Swayam/NPTL)	2

Question Pattern (Self– Learning Courses)

Internal Test	Marks	External Exam	Marks
Part– A(10x1) (No Choice– simple objective type)	10	Part– A(20x1) (No Choice– simple objective type)	20
Part B (5x2) (No Choice objective type)	10	Part B (10x2) (No Choice objective type)	20
Part C(5x4) (No Choice objective type) Higher order thinking skills	20	Part C(5x4) (No Choice objective type) Higher order thinking skills	20
Total	**40**	**Total**	**60**

Summer Training Program

Semester	Name of the Course	Total hours	Credit
III/IV	Computer Hardware –H20STP	30	1

Internal Component

Component	Marks
Assignment	20
Summer Training Program Attendance	30
Total	**50**

External Component

Course	Summative Examinations	Marks
Summer Training Program	Project report (15– 20 pages print)	**50**
	Total	**50**

Instruction for Course Transaction Theory (Major Core / Elective)

Component	Sem. I	Sem. II	Sem. III	Sem. IV
Lecture hours	70/55	70/55	70/55	70/55
Continuous Internal Assessment (2)	5	5	5	5
Quiz (2)	1	1	1	1
Class Test (2)	2	2	2	2
Seminar	10	10	10	10
Problem solving/Open book test/ Group Discussion	2	2	2	2
Total hours / semester	**90/75**	**90/75**	**90/75**	**90/75**

Practical Hours

Major	Semester	Hours per week	Total Hours / Semester
	I / II / III /IV	6	90

Examination Pattern :

Allotment of Marks for PG Programme Ratio of Internal and External (Core/Elective): 40:60

(a). Major / Elective

Internal: External – 40:60

Components	Allotment of Marks	
	Internal	**External**
Core & Elective Courses Theory Papers	40	60
Practicals	40	60
Project	40	60
Life Skill Training (I & II)	50	50

- Each paper carries an internal component.
- There is a passing minimum for external component.

Internal Component and Distribution of marks

Continuous Internal Assessment

Formative Assessment (FA)	Marks
Internal Test (2)	20
Quiz (2)	4
Class Test (2)	4
GD/Open Book test/ Article Review/ Book Review	4
Seminar	4
Online Home Assignment	4
Total	**40**

Question Pattern (Major / Elective)

Internal Test	Marks	External Exam	Marks
Part A(4x1) (No Choice)	4	Part A(10x1) (No Choice)	10
Part B (5x3) (Internal Choice)	15	Part B (5x3) (Internal Choice)	15
Part C(3x7) (Internal Choice)	21	Part C (5x7) (Internal Choice)	35
Total	**40**	**Total**	**60**

(b) Practical Papers:

Internal – 40 marks (Model exam 15, performance– 10, regularity– 5, submission of record– 10)

External – 60 marks (Marks will be allotted as per the practical syllabus)

(c) Project: Internal – 40 marks & External – 60 marks

Foundation Course

Life Skill Training– I (I Year)

Internal Component

Component	Marks
Album (20 pages)	40
Group Song, Mime, Skit(Groupof 5 students)	20
Total	**60**

External Component

Course	Summative Examinations	Marks
Life Skill Training– I	Questions are of open choice. Students must answer 5 out of 7 questions. Each question carries 8 marks (5x8=40 marks)	**40**
	Total	**40**

Life Skill Training– II (II Year)

Internal Component

Component	**Marks**
Case Study (30 page)	60
Total	**60**

External Component

Course	**Summative Examinations**	**Marks**
Life Skill Training–II	Questions are of open choice. Students must answer out of 7 questions. Each question carries 8 marks (5x8=40 marks)	**40**
	Total	**40**

Community Engagement Programme– SLP Extension Activity (II & III sem)

Courses / Programmes conducted outside the regular working hours on Saturdays and holidays.

No. of hours allotted for each of these programmes is 30 and is supervised by the faculty in charge. Field work : 15 hours; Class hours: 15 hours

Internal Component

Component	**Marks**
Assignment	10
Group Discussion	10
Field work Attendance	30
Total	**50**

External Component

Course	**Summative Examinations**	**Marks**
Community Engagement Programme	Project report/ Case study (10– 15 pages print)	**50**
	Total	**50**

Semester I
Classical Mechanics (Core – I)

Course Code: PP2011

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

Objectives

1. To have in depth knowledge in classical mechanics.
2. To enable students to develop skills in formulating and solving physics problems.
3. To study the kinematics of the rigid body through Euler equation.
4. To get knowledge in central force field and relativity.

CO	Upon completion of this course, students will be able to:	CL
CO – 1	understand the basic mechanical concepts related to single and system of particles.	U
CO – 2	apply various mechanical principles to find solution for physical problems.	Ap
CO – 3	solve the equations of motion using Lagrangian, Hamiltonian and Hamilton– Jacobi equations.	C
CO – 4	explain the origin of coriolis and centrifugal terms in the equation of motion in a rotating frame.	R
CO – 5	understand and develop a scientific knowledge in central force problems and relativity	U

Unit I: Lagrangian Formulation **15 hours**

Lagrangianformulation: System of particles – Constraints and degrees of freedom– Generalized coordinates, Force and Energy – Conservation laws – Conservations of linear and angular momenta– Symmetric properties – Homogeneity and isotropy – D'Alemberts principle of virtual work- Lagrange's equation of motion – non holonomic systems – velocity dependentpotential – Dissipative force – Newtonian and Lagrangian Formalism

Unit II: Hamilton's Equation and Canonical Transformation 15 hours

Calculus of variation – Principle of least action – Hamilton's principle – Hamilton`s function- Lagrange's equation from Hamilton's principle – Hamilton's principle for non-holonomic system – Variational principle – Hamilton's equations from variational principle – Legend retransformation Hamilton's equation of motion – Canonical transformations– Hamilton's canonical equations Generating functions– Examples – Poisson brackets and its properties.

Unit III: Hamilton– Jacobi Theory and Small Oscillations 15 hours Hamilton–Jacobi equation for Hamilton's principle function – Example: Harmonic oscillator problem – Hamilton's characteristic function – Action – Angle variable – Application to Kepler problem in action angle variables. Eigen value equation – Normal coordinates – Normal frequencies of vibration – Free Vibrations of linear tri atomic molecule.

Unit IV: Kinematics of Rigid Body 15 hours

Independent coordinates of rigid body – Orthogonal transformation – Properties of transformation matrix – Euler angle and Euler's theorem – Infinitesimal rotation – Coriolis force – Angular momentum and kinetic energy of motion about a point – Moment of inertia tensor – Euler's equations of motion – Force free motion of a symmetrical top – Heavy symmetrical top with one point fixed

Unit V: Central Force Problem and Theory of Relativity 15 hours Reduction to the equivalent one body problem– Centre of mass– Equation of motion and first integral– classification of orbits – Kepler problem: Inverse– Square law of force – Scattering in a central force field – Transformation of scattering to laboratory coordinates. Virial theorem – Lorentz transformation – Relativistic Mechanics – Relativistic Lagrangian and Hamiltonian for a particle – Mass in Relativity – Mass and energy – Space– time diagram – Momentum vectors

Skill Development

1. Making the students to go for industrial visit on Priyadharshini Planetarium, TVM and also the scientific centre, Bangalore, so that they are able to create skills in Mechanics.
2. By applying the Lagrangian, Hamilton and Hamilton– Jacobi equations, the students are able to solve the equations of motion.

Books for Study

1. Classical Mechanics – H. Goldstein, C. Poole and J. Safko, Pearson Education in SouthAsia, New Delhi, Third Edition, 2007.
2. Classical Mechanics – G. Aruldhas, PHI Learning Private Limited, New Delhi, 2009.

Books for Reference

1. Classical Mechanics – S. L. Gutpa, V. Kumar and H.V. Sharma, Pragati Prakashan, Meerut, 2016.
2. Classical Mechanics of Particles and Rigid Bodies – K.C. Gupta, New Age International Publishers, New Delhi, Third Edition, 2018.
3. Classical Mechanics – N. C. Rana and P. J. Joag, Tata Mc– Graw Hill Publishing Company Limited, New Delhi, 2004.
4. Classical Mechanics – J. C. Upadhaya, Himalaya Publishing House Pvt. Ltd, Bangalore, Second Edition, 2017.
5. Classical Mechanics, B. D. Gupta and Satya Prakash, Keder Nath Publishers, Meerut, Revised Edition, 2015.
6. Introduction to Classical Mechanics, R. G. Takwale and P. S. Puranik, Tata Mc Graw Hill, New Delhi, 1989.

Mathematical Physics (Core – II)

Course Code: PP2012

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

Objectives

1. To emphasize the use of mathematical tools like evaluation of definite integrals in the field of classical and quantum mechanics.
2. To demonstrate competence with a wide variety of mathematical techniques to enhance problem solving skills.

CO	Upon completion of this course, students will be able to:	CL
CO – 1	apply the various theorems in complex analysis to evaluate definite integrals.	E
CO – 2	determine the series solutions and the recurrence relations (Bessel, Legendre and Hermite differential equations) and solve problems associated with them.	E
CO – 3	discuss the basic principles and methods used for the analysis of partial differential equations and apply the techniques to related problems.	C
CO – 4	discuss the concepts of Fourier, Laplace and inverse Laplace transform, tensors, group theory and their properties.	C
CO – 5	develop expertise in mathematical techniques required inphysics and to enhance problem solving skills.	An

Unit I: Complex Analysis **15 hours**

Functions of Complex variable- Analytic functions – Cauchy – Riemann equations in cartesian and polar forms – Harmonic functions - Cauchy's integral theorem – Cauchy's integral formula – Taylor's Series – Laurent 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 **15 hours**

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: Differential and Partial Differential equations **15 hours**

Homogeneous linear equations of second order with constant coefficients and their solutions – ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods

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.

Unit IV: Tensors, Fourier and Laplace transforms **15 hours**

Contravariant 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-Inverse Laplace Transform.

Unit V: Group theory **15 hours**

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.

Skill Development

1. Solving the problems of Physics using mathematical principles and operations.
2. Applying the principles of linear differential equations which play an important role in theoretical physics in connection with mechanical vibrations, electric circuits and networks.

Books for Study

1. Satya Prakash, Mathematical Physics, New Delhi: S. Chand & Sons Company Pvt. Ltd, (4^{th} ed.) (2005).
2. Joshi A.W. Matrices and Tensors for Physicists, New Age International Publishers Limited, (1995).
3. H.K. Dass, Mathematical Physics, (1997), S. Chand & Company Pvt. Ltd, I edition.
4. Pipes Harwell, Mathematics for Physicists and Engineers. Mc Graw Hill International Book Company, (1976).

Books for Reference

1. Eugene Butkov, Mathematical Physics. New York, NY: Addison Wesley Publishing, (1978).
2. Courant, D. Hilbert. Methods of Mathematical Physics. New Delhi: Wiley Eastern Limited, (1978).
3. Arfken, Weber. Mathematical Methods for Physicists. (5^{th} ed.) San Diego. Elsevier Academic press, (2001).
4. B. S. Rajput, Mathematical Physics, 20^{th} Edition, Pragati Prakashan, 2008.
5. Group Theory – Chemical applications of Group Theory, F. Albert cotton, (1990), John Wiley & sons Ltd, 3^{rd} edition

Quantum Mechanics– I (Core – III)

Coursecode: PP2013

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

Objective

To help the students to acquire understanding of the fundamental concepts and mathematical tools necessary to solve the wave equations.

CO	Upon completion of this course, students will be able to:	CL
CO – 1	summarize the concept of wave function and the postulates of quantum mechanics.	U
CO – 2	formulate time dependent and time independent equation and solve them for simple potentials.	C
CO – 3	evaluate the eigen values and eigen function spin and total angular momenta and determine the matrices.	E
CO – 4	analyze the principles of quantum theory, equation of motion, scattering theory and angular momentum.	An

Unit– I: Foundations of Wave Mechanics 15hours

Wave packet – Time dependent Schrödinger equation – Interpretation of the wave function – – Admissibility conditions on the wave function – Hermitian operator – Postulates of quantum mechanics – Simultaneous measurability of observables – General uncertainty relation – Ehrenfest's theorem.

Unit– II: Eigen States and Many Electron Atoms 15 hours

Square– well Potential with Rigid Walls– Square Potential Barrier –Alpha Emision– Time independent Schrodinger equation – Time dependent Schrödinger equation – Stationarystates – Eigen functions and eigen values– Kronig Penny square well periodic potential – Indistinguishable Particles– Particle Exchange Operator– Symmetric and Antisymmetric Wave Functions– Pauli Principle – Inclusion of spin

Unit– III: Exactly Soluble Eigenvalue Problems 15 hours

Onedimensional linear harmonic oscillator – operator method – Particle moving in a spherically symmetric potential – Spherical harmonics– Radial equation– Rigid rotator– Hydrogen atom– solution of the radial equation – Energy eigen values– Radial wavefunctions– Wave functions of hydrogen– like atom– Radial Probability density–ThreeDimensional square– well potential.

Unit– IV: 15 hours

Matrix Formulation of Quantum Theory, Equation of Motion & Angular Momentum

Linear vector space– Dirac's notation– Equation of motions– Schrodinger, Heisenberg and Interaction representation. Angular momentum operators – Angular momentum commutation relations – Eigen values and eigen functions of L2 and Lz– General angular momentum – Eigen values of J2 and Jz– Angular momentum matrices – Spin angular momentum – Spin vectors for spin– (1/2) System –Addition of angular momentum : ClebschGordon coefficients – Stern Gerlach Experiment.

Unit– V: Scattering Theory 15 hours

Scatteringcross– section – Scattering amplitude – Partial waves – Scattering by a central potential:Asymptotic solution– Optical theorem– Ramsauer– Townsend effect–Partial wave analysis – Scattering by an attractive square– well potential – Breit– Wigner Formula– Scattering length – Expression for phase shifts – Integral equation – The Born approximation Scattering by screened coulomb potential – Validity of Born approximation.

Skill Development

1. Solve the time– independent Schrodinger equation for a three dimensional harmonic oscillator.
2. For the ground state of the hydrogen atom, evaluate the expectation value of the radius vector r of the electron.
3. Estimate the Einstein B coefficient for the n=2, l=1, m=0 to n=l, l=0, m=0 transition in the hydrogen atom.

Books for Study

1. A Text book of Quantum Mechanics – G. Aruldhas, Prentice Hall of India Pvt., Ltd., 2019.
2. A Text book of Quantum Mechanics – P. M. Mathews and K. Venkatesan, Tata McGraw – Hill Publications, Second Edition, 2010.

Books for Reference

1. Quantum Mechanics – Theory and applications – A. K. Ghatak and Lokanathan, Macmillan India Ltd Publication, Fifth Edition, 2015.
2. Quantum Mechanics – Satya Prakash, Kedar Nath Ram Nath and Co. Publications, 2018.
3. Quantum Mechanics – V. K. Thankappan, New Age International (P) Ltd. Publication, Second Edition, 2003.
4. Quantum Mechanics – E. Merzbacher, John Wiley Interscience Publications, Third Edition, 2011.
5. Quantum Mechanics – Quantum Mechanics: Concept and applications, Nouredine Zettili, John Wiley & sons Ltd, 2nd edition, 2009.

semester-I

Advanced Nuclear Physics (Elective – I)

Course code: PP2014

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

Objectives

1. To impart fundamental aspects of nuclear physics to the students.
2. To elaborate the idea on theory, production and nuclear reactions
3. To obtain vast knowledge in nuclear energy impacts

CO	Upon completion of the course, students will be able to:	CL
CO– 1	Understand the basic knowledge on nuclei and neutron to know other factors like properties and scattering	U
CO– 2	Examine the neutron interactions to formulate probability, Diffusion, Fermi– age equations	E
CO– 3	Analyse the working of nuclear reactors and its reaction to produce nuclear energy	An
CO– 4	Study the nuclear fusion reaction and apply its principle for stellar energy	Ap

UNIT– I: Methods Of Investigating Nuclear Size **15 Hours**

Classification of nuclei, nuclear size – methods to investigate nuclear size – Mesonic X– rays, Electron scattering, Coulomb energies of mirror nuclei, neutron scattering methods

UNIT– II: Discovery And Properties Of Neutron **15 Hours**

Discovery of neutron, fundamental properties of neutron, neutron sources, – radioactive sources, Photo– neutron sources, accelerated particle sources – Detection of neutrons – General principles, slow neutron detectors by foil activation method, detection of fast neutrons by scintillation counter.

UNIT– III: Classification And Interaction Of Neutron 15 Hours

Classification of neutrons according to energy, Neutron –electron interactions, slowing down of fast neutrons, slowing down time, slowing down density, resonance escape probability, neutron diffusion– solution to diffusion equation, diffusion of fast neutrons– Fermi– age equation

UNIT– IV: Reactor Physics 15 Hours

Condition of criticality of nuclear reactor, the critical equation and buckling, critical reactor dimensions, criticality of large thermal reactors– migration length, the reflector reactor, continuum theory of nuclear reactions, optical model theory of nuclear reactions, photonuclear reactions.

UNIT– V: Nuclear Fusion: Thermonuclear Energy 15 Hours

Nuclear fusion, the fusion reaction, thermonuclear reactions, sources of stellar energy, controlled thermonuclear reactions, the possibility of fusion reactor, cold fusion and transuranic elements.

Skill Development

1. Solving all types of problems of Nuclear and Particle Physics.
2. Exhibit a model on nuclear reactions.
3. Summer Internship Program and Industrial visit.

Books for Study

1. M. L. Pandya (1995), R.P.S Yadhav, Kedharnath, Ramnath, Elements of nuclear Physics, Meerut.
2. Robley D. Evans, (1982) ,The atomic nucleus, TMH, New Delhi.
3. Irving Kaplan, (1989), Nuclear Physics, Narosha Publishers, New Delhi.
4. V. Devanathan, Nuclear Physics, Narosa Publishing House, New Delhi.
5. A.B Gupta, Modern Atomic and Nuclear Physics, Books and Allied Limited, Kolkata.

Books for Reference

1. Tayal.D.C, (1982), Nuclear physics, Fourth edition, Mumbai, Himalaya Publishing House
2. Roy. R.R and Nigam.B. P, (1983), Nuclear Physics I edition, USA, New Age International Ltd.
3. Sathyaprakash (2005) Nuclear physics and Particle Physics, Sultan Chand and Sons, New Delhi.

Semester - I

Molecular Physics (Elective – I(b)

Course Code: PP2015

Hours / Week	No. of credits	Total No. of hours	Marks
6	4	90	100

Objectives

1. Providing the fundamental knowledge on the structure and dynamics of the molecules through various theories
2. Studying the relation between molecular interactions and properties
3. Providing phenomenological theories on reaction dynamics and transport properties

Course Outcome

CO	Upon completion of the course, students will be able to:	CL
CO – 1	understand the chemical bonding of molecules and various theories of homo and hetero nuclear diatomic molecules	U
CO – 2	analyze the symmetry operations and molecular orbital theory	An
CO – 3	analyse the electronic properties of molecules, Newtonian and Hamiltonian dynamics and Phase space trajectories	An
CO – 4	understand the molecular collisions and different energies caused by reactive collisions	U
CO – 5	evaluate the transport of electron and the formation of electronic bands and spectra.	E

Unit I: Molecular Structure and Bonding **15 hours**

Chemical bonding – The VSEPR model – Valence bond theory – The hydrogen molecule – Homonuclear diatomic molecules – Polyatomic molecules – Molecular orbital theory – Homonuclear diatomic molecules – Heteronuclear diatomic molecules – Bond properties – Polyatomic molecules – Molecular shape in terms of molecular orbitals – Molecular structure, properties and conformations

Unit II: Molecular Symmetry **15 hours**

Symmetry elements and operations – The symmetry classification of molecules – Some immediate consequences of symmetry – Applications to molecular orbital theory – Character tables and symmetry labels – Vanishing integrals and orbital overlap – Vanishing integrals and selection rule

Unit III: Molecular Interactions and Mechanics **15 hours**

Electric properties of molecules – Electric dipole moments – Polarizabilities – Relative permittivity's – Interactions between dipoles – Repulsive and total interactions – Molecular interactions in gases – Potential energy (force field) in molecular mechanics – Various energy terms in force field – Newtonian and Hamiltonian dynamics – Phase space trajectories

Unit IV: Molecular Reaction Dynamics **15 hours**

Collision theory – Diffusion controlled reactions – Reactive collisions – Potential energy surfaces – Transition state theory – The Eyring equation – Thermodynamic aspects – Microscopic–macroscopic connection – Zero– point Vibrational energy – Molecular electronic, rotational, Vibrational and translational partition functions

Unit V: Electron Transfer, Electronic Structure and Spectra **15 hours** The rates of electron transfer processes – Theory of electron transfer processes – Crystal– field theory – Ligand– field theory – Electronic spectra of atoms – Electronic spectra of complexes – Charge– transfer bands – Selection rules and intensities – Luminescence

Skill Development

1. Making a model on chemical bonding of molecular structure
2. Prepare a chart for electron transfer processes

Books for Study

1. P. Atkins and J. Depaula, Physical chemistry, (2009), Oxford University Press.
2. P. Atkins, T. Overton, J. Rourke and M. Weller, Inorganic chemistry, (2009), Oxford University Press.
3. Christopher J. Cramer John, Essential of Computational Chemistry – Theories and Models, (2004), Wiley & Sons, 2nd Edition.

Books for Reference

1. Walter S. Struve, Fundamentals of Molecular Spectroscopy, (1989), A– Wile – Interscience Publication.
2. Jann Lanne, Frontiers of Molecular Spectroscopy, (2009), Elsevier.

Semester - I
Numerical Methods (Elective – I(c)

Course code: PP2016

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

Objective

To understand various numerical methods used to solve the physical problems.

CO	Upon completion of this course the students will be able to :	CL
CO– 1	apply various interpolation methods and finite difference concepts	Ap
CO– 2	analyze the numerical solutions of linear and non linear equations	An
CO– 3	utilize various numerical methods for differentiation and integration	Ap
CO – 4	solve ordinary differential equations whenever and wherever routine methods are not applicable	C

Unit– I : Interpolation **15 Hours**

Introduction, Polynomial Forms, Linear interpolation, Lagrange Interpolation Polynomial, Newton Interpolation Polynomial, Divided difference table, Interpolation with equidistance points, Spline interpolation

Unit– II : Roots Of Nonlinear Equations **15 Hours**

Introduction, Methods of Solution, Iterative Methods, Starting and Stopping and Iterative Process, evaluation of Polynomials, Bisection method, False Position Method, Newton–Raphson Method, Secant Method, Fixed Point Method, Determining All Possible Roots.

Unit– III: Solutions of Linear Equations **15 Hours**

Need and Scope, Existence of Solutions, Solution by Elimination, Basic Gauss Elimination Method, Gauss Elimination with Pivoting, Gauss– Jordan Method, Triangular Factorization Methods, Round– off Errors and Refinement, Ill– Conditioned Systems, Matrix Inversion Method, Jacobi Iteration Method, Gauss Seidel Method.

Unit– IV: Numerical Differentiation and Integration **15 Hours**

Numerical Differentiation: Need and Scope, differentiating continuous functions, Differentiating tabulated functions, Difference tables, Numerical Integration: Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Higher Order Rules.

Unit– V : Numerical Solutions of Ordinary Differential Equations 15 Hours

Need and Scope, Tailor Series Method – Improving accuracy, Picard's method, Euler's Method – accuracy of Euler's method, Heun's Method – Error analysis, Polygon Method, Runge– Kutta Methods– Determination of weights, Fourth order Runge– Kutta methods.

Skill Development

1. Solve radioactive decay problem using Newton Raphson Method
2. Find the velocity and acceleration of a rocket using numerical differentiation method
3. Analyze the current in various branches of Wheatstone's bridge using Gauss elimination method

Books for Study

1. Sastry, S.S. (2009). Introductory Methods of Numerical Analysis. (3rd ed.) Prentice Hall of India Ltd.
2. Numerical Methods, R. K. Jain, S. R. K. Iyengar, (2012), New Age International (P) Ltd, 3rd edition
3. Numerical Methods, E. Balagurusamy (1999), Tata McGraw– Hill, India

Books for Reference

1. Numerical Methods for Engineers, Steven C. Chapra and Raymond P. Canale, (1990, McGraw Hill International editions, 2nd edtion)
2. Raja Raman, V. (2003). Computer Oriented Numerical Methods . Prentice Hall of India Ltd.
3. Xavier, C. (1996). Fortran 77 and Numerical Methods. New Age International Ltd.

Semester – II
Electromagnetic Theory (Core – IV)
Course code: PP2021

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

Objectives

1. To provide knowledge on the propagation of electromagnetic radiation
2. To develop theoretical knowledge, skills on solving analytical problems in electromagnetism.

CO	Upon completion of this course, students will be able to	PSO addressed	CL
CO – 1	summarize the fundamental laws of electrodynamics based on Maxwell's equations.	PSO – 1	U
CO – 2	enumerate the concept of energy in electrostatic and magnetostatic fields.	PSO – 2	K
CO – 3	illustrate the electrical properties of materials; solve the wave equation as plane waves in source.	PSO – 5	Ap
CO – 4	analyze the wave polarization and reflection/transmission of plane waves in homogenous media.	PSO – 4	An

Unit – I: Electrostatics **15 hours**

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

Unit– II: Magnetostatics **15 hours**

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

Unit– III: Electromotive Force 15 hours

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

Unit– IV: Electromagnetic Waves 15 hours

The wave equation for E and B – Monochromatic Plan waves – energy and momentum in electromagnetic waves – electromagnetic waves in matters –TE waves in rectangular wave guides – the co– axial transmission line. Potentials: potentials and fields – scalar and vector potentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form.

Unit– V: Application of Electromagnetic Waves 15 hours

Boundary conditions at the surface of discontinuity – Reflection and refraction of E.M waves at the interface of non – Conducting media – Kinematic and dynamic properties – Fresnel's equation – Electric field vector 'E' parallel to the plane of incidence and perpendicular to the plane of incidence – Reflection and transmission co– efficients at the interface between two non–Conducting media – Brewster's law and degree of polarization – Total internal reflection.

Skill Development

1. Make a model, displaying the applications of electromagnetism in day– to– day life.
   Use various mathematical tools to solve Maxwell's equation in problems of wave propagation and radiation.
2. Apply the concept of electromagnetism to study the magnetic susceptibility of paramagnetic substance in the form of a liquid.

Book for Study

1. Introduction to Electrodynamics – David J. Griffiths, 4th Edition, Cambridge University Press, 2017.

Books for Reference

1. Electromagnetic Field Theory – K.A. Gangadhar, P. M. Ramanathan, Khanna Publishers. 2009.
2. Electromagnetic Theory and Electrodynamics, SathyaPrakash, KedarNath RamNath and Co, 2017.
3. Electromagnetics, B.B Laud, Wiley Eastern Company, 2000.
4. Basic Electromagnetics with Application, Narayana rao, (EEE) Prentice Hall, 1997.
5. Fundamentals of Electromagnetic Theory, Third edition, Narosa Publishing House, New Delhi
6. John R.Reitz, Frederick J Milford and Robert W.Christy, 1998.
7. Electromagnetics, B.B Laud, Wiley Eastern Company, 2000.

Semester – II
Quantum Mechanics – II (Core –V)
Course code: PP2022

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

Objective

To develop several approximation methods, for bounds states and scattering states and apply them to illustrative problems.

CO	Upon completion of this course, students will be able to:	CL
CO – 1	enumerate time independent perturbation theory and use approximation methods. (variation principle and WKB method) to solve simple problems (ground state helium, barrier penetration, etc)	K
CO – 2	analyze time dependent perturbation theory to discuss absorption and emission of radiation for harmonic perturbation.	An
CO – 3	nterpret quantum theory of atomic and molecular structure.	U
CO – 4	formulate Klein– Gordan and Dirac equations and discuss the applications. (particle in a Coulomb field, Spin of electron)	C

Unit– I: Approximation Methods for Time Independent Problems 15 hours Time independent perturbation theory: Basic concepts – Non– degenerate energy levels – first and second order – Anharmonic oscillator – First– order correction – Ground state of Helium– Effect of electric field on the ground state and n=2 of hydrogen– Degenerate Energy Levels– Stark effect in hydrogen molecule– Spin– Orbit interaction.

Unit– II: Approximation Methods for Time Dependent Perturbation Theory 15 hours

Time dependent perturbation theory: First order perturbation – Harmonic perturbation – Transition to continuum states – Fermi Golden Rule – Absorption and Emission of radiation – The Electromagnetic field– Hamiltonian operator– Electric dipole approximation– transition probability– Einstein's A and B coefficients – Selection rules– forbidden transitions.

Unit– III: Variation and WKB Method **15 hours**

Variation method :Variational principle – Ground state of Helium and Deuteron– WKB Approximation : WKB method – Connection formula – Solution near a turning point – Validity of the WKB method – Barrier penetration – Alpha emission– Bound states in a potential well.

Unit–IV: Quantum Theory of Atomic and Molecular Structure 15 hours Spin functions – Helium atom– Ground state– First excited state– Central field approximation: – Determination of central field: Thomas Fermi method– Hartree– Fock approximations –

Molecular Orbital method–

Born– Oppenheimer approximation – MO treatment of hydrogen molecule Ion (H_2^+) – Molecular orbital theory of Hydrogen molecule.

Unit– V: Relativistic Quantum Mechanics & Quantization of the Field 15 hours

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. Quantization of the Field – Lagrangian equation–Hamiltonian equation– Schrodinger equation– Quantization of Electromagnetic fields

Books for Study

1. A Text book of Quantum Mechanics – G. Aruldhas, Prentice Hall of India Pvt., Ltd., 2019.
2. A Text book of Quantum Mechanics – P. M. Mathews and K. Venkatesan, Tata McGraw – Hill Publications, Second Edition, 2010.

Books for Reference

1. . Quantum Mechanics – Satya Prakash, Kedar Nath Ram Nath and Co. Publications, 2018.
2. Quantum Mechanics V. K. Thankappan, New Age International (P) Ltd. Publication, Second Edition, 2003.
3. Quantum mechanics – Franz Schwabl, Narosa Publications, Fourth Edition, 2007.
4. Molecular Quantum mechanics – P.W.Atkins and R.S. Friedman,, Oxford University Press publication, Fifth Edition, 2010.
5. Quantum Mechanics – Theory and Applications, A. K. Ghatak and Lokanathan, Macmillan India Ltd Publication, Fifth Edition, 2015.
6. 6.Quantum Mechanics – Quantum Mechanics: Concept and applications, Nouredine Zettili, 2009, John Wiley & sons Ltd, 2nd edition.

Condensed Matter Physics– I (Core –VI)

Course code: PP2023

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

Objective

To give strong foundation in the conceptual understanding of the development of solid state physics with appropriate theoretical background.

CO	Upon completion of this course the students will be able to :	CL
CO– 1	differentiate between different lattice types and explain the concepts of reciprocal lattice and crystal diffraction	U
CO– 2	analyze various crystal imperfections and ordered phases of crystal	An
CO– 3	explain the theory of lattice vibrations and analyze the thermal properties of solids	An
CO – 4	formulate the problem of electrons in a periodic potential	Ap

Unit– I: Crystal Physics: Crystal Structure 15 hours

Lattice representation – Simple symmetry operations – Bravais Lattices, Unit cell, Wigner Seitz cell – Miller planes and spacing – Characteristics of cubic cells – Structural features of NaCl, CsCl, Diamond, ZnS – Close packing.

Crystal Binding*:* Interactions in inert gas crystals and cohesive energy – Lennard – Jones potential – Interactions in ionic crystals and Madelung energy – Covalent bonding – Heitler – London Theory – Hydrogen bonding – metallic bonding.

Unit– II: Diffraction of Waves and Particles by Crystals 15 hours

X– rays and their generation – Moseley's law – Absorption of X– rays (Classical theory) – Absorption Edge – X– ray diffraction – The Laue equations – Equivalence of Bragg and Laue equations – Interpretation of Bragg equation – Ewald construction – Reciprocal lattice – Reciprocal lattice to SC, BCC and FCC crystals– Importance properties of the Reciprocal lattice – Diffraction Intensity – The Powder method – Powder Diffractometer – The Laue method – The Rotating Crystal method – Neutron Diffraction – Electron diffraction.

Unit– III: Crystal Imperfections And Ordered Phases Of Matter 15 hour

sPoint imperfections – Concentrations of Vacancy, Frenkel and Schottky imperfections – Line Imperfections – Burgers Vector – Presence of dislocation – surface imperfections– Polorans Excitons. Ordered phases of matter: Translational and orientation order – Kinds of liquid crystalline order – Quasi crystals – Superfluidity.

Unit– IV: Lattice Dynamics 15 hours

Theory of elastic vibrations in mono and diatomic lattices – Phonons – Dispersion relations – Phonon momentum. Heat Capacity: Specific heat capacity of solids – Dulong and Petit's law Vibrational modes– Einstein model – Density of modes in one and three dimensions – Debye Model of heat capacity. Anharmonic Effects: Explanation for Thermal expansion, Conductivity and resistivity – Umklapp process.

Unit– V: Theory of Electrons 15 hours

Energy levels and Fermi– Darac distribution for a free electron gas – Periodic boundary condition and free electron gas in three dimensions – Heat capacity of the electron gas – Ohm's law, Matthiessen's rule – Hall effect and magnetoresistance – Wiedemann – Franz law. Nearly free electron model and the origin and magnitude of energy gap – Bloch functions – Bloch theorem – Motion of an electron in a periodic potential – Kronig – Penney model – Approximate solution near a zone boundary –Metals, semiconductors and insulators

Skill Development

1. Calculate lattice parameters and crystal structure of a material using the given data
2. Display various models of crystal systems
3. Draw the band structure of a material using the given data

Books for Study

1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Wiley India Pvt. Ltd. , New Delhi, 2005.
2. Rita John, Solid State Physics, Tata Mc Graw Hill Publications, 2014.
3. M. A. Wahab, Solid State Physics – Structure and Properties of Materials. Narosa, New Delhi, 1999.
4. J.D. Patterson, B.C. Bailey Solid– State Physics: Introduction to the Theory, Springer Publications, 2007.
5. M. Ali Omar, Elementary Solid State Physics – Principles and Applications, Pearson, 1999.

Books for Reference

1. J. Blakemore, Solid State Physics, 2nd Edition, W. B. Saunders Co, Philadelphia, 1974.
2. C. M. Kachhava, Solid State Physics, Tata Mcgraw Hill, New Delhi, 1990.
3. N. W. Aschroft and N. D., Mermin, Solid State Physics, Rhinehart and Winton, New York. 1976.
4. M. Tinkham, Introduction to Superconductivity, Tata Mcgraw Hill, New Delhi, 1996.

Semester – II

Experimental Design (Elective –II (a))

Course code: PP2024

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

Objectives

1. To enhance comprehension capabilities of students through understanding of electronic devices.
2. To understand the physical construction, working and operational characteristics of semiconductor devices.

CO	Upon completion of the course, students will be able to:	CL
CO– 1	understand the principle and working of transducers	U
CO– 2	examine the measurement systems and errors in it	E
CO– 3	analyse the X ray measurements and to find TEM, SEM, EDS, FESEM, AFM, UV Vis, IR, FTIR characterizations	An
CO– 5	get an introduction and idea on optical fibres	U

Unit– I:

Measurements, Measurement Systems and Error in Measurements 15 hours Measurements: Measurement and its significance; Methods of Measurements – Direct andIndirect methods; Instruments– Mechanical, Electrical and Electronic Instruments;Classification of instruments – Deflection and Null type instruments. Noise in Measurements*:* Signal to Noise ratio; Sources of Noise, Johnson noise, Power Spectrum Density, Noise Factor and Noise Figure. Error in Measurements*:* Gross Errors, Systematic Errors and Random Errors; Statistical Treatment of Data – Arithmetic Mean, Dispersion from the Mean, Rang, Deviation, Average Deviation, Standard Deviation and Variance.

Unit– II: Transducer and their Classification 15 hours

Transducer: Electric Transducer and its Advantages; Classification of Transducer – Principle of Transduction, Primary and Secondary, Active and Passive, Analog and Digital, Transducer and Inverse Transducer; Characteristics and Choice of Transducer – Input, Transfer and Output; Principle, Construction, Working, Advantages and Disadvantages of the following Transducer's: Resistive, Stain Gauges, Resistance Thermometers, Thermistors, Thermocouple, LVDT, Capacitive and Piezo– electric Transducers; Opto– Electronic Transducers – Photo– Voltaic cell, Photo– Conductive cell, Photo– Diodes and Photo– Transistors.

Unit– III: Opto– Electronic Instruments **15 hours**

Introduction of Optical Systems: Refraction, Refractive index, Reflection, Absorption, Transmittance, Radiometry and Photometry; Terms relating to Radiometry and Photometry; Laws of Illumination; Optical Sources and Detectors; Optical Fibers – Principle, Acceptance angle and Numerical Aperture; Fiber Optic Sensor – Factors affect and Advantages.

Unit– IV: Vacuum Techniques and X – Ray Measurements **15 hours**

Vacuum Techniques: Units of Pressure Measurement, Characteristics of Vacuum and its Application; Vacuum Systems – Pump– down sequence, Construction, Vacuum Pumps and Vacuum Gauges; Pumping Speed for a Vacuum System; Thin Film Deposition Techniques(Principle, Construction, Working, Advantages and Disadvantages): Thermal Evaporation, Sputtering, Spray Pyrolysis, Chemical Vapour Deposition, Molecular Beam Epitaxy; Film Thickness Monitors and Film Thickness Measurements; X – Ray Measurements: The Electronic Structure of Atoms, Multi– Electron Atoms, X – Ray Fluorescence, Fine Structure, Absorption and Emission Processes

Unit– V: **15 hours**

Characterization of Materials and Radiation Detection

Electron Microscopes: Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Electron Microprobe Analysis(EDS), Field Emission Scanning Electron Microscopy(FESEM), Atomic Force Microscope(AFM); Spectroscopy: UV– Vis Spectroscopy, Infra– red Spectroscopy, Fourier Transform Spectroscopy, Raman Spectroscopy, Auger Electron Spectroscopy. Radiation Detection: Principle and Types.

Skill Development

1. Demonstration on SEM, TEM FESEM to understand the characterization techniques lively.
2. Industrial visit to Regional Research Lab (RRL), Thiruvananthapuram.

Book for Study

1. Measurement, Instrumentation and Experiment Deign in Physics and Engineering – Michael Sayer and Abhai Mansingh – PHI (2005).

Books for Reference

1. A Course in Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney and Puneet Sawhney – Dhanpat Rai & Sons (1995).
2. Characterization of Materials – P. K. Mitra – PHI (2014).

Semester – II

Introductory Astronomy, Astrophysics & Cosmology (Elective – II b)

Course Code: PP2025

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

Objective

To give strong origin in the historical evolution of Universe and principles of physics in the formation of astronomical objects like stars and planets with appropriate cosmological background.

CO	Upon completion of this course, students will be able to:	CL
CO – 1	perceive the historical evolution of solar system and universe.	E
CO – 2	describe the principles of physics in the formation of astronomical objects like planets, satellites, asteroids and comets.	U
CO – 3	gain experience with measurement techniques and equipment and develop the ability to assess uncertainties and assumptions.	An
CO – 4	interpret the observations of galaxies, dark matter, quasars and pulsars.	Ap
CO – 5	achieve a good understanding of physical laws and principles in cosmology.	C

Unit I : History of Astronomy **15 hours**

Introductory History of Astronomy– Ptolemy's Geocentric Universe– Copernicus' Heliocentric Universe– Tycho Brahe and Galileo's Observations– Kepler's Laws of Planetary Motion– Newtonian Concept Of Gravity– Highlights of Einstein's Special and General Theory Of Relativity– Curved Space Time– Evidence of Curved Space Time– Bending Of Light– Time Dilation

Unit II : Stars & Galaxies **15 hours**

Stars and Galaxies– Distances– Trigonometric Parallax– Inverse Square Law– Magnitude of Stars– Apparent Magnitude– Absolute Magnitude and Luminosity– Color and TemperatureComposition of Stars– Velocity, Mass and Sizes of Stars– Types of Stars– Temperature Dependence– Spectral Types– Hertzsprung– Russell (HR) Diagram– Spectroscopic Parallax

Unit III : Lives And Death of Stars 15 hours

Stellar Evolution– Mass Dependence– Giant Molecular Cloud– Protostar– Main Sequence StarSubgiant, Red Giant, Supergiant– Core Fusion– Red Giant (Or) Supergiant– Planetary Nebula(Or) Supernova– White Dwarfs– Novae And Supernovae– Neutron Stars– Pulsars– Black Holes– Detecting Black Holes– The Sun– Its Size and Composition– Sun‟s Interior ZonesSun‟sSurface– Photosphere– Chromosphere– Corona– Sun's Power Source– Fusion Reaction Mechanism.

Unit IV: Cosmology I 15 hours

Introduction to Cosmology– Basic Observations and implications– Olbers' Paradox – Expanding Universe – Gravitational Redshift– Doppler Effect– Hubble's Law and the Age of the Universe – Cosmological Principle– The Perfect Cosmological Principle– Observation and interpretation of Cosmic Microwave background Radiation (CMBR)– Evidence Supporting the General Big Bang Theory– Salient features of Steady State Theory

Unit V: Cosmology II 15 hours

Fate of the Universe– Dependence on Mass (Curvature of Space)– Critical density– Open Universe– Closed Universe– Homogenous and Isotropic Freidman– Robertson– Walker Universes– Deriving the Geometry of the Universe from the Background Radiation– Flatness Problem– Horizon Problem– Inflation and its effect on the universe– The Cosmological Constant.

Skill Development

1. Summer Internship Program for PG students in the field of Astronomy and Cosmology in National Astro Physics centres located in Kadaikanal and Banglore.
2. Making the students to go for industrial visit on various Planetarium and also the Science centers in Chennai, Trivandrum and Bangalore.
3. Exhibit models of Universe, Cosmos, galaxy and black holes.

Books for Study

1. Bhatia. V.B. (2001). Text book of Astronomy and Astrophysics with Elements of Cosmology, (1st ed.). New Delhi: Narosa publishing House.
2. Singhal. R.P. (2009). Elements of Space Physics, (1st ed.). New Delhi: PHI Learning

Private limited.

3. Baidyanath Basu. (2006). An introduction to Astrophysics. (1st ed.). New Delhi: Prentile Hall of India PVT Lt publications.
4. Abhyankar, K.D. (1989). Astrophysics – Stars and Galaxies. (1st ed.). New Delhi: Tata – McGraw Hill Publications.

Books for Reference

1. Thomas T., Arny. (1996). *Explorations –An Introduction to Astronomy*, (1st ed.). California: Mosby Version publications.
2. Narlikar, J.V. (1995). *Structure of the Universe.* (1st ed.). New York: Oxford University Press.
3. George O., Abell. (1986). *Exploration of the universe*. (1st ed.). New Delhi: Saunder's college publishing.
4. Frark, H., Shu. (1982). *The Physical Universe An Introduction to Astronomy*. (1st ed.).
5. California: University science books, Mill valley.

Semester – II
Laser Physics (Elective –II (c))
Course code: PP2026

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

OBJECTIVES

1. To develop knowledge in the basics of lasers.
2. To enhance comprehension in the principles of lasers.
3. To explore the control of laser properties.
4. To familiarize with the diverse applications of lasers.

CO	Upon completion of this course, students will be able to:	CL
CO – 1	develop knowledge in the basics of lasers.	R
CO – 2	enhance comprehension in the principles of lasers	U
CO – 3	analyse the control of laser properties.	An
CO – 4	familiarize with the diverse applications of lasers	Ap

UNIT – 1:

Wave Propagation In Anisotropic Media **15 hours**

Double refraction– plane waves in anisotropic media– wave refractive index– ray refractive index– the ray velocity surface– The index ellipsoid.

UNIT– 2: Lasing Mechanism– I **15 hours**

The Einstein Coefficients– Light amplification– The threshold condition– Laser rate Equations Variation of laser power around Threshold– Optimum output coupling– Line broadening mechanisms.

UNIT– 3: Lasing Mechanism II **15 hours**

Modes of a rectangular cavity and the open planar resonator– The quality factor– The ultimate linewidth of the laser– Mode selection– Q– switching– Mode locking in lasers– Modes of a confocal resonator system– General spherical resonator– Higher order modes.

Some laser systems:

Ruby lasers– Neodynmium based lasers– The He– Ne laser– The argon ion laser– The CO2laser – Dye lasers– Excimer lasers– Semiconductor lasers.

UNIT– 4: Electrooptic And Acousto– Optic Effects **15 hours**

Index ellipsoid in the presence of an external electric filed– Electrooptic effect in KDP crystal: Longitudinal mode– Raman Nath and Bragg regimes of diffraction– A simple experimental setup to observe Raman– Nath Diffraction– Theory for Raman Nath Diffraction– Raman Nath acousto– optic modulator –Acousto– optic spectrum analyser.

UNIT– 5: Non– Linear Optical Phenomena **15 hours**

Harmonic Generation – Second Harmonic Generation – Phase Matching – Third Harmonic Generation – Optical Mixing – Parametric Generation of Light.

Skill Development

1. Calculate the refractive index of various materials
2. Apply the SHG principles to study NLO effects

Books for Study

1. Optical electronics A.K.Ghatak and K.Thyagarajan, Cambridge University press 1991.

Books for Reference

1. Principles of Lasers and Optics, William S.C. Chang, Cambridge University Press, 2005
2. Laser and Non– Linear Optics, B.B. Laud, New Age International Publisher.

Semester I &II

Advanced Physics Lab -I General Physics

Course Code: PP20P1

Objectives:

1. To acquire knowledge about basic concepts of physics and to calculated the related physical parameters.
2. To provide the students with different practical, intellectual and transferable skills.

CO	**Upon completion of this course, students will be able to:**	**PSO addressed**	**CL**
CO – 1	demonstrate practical skills to work with complexproblems and advanced experimental equipment.	PSO – 4	U
CO – 2	develop a practical knowledge in Hall Effect and in determination of Magneto resistance	PSO – 1	Ap
CO – 3	develop practical experience in LASE R experiments	PSO – 2	Ap
CO – 4	measure and compare the dielectric constant of various liquids	PSO – 4	E
CO – 5	apply Ultrasonic Interferometers to determine the velocity of sound	PSO – 2	E
CO – 6	analyse the parameters of dielectric crystals experimentally.	PSO – 3	Ap

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.

Semester I &II
Advanced Physics Lab -I - Programming with C++

Course Code: PP20P2

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.

CO	Upon completion of this course, students will be able to:	PSO addressed	CL
CO – 1	understand the basic concept of Object Oriented Programming (OOP)	PSO – 1	U
CO – 2	interpret the theoretical formulation for physical phenomena and apply experimental numerical simulations methods to find the solution	PSO – 2	Ap
CO – 3	apply computational methods and numerical algorithms to problems in advanced physics using C^{++} programming	PSO – 4	C
CO – 4	develop a basic knowledge in high level programming languages	PSO – 2	Ap

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

Semester: III

Core VII –Electronics

Course code: PP2031

Learning Objectives

1. To impart in depth knowledge about Semiconductors, diodes, Transistors, Operational Amplifiers, Memories and converters etc
2. To provide knowledge in the basic structure and working concepts of electronic devices.
3. To acquire application skills involving digital integrated circuit.

COs	**Upon completion of this course, students will be able to:**	**PSO addressed**	**CL**
CO 1	Understand the basic operation, and features related to diodes, transistor, op– amps, converter and interpret the	**PSO– 1**	**U**
CO 2	Explain about the internal circuitry and logic behind semiconductor memory devices.	**PSO– 2**	**U**
CO 3	Assess the working of diodes, transistor, op– amps and converters.	**PSO– 3**	**E**
CO 4	Design various filter circuits.	**PSO– 6**	**C**
CO 5	Interpret the Internal Architecture of memory devices	**PSO– 4**	**An**

Unit I **15 hrs**

Semiconductor Diodes: Introduction to Semiconductor– Intrinsic Semiconductor– Extrinsic Semiconductor– P– type– N– Type – PN Junction diode –Crystal Diode – Zener diode– LED – Varactor Diode – Tunnel diode Photo diode – schottky diode – Impatt diode– Characteristics and Applications.

Unit II **15 hrs**

Transistor Biasing and opto Electronic Devices: Thevenin's and Norton's theorems – Transistor action– PNP– NPN transistors – Transistor biasing and stabilization– Need for biasing– DC load line– operating point– Bias stability– Two port Network – Hybrid model – h parameters — JFET – UJT– SCR.

Unit III **15 hrs**

Operational Amplifier Applications: Operational Amplifier– CMRR– Slew rate – Instrumentation amplifier – V to I and I to V converter – Op– amp stages– Equivalent circuits – Sample and Hold circuits. Applications of Op– Amp: Inverting, Non– inverting Amplifiers– circuits – Adder– Subtractor– Differentiator– Integrator– Electronic analog Computation solving simultaneous and differential equation –. Schmitt Trigger – Triangular wave generator – Sine wave generator – Active filters: Low, High and Band pass first and second order Butterworth filters – wide and narrow band reject filters.

Unit IV **15 hrs**

Semiconductor Memories: Classification of memories and sequential memory –Static Shift Register and Dynamic Shift Register, ROM, PROM and EPROM principle and operation Read & Write memory – Static RAM, dynamic RAM, Content Addressable Memory – principle, block diagram and operation. Programmable Logic Array (PLA) – Operation, Internal Architecture. Charge Couple Device (CCD) – Principle, Construction, Working and Data transfer mechanism.

Unit V **15 hrs**

A/D and D/A Converter: Sampling theorem– Time division multiplexing – Quantization – DAC– Weighted resistor method – Binary Ladder network – ADC – successive approximation, Dual slope and Counter method – Voltage to Frequency conversion and Voltage to Time conversion .

Text Books

1. Jain,R.P. (2007). *Modern Digital Electronics*.New Delhi:Tata McGraw Hill.
2. Coughlin,R.F.Driscol,F.F. (1996)*Op– Amp and linear integrated circuits*.NewDelhi: Prentice Hall of India.
3. Ramakant, A. Gayakwad. (2015) *Op– Amps and Linear Integrated Circits.* – Pearson Education: Fourth Edition.
4. Albert MalvinoDavid J Bates.(2007) *Electronic Principles*, 7 th Edition,New Delhi: McGraw Hill.
5. Mehta,V.K. (2001)*Principles of Electronics.* 6thRevised Edition, S.Chand and Company.
6. David A. Bell.(2007)*Electronic Devices and Circuits*. 4th Edition, Prentice Hall.

Reference Books

1. Mehta V.K., Rohit Mehta. (2016). *Principles of Electronics*. New Delhi: S.Chand andCompany.
2. Vijayendran.V., Viswanathan.S. (2011). *Introduction to Integrated Electronics Digital andAnalog*. (1st ed.).Chennai: (printers and Publishers) Pvt. Ltd.
3. Thomas L.Floyd. (1999). *Digital Fundamentals*.(3rd ed.). New Delhi: UBS– PublishersDistributers LTD.
4. Millman J. Halkias, C.C. (1991). *Integrated Electronics*. New Delhi: Tata McGraw–HillPublishing Company Limited.
5. Ryder, J.D. (2004). *Electronics: Fundamentals and Applications*. United States: PrenticeHall International, INC., Englewood Cliffs.
6. Salivahanan, S., Kumar, N.S. (2012). *Electronic Devices and Circuits*. (3rd ed.). New Delhi: Tata McGraw– Hill Publishing Company Limited.
7. Donald .P. Leach, Albert Paul Malvino, Goutam suba. (2006). *Digital Principles and Applications.* New Delhi: Tata, Mc Graw Hill publishing company, Ltd..
8. Malvino A.P. and Brown J.A. (1997). *Digital Computer Electronics*. (3rd ed.). NewDelhi: TataMcGraw Hill Publishing Company.

Semester III
Core VIII: Condensed Matter Physics – II
Course code: PP2032

Hours/Week	Credits	Total Hours	Marks
6	5	90	100

Learning Objective

1. To develop analytical thinking to understand the phenomenon that decide various properties of solids thereby equip students to pursue higher learning confidently.

Cos	Upon completion of this course, students will be able to:	PSO addressed	CL
CO – 1	Understand the theory of dielectrics and analyze the dielectric properties of materials	**PSO – 1**	**An**
CO – 2	Explain various types of magnetic phenomenon and their properties and applications	**PSO – 4**	**E**
CO – 3	Elaborate the properties and applications	**PSO – 4**	**C**
CO – 4	Apply the obtained concepts to challenges	**PSO – 6**	**Ap**

Unit I **15 hrs**

Theory of Dielectrics: Dipole moment – Polarization – The electric field of a dipole – Local electric field at an atom – Clausius – Mosotti equation – Dielectric constants and its measurements – Polarizability – The Classical theory of electronic polarizability – Ionic polarizabilities – Orientational polarizabilities – The polarizability catastrophe – Dipole orientation in solids – Dipole relaxation and dielectric losses – Debye Relaxation time – Relaxation in solids – Complex dielectric constants and the loss angle – Frequency and temperature effects on Polarization – Dielectric breakdown and dielectric loss

Unit II **15 hrs**

Theory of Ferroelectrics and Piezo Electrics: Ferroelectric Crystals – Classifications of Ferroelectric crystals – Dipole theory of ferroelectricity – LandauTheory of the phase transition – Second order Transition – First Order Transition – Ferroelectric Transition – One– Dimensional Model of the Soft Mode of FerroelectricTransitions – Antiferroelectricity – Ferroelectric domains – Ferroelectric domain wall motion – Piezoelectricity – Phenomenological Approach to Piezoelectric Effects – Piezoelectric Parameters and Their Measurements – Piezoelectric Materials

Unit III **15 hrs**

Magnetic properties of Materials: Terms and definitions used in magnetism – Classification of magnetic materials – Atomic theory of magnetism – The quantum numbers – The origin of permanent magnetic moments – Langevin's classical theory of diamagnetism – Sources of paramagnetism – Langevin's classical theory of paramagnetism – Quantum theory of paramagnetism – Paramagnetism of freeelectrons – Ferromagnetism – The Weiss molecular field – Temperature dependence of Spontaneous magnetization – The physical origin of Weiss Molecular field – Ferromagnetic domains – Domain theory – Antiferromagnetism – Ferrimagnetism – Structure of Ferrite.

Unit IV **15 hrs**

Superconductivity: Occurence of super conductivity – Destruction of superconductivity by magnetic fields – Meissner Effect – Type I and Type II Super conductors– Heat Capacity – Energy gap – Microwave and infrared properties – Isotope effect – Thermodynamics of the superconducting transition – London equation – CoherenceLength – BCS theory of superconductivity, BCS ground state– Fluxquantisationina super conduction ring– Durationofpersistencecurrents– Single particle tunnelling – DC Josephson effect – AC Josephson effect – Macroscopic quantum interference – High temperature super conductors – Applications.

Unit V **15 hrs**

Physics of Nanosolids: Definition of nanoscience and nanotechnology – Preparation of nanomaterials – Surface to volume ratio – Quantum confinement – Qualitative and Quantitative description – Density of states of nanostructures – Excitons in Nano semiconductors – Carbon in nanotechnology – Buckminsterfullerene – Carbon nanotubes – Nano diamond – BN nano tubes – Nanoelectronics – Single electron transistor – Molecular machine – nanobiometrics.

Text Books

1. Charles Kittel.(2004).*Introduction to Solid State Physics*. 7th Edition,New Delhi: WileyIndia Pvt. Ltd.
2. Rita John.(2014).*Solid State Physics.* New Delhi:Tata Mc Graw Hill Publications.
3. Wahab M. A.(1999).*Solid State Physics – Structure and Properties of Materials.*NewDelhi: Narosa.
4. Patterson,J.D. Bailey,B.C. (2007).*Solid– State Physics: Introduction to the Theory*,springer Publications.
5. Ali Omar,M. (1999).*Elementary Solid State Physics – Principles and Applications.*Pearson.

Reference Books

1. Blakemore, J.(1974). *Solid State Physics*, 2nd Edition, Philadelphia: W. B. Saunders Co.
2. Kachhava,C. M. (1990).*Solid State Physics*, New Delhi: Tata Mcgraw Hill.
3. AschroftN. W., Mermin,N. D.(1976).*Solid State Physics*, New York: Rhinehart andWinton.
4. Tinkham,M.(1996). *Introduction to Superconductivity.* New Delhi : Tata Mcgraw Hill.
5. Chattopadhyay, K.K.Banerjee, A.N.(2014) *Introduction to Nanoscience and Nanotechnolog*. Delhi: PHI Learning private Ltd.
6. Dekker, A. J. (1975).*Electrical Engineering Materials*. Prentice Hall of India.
7. Pillai, S.O.(1994)*Problems and Solutions in Solid State Physics*.New Delhi:New Ageinternational Publishers.
8. Bain, A.K. Chand,P. (2017) *Ferroelectrics*. Wiley.
9. Kwan Chi Kao.(2004)*Dielectric phenomena in solids with emphasis on physical concepts of electronic processes*. Elsevier Academic Press.
10. Alexander O. E. Animalu. (1978)*Intermediate Quantum Theory of Crystalline solids.* New Delhi :Prentice Hall of India.
11. Eleftherios N. Economou. (2010)*The Physics of Solids – Essentials and Beyond*. Springer.

Semester III Project

Course code: PP20PR

Hours/Week	Credits	Total Hours	Marks
6	5	90	100

Learning Objectives

1.To enable students to design experiment, analyse data and interpret results.
2.To develop skills to identify subject related problems in the neighborhood and report to the scientific community.

COs	Upon completion of this coursethe students will be able to:	PSO addressed	CL
CO – 1	explore new areas of research in physics	PSO – 5	Ap
CO–2	analyze a research problem and construct tools for data collection.	PSO – 6	An
CO–3	write research reports and present results in the scientific community.	PSO – 7	Ap
CO–4	develop skills to serve in science related industries and agencies.	PSO – 5	Ap
CO–5	develop skills to publish articles in reputed journals.	PSO – 4	An

Guidelines

- All the students must undertake project work at the final year (III semester).
- The students, with the consent of the Supervisor, HOD and the Principal can pursue their project in another institution, especially with MoU/ Collaboration for the successful completion of the project work.

Project framework

1. The Project format should be in:

- **Font – Times New Roman**
- **Heading – Font size 14 (Bold) – Uppercase**
- **Sub headings – Font size 12 (Bold) — Lowercase;**

should be numbered.(Eg: Introduction 1; Subheading 1.1; 1.2)

- **Text, the content of the dissertation — Font size – 12 (Normal).**

- Citation – Any works of other researchers, if used either directly or indirectly should be indicated at appropriate places in the text.

The citation may assume any one of the following forms:

i) A paper, a monograph or a book with single author may be designated by the name of the *fast* author followed by the year of publication, placed inside brackets at the appropriate places in the text.

ii) A paper, a monograph or a book with two authors may be designated by the name of the first and second author followed by the year of publication, placed inside brackets at the appropriate places in the text.

iii) A paper, a monograph or a book with more than two authors may be designated by the name of the first author followed by et al, and the year of publication, placed inside bracketsat the appropriate places in the text.

- **Line space – 1.5**
- **Margin – 2" on the left and 1" on the right, Gutter – 0.5.**
- **Page Numbering — Bottom middle alignment; excluding initial pages and reference**
- **Total number of pages – Minimum 30 – Maximum 50 (excluding initial pages andreference).**
- **The Tables and Figures should be included subsequently after referring them in thetext of the Report.**

II. Project Report must be completed within the stipulated time .

III Submission of Project Report:

- one soft copy (PDF format in CD)
- three hard copies (soft binding) duly signed and endorsed by the Supervisor and theHead.

The Project Report **will have three main parts:**

I. Initial Pages – in the following sequence

i. Title Page

ii. Certificate from the Supervisor

iii. Declaration by the candidate endorsed by the Supervisor and HOD

iv. Acknowledgement (within one page – signed by the candidate).

v. Table of Contents
vi. List of abbreviations
vii. Abstract

II. Main body of the dissertation

i) Introduction with Literature review and Objectives
ii) Methodology
iii) Results
iv) .Discussion
v) Summary
vi) References

The guidelines for reference

Journal Article : with Single Author

Waldron, S 2008, "Generalized Welch bound equality sequences are tight frames", IEEETransactions on Information Theory, vol. 49, no. 9, pp. 2307– 2309.

Journal Article : with Two Authors

Conley, TG & Galeson, DW 1998, "Nativity and wealth in mid– nineteenth century cities", Journal of Economic History, vol. 58, no. 2, pp. 468– 493.

Journal Article: with more than two Authors

Alishahi, K, Marvasti, F, Aref, VA & Pad, P 2009, „Bounds on the sum capacity of synchronous binary CDMA channels", Journal of Chemical Education, vol. 55, no. 8, pp. 3577– 3593.

Books

Holt, DH 1997, Management Principles and Practices, Prentice– Hall, Sydney. Centre forResearch, M S University – Ph.D. Revised Guidelines Page | 39 / 41

E– book

Aghion, P &Durlauf, S (eds.) 2005, Handbook of Economic Growth, Elsevier, Amsterdam.Available from: Elsevier books. [4 November 2004].

Semester III

Elective III (a):Bio Physics

Course Code: PP2033

Hours/Week	Credits	Total Hours	Marks
6	4	90	100

Learning Objectives

1. To understand the organization of cell structure and different types of cell.
2. To understand the principles and applications of various microscopic and separation tools in cell biology.
3. To understand the fundamentals of macromolecular structure and the analytical techniques in characterizing biomolecular interactions and its structure.

Course Outcome

COs	Upon completion of this course, students will be ableto:	PSO addressed	CL
CO – 1	understand the basic structural unit and its different types.	PSO – 1	U
CO – 2	acquire the basic knowledge on various microscopes used to analyse the cell structure.	PSO – 2	U
CO – 3	analyse the structure of DNA, RNA and Proteins.	PSO – 1	A
CO – 4	explain the techniques used to separate the biomolecules.	PSO – 4	E
CO – 5	determine the interaction of molecules by using different optical and diffraction techniques.	PSO – 4	Ap

Unit I **15 hrs**

Cell Organization: Cell as the basic structural unit– Origin & organization of Prokaryotic and Eukaryotic cell– Cell size & shape– Fine structure of Prokaryotic & Eukaryotic cell organization (Bacteria, Cyanobacteria, plant & Animal cell)– Internal architecture of cells– cell organelles– compartment & assemblies membrane system– Ribosome– Polysomes– Lysosomes– Peroxisomes– Connection between cell & its environment– Extracellular Matrix.

Unit II **15 hrs**

Tools in Cell Biology: Light microscope– Resolving Power– Phase contrast microscope– Detection of small differences in refractive indices– Interference microscope– methods– Flowcytometry& cell sorting– Electron microscopy– specimen preparation– Scanning Electron Microscopy (SEM)– Transmission Electron Microscopy (TEM)– Applications.

Unit III **15 hrs**

Macromolecular Structure: Nucleic acid structure: Chemical structure of the nucleic acid – Conformational possibilities of monomers and polymers– Double helix structure of DNA– Polymorphism of DNA– DNA nanostructures and the structure of transfer RNA. Proteins structure: Amino acids and the primary structures of proteins – Secondary – Tertiary – Quaternary structure and virus structure.

Unit IV **15 hrs**

Separation Techniques: Centrifugation: Principle of centrifugation –Analytical ultracentrifugation – Differential centrifugation – Density gradient centrifugation. Chromatography: Principles of chromatography– Paper chromatography – Thin layer chromatography (TLC) – Gas liquid chromatography (GLC) – High performance liquid chromatography (HPLC).Electrophoresis: Principles – Factors affecting the migration of substances – Supportingmedia in electrophoresis – Gel electrophoresis – Polyacrylamide gel electrophoresis (PAGE) – Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS– PAGE).

Unit V **15 hrs**

Optical & Diffraction Techniques: Circular Dichroism and optical rotator dispersion– : Plane, circular and elliptical polarization of light– Absorption by oriented molecules– Dichroic ratio of proteins and nucleic acids– Circular dichroism (CD) – optical rotatory disperson (ORD) – Relation between CD and ORD– Application of ORD in conformation and interactions of biomolecules. Crystallization of proteins– preparation of heavy metal derivatives– Patterson synthesisisomorphous replacement methods– structure factors of centro– symmetric and noncentrosymmetric crystals– General remarks on Protein– Structure determination from X– ray diffraction data– Neutron diffraction– , Electron diffraction– , Synchrotron diffraction, Application in Biomolecular structural studies.

Text Books

1. Geoffrey M.Cooper. (2013).*The Cell: A Molecular Approach.* ASM Press.
2. Veerakumari,L. (2006) . *Bioinstrumentation*, MJP Publishers.
3. Deb,A.C. (2011). *Fundamentals of Biochemistry*, New central book agency.

Reference Books

1. VasanthaPattabhi, Gautham,N.(2009). *Biophysics*. Narosa Publishing.
2. Mishra,VK. (2010). *Biophysics.* P.S. Enterprises.
3. Subramanian,M.A. (2005). *Biophysics.* MJP Publishers.

Semester III
Elective III (b): Microprocessor and Microcontroller
Course Code: PP2034

Hours/Week	Credits	Total Hours	Marks
6	4	90	100

Learning Objectives

1. To provide an extensive knowledge about the architecture and assembly language programming of microprocessors 8085 & 8086 and microcontroller 8051.
2. To gain hands on experience in interfacing of 8085 microprocessor.

Course Outcome

COs	Upon completion of this course, students will be able to	PSOs addressed	CL
CO– 1	Identify/ Explain the operation of various components of the microprocessor 8085 and microprocessor 8086	PSO– 1	A
CO– 2	Relate and explain the various addressing modes and the instruction set of 8085 microprocessors	PSO– 1	R
CO– 3	Develop skill in writing simple programs for 8085 microprocessor	PSO– 2	C
CO– 4	Explain the architecture of 8051 microcontroller	PSO– 1	U
CO– 5	Understand the various interrupts of 8085 microprocessor	PSO– 2	U

Unit I **15 hrs**

Microprocessors 8085 Architecture: Intel 8085 microprocessor: Introduction – Pin configuration– Architecture and its operations – Machine cycles of 8085– Interfacingof memory and I/O devices– Instruction classification: number of bytes, nature ofoperations– Instruction format– Vectored and non– vectored interrupts.

Unit II **15 hrs**

8085 Assembly Language Programming: Instruction set: Data transfer operations – Arithmetic operations Logical operations – Branching and machine controloperations– Addressing modes– Writing assembly language programs: Looping, counting and indexing– Counters and time delays – Stack – subroutine– Translation from assembly language to machine language

Unit III **15 hrs**

Microprocessor 8086: Intel 8086 microprocessor: Introduction – Architecture – Pin configuration– Operating modes: Minimum mode, Maximum mode. Memory addressing: 8– bit data from even and odd address bank, 16– bit data from even and odd address bank– Addressing modes– Interrupts: Hardware interrupts – Software interrupts –Interrupt priorities– Simple programs.

Unit IV **15 hrs**

Microcontroller 8051 Architecture and Programming: Introduction to microcontroller and embedded system– Difference between microprocessor and microcontroller– 8051 microcontrollers: Pin configuration, Architecture and Key features. 8051 Data types and directives Instruction set: Data transfer instructions – Arithmetic instructions – Logical instructions– Branching instructions– Single bit instructions. Addressing modes– Simple programs using 8051 instructions set.

Unit V **15 hrs**

Interfacing of Microprocessor 8085: Basic concepts of programmable device – 8255 Programmable Peripheral Interface (PPI) – interface of ADC and DAC– 8257 Direct Memory Access (DMA) controller– Basic concepts of serial I/O and data communication – interface of 8251 Universal Synchronous Asynchronous Receiver Transmitter (USART)

Text Book

1. Ramesh Goankar. (2013). *Microprocessor Architecture. Programming and Applications with the 8085.* (6th ed.). India: Penram International Publishing Pvt. Ltd.

Reference Books

1. Ram, B. and Sanjay Kumar. (2013). *Fundamentals of Microprocessors and Microcontroller*. (7th ed.). India: Dhanpat Rai Publications (P) Ltd.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin, D. Makinlay. (2009). *The 8051 Microcontroller and Embedded Systems.* (2nd ed.). New Delhi: Pearson Education.

Semester III
Elective III (c) : Solar Energy Utilization
Course Code: PP2035

Hours/Week	Credits	Total Hours	Marks
6	4	90	100

Learning Objectives

1. To provide knowledge on the fundamental aspects of solar energy Utilization.
2. To understand different approaches on the process and use of nanomaterials in fuel Cell technology

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO – 1	understand the basic concept of heat transfer	PSO – 2	U
CO – 2	Design the solar collectors and solve the optical loss.	PSO – 6	C
CO – 3	relate the different types of solar water heaters.	PSO – 1	R
CO – 4	analyze the use of nanostructures and nanomaterials in fuel cell technology	PSO – 4	An
CO – 5	Evaluate the photo voltaic principles and compare the types of solar cells	PSO – 5	E

Unit I **15 hrs**

Heat Transfer & Radiation Analysis: Conduction– Convection and Radiation – Solar Radiation at the earth's surface – Determination of solar time – Solar energy measuring instruments.

Unit II **15 hrs**

Solar Collectors: Physical principles of conversion of solar radiation into heat flat plate collectors – General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss.

Unit III **15 hrs**

Solar Heaters: Types of solar water heater – Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.

Unit IV **15 hrs**

Solar Energy Conversion: Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo – electric conversion – process flow of silicon solar cells– different approaches on the process– texturization, diffusion, Antireflective coatings, metallization.

Unit V **15 hrs**

Nanomaterials in Fuel Cell Applications: Use of nanostructures and nanomaterials in fuel cell technology – high and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts– Use of nanotechnology in hydrogen production and storage.

Text Books

1. Rai,G.D. (1987).*Solar energy utilization*.Delhi: Khanna publishers.
2. Sukhatme,S.P. (1984).*Solar energy – principles of thermal collection &storage*.Delhi: TMH.
3. Maheshwar Sharon, Madhuri Sharon (2010) *Carbon "Nano forms andApplications",*McGraw– Hill.

Reference Books

1. Romer,R.H. Freeman,W.H.(1976).*Energy – An Introduction to Physics.*

Semester IV

Core IX:Nuclear and Elementary Particle Physics

Course Code: PP2041

Hours/Week	Credits	Total Hours	Marks
6	**5**	**90**	**100**

Learning Objectives

1. To know about the fundamental principles and concepts governing nuclear and particle physics and their social, economic and environmental implications.
2. To understand the concept of elementary particles.

Course Outcome

Cos	Upon completion of this course, students will be able to:	**PSO addressed**	**CL**
CO– 1	Understand the properties of nuclear forces and outline their behavioral formulation.	**PSO – 1**	**U**
CO– 2	Analyze the different nuclear models of the nucleus and examine the application of the shell model of nucleus.	**PSO – 4**	**E**
CO– 3	Explain the characteristics and effect of radioactive decay phenomena. (alpha,beta,gamma)	**PSO – 1**	**U**
CO– 4	Discuss the outcome of various types of nuclear reactions.	**PSO – 4**	**C**
CO– 5	Examine the Particle Physics phenomena andtheir basic theoretical description.	**PSO – 3**	**An**

Unit I **15 hrs**

Nuclear Forces: Characteristics of Nuclear Forces – Exchange forces and tensor forces – charge independence– Spin dependence of Nucleus Forces – Meson theory of nuclear forces– Ground state of deuteron– Nucleon– nucleon scattering singlet and tripletparameters – Nucleon– Nucleon scattering: Cross– section, Differential Cross– section, Scattering Cross– sections – magnetic moment– Quadrupole moment –S and D state admixtures – Effective range theory of n– p scattering at low energies.

Unit II **15 hrs**

Nuclear Models: Binding energy & mass defect – Weizacker's formula – mass parabola – Liquid drop model – Bohr – Wheeler theory of fission– Activation energy for fission– Shell model– Spin –Orbit coupling– Spins of nuclei– Magnetic moments – Schmidt lines– Electric quadrupole moments – Collective model of Bohr and Mottelson:Nuclear vibration – Nuclear rotation –Nelson model.

Unit III **15 hrs**

Nuclear Reactions: Nuclear reaction – Q– value – Nuclear reaction cross section – Direct Nuclear Reactions: Knock out reaction, Pick– up reaction, Stripping reaction – Compound nucleus theory – Formation – Disintegration energy levels – Partial wave analysis of Nuclear reaction cross– section – Resonance Scattering and Reaction cross– section (Breit– Wigner dispersion formula) – Scattering matrix – Reciprocity theorem – Breit – Wigner one level formula – Resonance scattering – Absorption cross section at high energy.

Unit IV **15 hrs**

Radioactive Decays: Alpha decay – Beta decay –Energy release in beta decay – Fermi theory of beta decay – Shape of the beta spectrum – decay rate Fermi– Curie plot – Fermi & G.T Selection rules – Comparatives half – lives and forbidden decays– Gama decay – Multipole radation – Angular momentum and parity selection rules – Internal conversion – Nuclear isomerism.

Unit V **15 hrs**

Elementary Particle Physics: Classification of elementary particles – Types of interaction betweenelementary particles – Hadrons and leptons – Symmetry and conservation laws – Strangeness and associate production – CPT theorem –classification of hadrons – Quark model – Isospin multiples – SU(2)– SU(3) multiplets– Gell– Mann – Okubo mass formula for octet and decouplet hadrons – Phenomenology ofweak interaction hadrons and leptons– Universal Fermi interaction – Elementary concepts of weak interactions.

Text Books

1. Cohen.B. L. (1971). *Concepts of Nuclear Physics*, Bombay :TMGH.
2. Krane.K. (1987). *Introductory Nuclear Physics*, New York: Wiley.
3. Devanathan.V. (2012). *Nuclear Physics*, Narosa Publishing house.
4. Griffiths.D,(2008). *Introduction to Elementary Particles*, 2nd Ed, Vch: Wiley.
5. Ghoshal. S.N. (1994). *Nuclear Physics*,II edition, New York: S. Chand and Co.
6. Tayal.D.C. (2018). *Nuclear Physics*, V edition, New Delhi: Himalaya Publishing House Pvt., Ltd.

Reference Books

1. Irving Kaplan.(2012). *Nuclear Physics.* Narosa Publishing House.
2. Srivatsava,B.N. (2016). *Basic Nuclear Physics and Cosmic Rays*,Edition: XVII,Meerut:Pragati Prakashan publications.
3. Pandya.M.L. P.R.S Yadav, (2016).*Elements of Nuclear Physics*, Meerut: Kedar Nath Ram Nath publications.

Semester IV

Core X : Spectroscopy

Course Code: PP2042

Learning Objectives

1. To gain knowledge about the basic principles of spectroscopy.

2. To gain insight about the spectroscopic instruments and its applications.

Course Outcome

Cos	**Upon completion of this course, students will be able to:**	**PSO addressed**	**CL**
CO – 1	apply basic spectroscopic techniques. (Microwave, IR, Raman and NMR)	**PSO – 4**	**U**
CO – 2	infer basic spectroscopic techniques. (Microwave, IR, Raman, ESR, NQR and NMR)	**PSO – 6**	**Ap**
CO – 3	understand the molecular interactions in different spectroscopic methods.	**PSO – 1**	**An**
CO – 4	analyze the characteristics of rotational spectra and vibrational energy of molecules.	**PSO – 3**	**An**
CO – 5	utilize various spectroscopic methods suitable for characterizing molecules.	**PSO – 6**	**C**

Unit I **15 hrs**

Microwave Spectroscopy: Rotation of Molecules – Rigid Rotor (Diatomic Molecules) – Expression for the Rotational Constant – Intensity of Spectral Lines – Effect of Isotopic Substitution – Molecular Parameters (Bond Length, Bond Angle, Dipole Moment) from Rotation Spectra – Techniques and Instrumentation.

Unit II **15 hrs**

Infrared Spectroscopy: Vibrational energy of a diatomic molecule– Infrared selection rules– Vibrating diatomic molecule– Diatomic vibrating rotator– Vibrations of polyatomic molecules– Fermi resonance– Rotation vibration spectra of polyatomic molecules– Normal modes of vibration in crystal– Interpretation of vibrational spectra– Group frequencies– IR spectrophotometer– Instrumentation– Sample handling techniques– Fourier Transform Infrared spectroscopy– Applications

Unit III **15 hrs**

Raman Spectroscopy: Introduction– Theory Of Raman Scattering– Rotational Raman Spectra– Vibrational Raman Spectra– Mutual Exclusion Principle– Raman Spectrometer– Sample Handling Techniques– Polarization Of Raman Scattered Light– Structure Determination Using IR And Raman Spectroscopy– Raman Investigation Of Phase Transitions– Resonance Raman Scattering– Nonlinear Raman Phenomena– Preliminaries– Hyper Raman Effect– Stimulated Raman Scattering– Inverse Raman Effect– Coherent Anti– Stokes Raman Scattering.

Unit IV **15 hrs**

Nuclear Magnetic and Electron Spin Resonance Spectroscopy: Basic principles – Quantum theory of NMR – magnetic resonance – relaxation processes – chemical shifts – spin– spin coupling – Spectra and molecular structure – Fourier Transform NMR – Instrumentation – Applications.

Basic principles – Quantum theory – g– factor – Nuclear Interaction and Hyperfine structure – Relaxation effects – Hyperfine interaction – line widths – ESR spectrometer – Instrumentation – applications.

Unit V **15 hrs**

Nuclear Quadrupole Resonance and Mossbauer Spectroscopy: Basic theory – Nuclear Electric quadrupole interaction – Energy levels – Transition frequency- Excitation and Detection – Effect of magnetic field – Instrumentation – applications.

Mossbauer effect – recoilless emission and absorption – hyperfine interaction – chemical isomer shift – magnetic hyperfine and electric quadruple interactions –Instrumentation – applications.

Text Books

1. Aruldhas. G. (2005). *Molecular structure and spectroscopy*. (2nd ed). New Delhi: Prentice– Hall of India private Ltd.
2. Colin N.Banwell, Elaine M.Mc Cash.(1995). *Fundamentals of Molecular Spectroscopy* (Fourth Edition), Tata McGraw– Hill Publishing Company Ltd.

Reference Books

1. Graybeal, J.D. (1988)*Molecular Spectroscopy*, McGraw– Hill, New York,.
2. Hollas, Michael, *Modern Spectroscopy (Fourth Edition)* John Wiley, New York, 2004.
3. R.P Straughen, S.Walker, Spectroscopy Vols.I,II and III, Chapman & Hall, London, 1976.

Semester IV
Core XI : Thermodynamics and Statistical Mechanics
Course Code: PP2043

Learning Objectives

1. To provide a phenomenological introduction to thermodynamics through thermodynamics postulates, quantities and relations.
2. To understand the micro and macroscopic properties of the matter through the statistical probability laws and distribution of particles and study the transport properties, different phases of maters, equilibrium and nonequilibrium process.

Course Outcomes

Cos	**Upon completion of this course, students will be able to:**	**PSO addressed**	**CL**
CO – 1	understand the basic concepts related to thermodynamics, microstates and macrostates	**PSO – 4**	**U**
CO – 2	apply principles to find relation between grand canonical and canonical partition functions	**PSO – 1**	**Ap**
CO – 3	Solve t Bose– Einste Fermi– Dirac and Maxwell distributions –	**PSO – 4**	**C**
CO – 4	analyze the origin of transport and non– equilibrium processes	**PSO – 3**	**An**
CO – 5	understand the concept of heat capacities and phase transitions	**PSO – 4**	**U**

Unit I **15 hrs**

Thermodynamics, Microstates and Microstates: Basic postulates of thermodynamics – Phase space and ensembles – Fundamental relations and definition of intensive variables – Intensive variables in the entropic formulation – Equations ofstate – Euler relation, densities – Gibbs– Duhem relation for entropy – Thermodynamic potentials–Maxwell relations – Thermodynamic relations – Microstates and macrostates – Ideal gas –Microstate and macrostate in classical systems – Microstate and macrostate in quantum systems– Density of states and volume occupied by a quantum state

Unit II **15 hrs**

Microcanonical, Canonical and Grand Canonical Ensembles: Microcanonical distribution function – Two level system in microcanonical ensemble – Gibbsparadox and correct formula for entropy – The canonical distribution function – Contact with thermodynamics – Partition function and free energy of an ideal gas –The grand partition function – Relation between grand canonical and canonical partition functions – One– orbitalpartition function

Unit III **15 hrs**

Bose– Einstein, Fermi– Dirac and Maxwell– Boltzmann Distributions: Bose– Einstein and Fermi– Dirac distributions – Thermodynamic quantities – Non– interactingBose gas and thermodynamic relations – Chemical potential of bosons – The principle ofdetailed balance – Number density of photons and Bose condensation – Thermodynamic relationsfor non– interacting Fermi gas – Fermi gas at zero and low temperature – Fermi energy and Fermimomentum – Maxwell– Boltzmann distribution law for microstates in a classical gas – Physical interpretation of the classical limit – Fluctuations in different ensembles

Unit IV **15 hrs**

Transport and Non– Equilibrium Processes: Derivation of Boltzmann transport equation for change of states without and with collisions –Boltzmann equationfor quantum statistics – Equilibrium distribution in Boltzmann equation –Transport processes; One speed and one dimension – All speeds and all directions – Conservedproperties – Distribution of molecular velocities – Equipartition and Virial theorems – Randomwalk – Brownian motion – Non– equilibrium process; Joule– Thompson process – Free expansionand mixing – Thermal conduction – The heat equation.

Unit V **15 hrs**

Heat Capacities, Ising Model and Phase Transitions: Heat capacities of heteronuclear diatomic gas – Heat capacities of homonuclear diatomic gas –Heat capacity of Bose gas – One– dimensional Ising model and its solution by variational method– Exact solution for one– dimensional Ising model – Phase transitions and criterion for phasetransitions – Classification of phase transitions by order and by symmetry – Phase diagrams forpure systems – Clausius– Clapeyron equation – Gibbs phase rule

Text Books

1. Sinha. S.K. (2007).*Introduction to Statistical Mechanics*. New Delhi: Narosa PublishingHouse Pvt.Ltd.
2. Saxena, A.K. (2010). An *Introduction to Thermodynamics and Statistical Mechanics*.New Delhi: Narosa Publsihing House Pvt.Ltd.
3. Kerson Huang.(1986). *Statistical mechanics*. Wiley Eastern Ltd.

Reference Books

1. Reif. (2010). *Fundamentals of Statistical and Thermal Physics*. Paperback. Sarat BookDistributors.
2. Laud.B.B.(2012).*Fundamentals of Statistical Mechanics*. Paperback. New Age International Private Limited.
3. Kittel.C.(2004). *Elementary Statistical Physics*.John Wiley & Sons.
4. Reif.F. (2010). *Statistical and Thermal Physics*.Fifth Edition.McGraw Hill.
5. Gupta & Kumar. (2003).*Statistical Mechanics*. 20th Edition, Meerut: Pragati Prakashan.
6. Agarwal.B.K. and Meisner. (2016). *Statistical Mechanics*. Second Edition. New Delhi:New Age International Private Limited.
7. Gopal.E.S.R. (1974).*Statistical Mechanics and Properties of Matter* (Theory and \ Applications). Ellis Horwood Ltd.

Semester: IV

Elective IV(a): Materials Physics and Processing Techniques

Course code: PP2044

Hours/Week	Credits	Total Hours	Marks
6	**5**	**90**	**100**

Learning Objectives

1. To impart knowledge on various materials growth, synthesis and processing techniques
2. To learn the structural, morphology, and surface characterization techniques.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO– 1	Remember basic principles in material physics	**PSO – 1**	**R**
CO– 2	Understand various material fabrication methods	**PSO – 2**	**U**
CO – 3	Analyse different characterization used for materials processing	**PSO– 4**	**An**
CO– 4	Apply different methods of material processiing	**PSO– 5**	**Ap**
CO– 5	Evaluate the materials and characterization tools	**PSO – 4**	**E**

Unit I **15 hrs**

Crystal Growth: Significance of crystal growth– Naturally occurring crystal growth processes– Crystal growth processes in laboratory and industrial scale– Classification of crystal growth methods Growthfrom solutions – Nucleation: Homogeneous and heterogeneous, Solubility phase diagram Saturation– Supersaturation– Metastable zone width– Slow evaporation and slow cooling methods, Growth from gel– Growth from flux– Growth from melt– Bridgeman– Stockbarger method– Czochralski pulling method– Growth from vapour– Sublimation method.

Unit II **15 hrs**

Plasma Processing: Basics Of Plasma: Introduction, Types Of Plasma; Properties Of Plasma; V– I Characteristics; Advantages Of Plasma Processing. Thermal Plasma: Principles Of Plasma Structure Of Sprayed Deposits, Plasma Spheroidization; Plasma Decomposition; Treatment Of Hazardous Wastes – Synthesis Of Ultrafine/Nanopowders. Plasma Melting And Remelting– Nonthermal Plasma: Glow Discharge Plasma, Plasma Reactors For Surface Treatment: Corona&DBD Atmospheric Pressure Surface Treatment Reactors

Unit III **15 hrs**

V**acuum techniques:** Units and range of vacuua – Formulas for important quantities Qualitative description of pumping process – Surface processes and outgassing – Gas flow mechanism – Classification of pumps :Positive displacement pumps – Kinetic pumps – Entrapment pumps – Classification of pressure gauges : Total pressure gauges–Hydrostatic pressure gauges – Thermal conductivity gauges –Ionization gagues –Vacuum system : simple rotary, diffusion, turbo molecular, ultrahigh vacuum and cryo– pumped systems.

Unit IV **15 hrs**

Growth Technique Of Thinfilms And Nanomaterials: Plasma arc discharge– sputtering– chemical vapour deposition– pulsed laser deposition– molecular beam epitaxy– Electrochemical deposition– SILAR method Solid– State Reaction – Sol– Gel Technique – Hydrothermal growth – Ball Milling – Combustion synthesis – Sonochemical method – Microwave synthesis – Coprecipitation

Unit V **15 hrs**

Characterization Tools: Working principles and instrumentation – XRD – XPS – AES– SIMS – RBS– LEED – AFM – SEM – STM

Text Books

1. Maissel, Glange. (1970).*Handbook of Thin Film Technology*.First Edition. McGraw Hill.
2. Roth,A.(1990).*Vacuum Technology*. Third Edition , North Holland.
3. Pipko A, Pliskosky, V. (1984).*Fundamentals of Vacuum Techniques*. First Edition. MIRPublishers.
4. Chopra,K. L. (1969). *Thin Films Phenomena*.First Edition . McGraw Hill.
5. Avasthi,D. K. Tripathi,A. Gupta,A. C. (2002).*Ultra High Vacuum Technology*. Allied Publishers Private Limited.
6. Kasturi Lal Chopra, Suhit Ranjan Das.(1983).*Thin Film Solar Cells*. New York : PlenumPress.

Reference Books

1. Chambers, A, Fitch, R.K. Halliday, B.S.(1998)*Basic Vacuum Technology*. 2 ND Edition,IOP Publishing Ltd.
2. Roth,A.(1990).*Vacuum Technology*. 3 rd Edition. Elsevier Science.
3. Suryanarayana,C.(Edited). (1999).*Non– equilibrium processing of materials* (Chapter –6) Pergamon.
4. Ananthapadmanabhan,P.V.Venkataramani,N. (1999).*Thermal plasma processing Pergamon materials.* series Vol 2.
5. Reece Roth, J. (2001).*Industrial plasma engineering – Applications to Nonthermal plasmaprocessing*. (Vol. 2) Bristol: Institute of Physics Publishing.
6. Maher I. Boulos, PierreFauchais, Emil Pfender. (1994).*Thermal plasmas– Fundamentalsand Applications*. (Vol. 1) Springer Science.

Semester IV

Elective IV (b): Advanced Nano Physics

Course code: PP2045

Hours/Week	Credits	Total Hours	Marks
6	5	90	100

Learning Objectives

1. To understand the theoretical aspects of low dimensional semiconductor systems.
2. To learn the structures, properties, characterization and applications of nanomaterials.

Course Outcome

COs	Upon completion of this course the students will beable to :	PSO addressed	CL
CO– 1	Identify how basic physics can be used to describe The behaviour of electrons in nano– scale materials.	**PSO– 1**	**R**
CO– 2	Explain the variation in the electron distribution in nanostructures for different dimensions (Quantum well,Quantum wires & quantumdots)	**PSO– 3**	**U**
CO– 3	Analyze magneto electronics and applications of Nanotechnology in various fields.	**PSO– 6**	**An**
CO – 4	Explain Laser effect in Quantum well, Quantum wires and quantum dots .	**PSO– 2**	**U**
CO– 5	Compare the structure and properties of Carbon nanostructures	**PSO– 6**	**E**
	and their applications in the emerging nanotechnology		
CO – 6	Discuss the fabrication and characterization techniques of nanomaterials	**PSO– 2**	**U**
CO – 7	Develop key concepts in Single electron transistor, Spintronics and Giant magnetoresistance	**PSO– 4**	**C**

Unit I **15 hrs**

Introduction to Nano and Types of Nanomaterials: Need and origin of nano – Nano and energetic – Top– down and bottom– up approaches– Introductory ideas of 1D, 2D and 3D nanostructured materials Quantum well: Quantum well infrared detector– quantum well laser– quantum cascade laser– Quantum wire: Production– VLS growth mechanism– structure and uses– Quantum dots: Description– Exciton confinement in quantum dots – Epitaxially self– assembled quantum– dot– Application: Quantum dot laser.

Unit II **15 hrs**

Carbon Nanostructures: Carbon molecules and carbon bond – – C60: Discovery and structure of C60 and its crystal – Superconductivity in C60 – Fullerene– Carbon Nano Tubes (CNT): Types– Fabrication: Electric Arc– discharge method– Laser method– Solar production of carbon nanotubes – Chemical vapour deposition– Electronic structure – Electrical properties – Vibrational properties – Mechanical properties – Applications (fuel cells, chemical sensors, catalysts) – Filling of carbon nanotubes – CNT emitters.

Unit III **15 hrs**

Fabrication of Nanomaterials: Synthesis of oxide nanoparticles by sol– gel method – Synthesis of metallic nanoparticles Electrochemical deposition method – Sonochemical reduction method – Lithography – – Atomic layer deposition – Synthesis of semiconductor nanoparticles – Arrested precipitation method– Core shell structures – Bio synthesis of nanoparticles using plants – Preparation of magnetic nanomaterials – Super paramagnetism – Coulomb blockade – Single electron transistor.

Unit IV **15 hrs**

Characterization of Nanomaterials: Principles, experimental set– up, procedure and utility of X– ray diffraction (XRD), Scanning electron microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscope (STM) and scanning probe microscopy (SPM) – Fourier transform infrared spectroscopy– Quantum cellular Automata– Spintronics – Giant magnetoresistance – Quantum Hall effect – Quantum spin Hall effect Fractional quantum Hall effect.

Unit V **15 hrs**

Applications: Molecular electronics and nanoelectronics – Nanorobots – – Biological applications of nanoparticles – – Catalysis by gold nanoparticles – Band– gap engineered quantum devices – Nanomechanics –Photo electro chemical cells – Photonic crystals – Plasmon waveguides. Sensors – MEMS/NEMS – Solar cells – Displays – Optical switches – Graphene electronics – Biosensors – Biomarkers and Bio imaging – Targeted drug delivery

Text Books

1. Pradeep.T. (2012). *A Textbook of Nanoscience and Nanotechnology*.New Delhi: Tata McGraw Hill.
2. Kelsall.R.W. Hamley.I.W. (2005).*Nanoscale Science and Nanotechnology*. Chichester:John – Wiley & Sons.
3. Sr. Gerardin Jayam. (2019). *Nano Physics*, (3st ed.). Nagercoil: Department ofPhysics, Holy Cross College.

Reference Books

1. Cao. G. (2004). *Nanostructures and Nanomaterials.* London: Imperial College Press.
2. Poole. C.P. Owens.F.J.(2003).*Introduction to Nanotechnology*. New Delhi: Wiley.

Semester IV

Elective IV (c):X– Ray CrystallographyCourse Code: PP2046

Hours/Week	Credits	Total Hours	Marks
6	5	90	100

Learning Objectives

1. To study the production of X– rays, crystals and its symmetry and their properties.
2. To understand the X– ray intensity data collection techniques, data reduction and structure solution and refinement from crystallographic method.

Course Outcome

Cos	Upon completion of this course students will be able to:	PSO addressed	CL
CO – 1	understand the sources and diffraction of X– rays.	PSO – 1	U
CO – 2	acquire the basic knowledge on crystal systems and various properties of crystals.	PSO – 1	U
CO – 3	explain the crystallographic data collection tools and intensity measurement method.	PSO – 2	E
CO – 4	analyse the structure factor and intensity of diffracted peaks.	PSO – 4	A
CO – 5	obtain the refined crystal structure by applying mathematical calculations.	PSO – 4	Ap

Unit I **15 hrs**

X– rays: X– rays sources – conventional generators– construction and geometry– sealed tube–rotating anode generators–choice of radiation– Synchrotron radiation – X– ray optics: filters– monochromators– collimators– mirrors– safety. Diffraction of X– rays:Lattice– Lattice planes– Miller indices–X– ray diffraction reciprocal lattice–relation between direct and reciprocal space–Bragg's law in reciprocal lattice–sphere of reflection – limiting sphere.

Unit II **15 hrs**

Crystals and their Properties: Crystal systems and symmetry – unit cell – space lattices– non primitive lattices – point groups– space groups–screw axes–glide planes– equivalent positions–matrix representation of symmetry intensity weighted reciprocal lattice-analysis of space group symbols. Crystallization – growing crystals choosing a crystal – mosaic structure– absorption– crystal mounting–alignment – measurement of crystal properties.

Unit III **15 hrs**

Data Collection Techniques for Single Crystals: Laue method– single crystal diffraction cameras: rotation and oscillation method – Ewald construction – Weissenberg method – Precession method. Single crystal diffractometers and datacollection strategy: Instrument geometry–crystal in a diffracting position–determination of unit cell– orientation matrix–Intensity Data collection–Unique data–equivalent reflections – selection of data–Intensity measurement methods: Film methods–counter methods: Point detector– Area detectors–CCD's–Image plates–Low temperature single crystal diffractometry.

Unit IV **15 hrs**

Data Reduction: Integration of intensity–Lorenz and Polarization corrections – absorption– deterioration or radiation damage–scaling – Interpretation of Intensity data. Structure factor – Friedel's Law – exponential and vector form – generalized structure factor Fourier synthesis –Fast Fourier transform – Anomalous scattering and its effect– Calculation of structure factors and Fourier syntheses.

Unit V **15 hrs**

Refinement of Crystal Structures: Weighting – Refinement by Fourier syntheses – Locating Hydrogen atoms– identification of atom types – Least squares – goodness of fit– Least square and matrices– correlation coefficients– Relationship between Fourier and Least squares – Practical consideration in least squares methods.

Text Books

1. G.H. Stout and L.H.Jensen, (1989). Second Edition. *X– ray Structure Determination*:John Wiley Publications.
2. C. Giacovazzo, (2011) *Fundamentals of Crystallography* Second Edition: OxfordPress.
3. Ladd and Palmer Structure (2013) *Determination by X– ray Crystallography*, SecondEdition: Plenum Publishing Corporation.

Reference Books

1. Woolfson, (1997) X– *ray Crystallography*. Second Edition.Cambridge University:Press Publications.
2. Leonid V. Azaroff, (1968) *Elements of X– ray Crystallography*. McGraw Hill Publications.
3. J.P. Glusker, M. Lewis and M. Rossi (1994),*Crystal Structure analysis for Chemistand Biologist* .VCH Publishers Inc.
4. D. Sherwood, and J. Cooper, (2010) *Crystal X– ray and Proteins*. Oxford UniversityPress.
5. F.C. Phillips, John Wiley, (1971) An *Introduction to Crystallography*.

Semester: III & IV

Practical – III Advanced Physics Lab – III (Electronics)

Course Code: PP20P3

Hours/Week	Credits	Total Hours	Marks
6	3	90	100

Learning Objectives

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

Learning Outcome

LOs	Upon completion of this course, students will be able to:	PSO addressed	CL
LO – 1	Analyse the working of code converters (BCD / Gray, excess 3)	**PSO – 2**	**An**
LO – 2	Design various synchronous and asynchronous sequential circuits and study their working	**PSO – 6**	**Ap**
LO – 3	Analyse the applications of op– amps (sine, triangular wave generator, low, high and band pass filters)	**PSO – 2**	**An**
LO – 4	Analyse the behavior of counters (up/down, mod, ring)	**PSO – 2**	**An**
LO – 5	Analyse the working of electronic circuits (multiplexer, demultiplexer, adder, subtractor)	**PSO – 2**	**An**

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

Reference: Material prepared by the department.

Semester: III & IV
Practical IV–Advanced Physics Lab –IV(Microprocessor and MicroController)
Course code: PP20P4

Hours/Week	Credits	Total Hours	Marks
6	3	90	100

Learning 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 microprocessors.

Learning Outcome

Los	**Upon completion of this course, students will be able to:**	**PSO addressed**	**CL**
LO – 1	Experiment with assembly language programming on 8085 microprocessor (Addition, Subtraction, Multiplication &Division)	**PSO – 2**	**Ap**
LO – 2	Apply assembly language programming on microprocessor (Data Manipulation, square of numbers,counters)	**PSO – 4**	**Ap**
LO – 3	Analyse the interfacing of microprocessor 8085 with I/O devices (A/D& D/A, Stepper motor)	**PSO – 2**	**An**
LO – 4	Apply assembly language programs for 8051 microcontroller.	**PSO – 4**	**Ap**

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 data in 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 8085microprocessor
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

Reference: Material prepared by the department.

Self– Learning Course
Semester III
Physics for Lectureship Exam – I
(PP20S1)(CSIR/ JRF/ SLET/ GATE)

Hours/Week	Credits	Total Hours	Marks
–	2	–	100

Learning Objective

1. To motivate the students for career opportunities and also for research activities.

Course Outcome

Cos	Upon completion of this course, students will be able to:	PSO addressed	CL
CO – 1	familiarize with a range of mathematical methods that are essential for solving advanced problems in theoretical physics.	**PSO – 1**	**U**
CO – 2	model mechanical systems, both in inertial and rotating frames, using Lagrange and Hamilton equations	**PSO – 4**	**Ap**
CO – 3	gain insight into the physical nature of electric and magnetic phenomena	**PSO – 1**	**U**
CO – 4	use quantum mechanical principles to analyze advanced Physical phenomena of nature	**PSO – 6**	**Ap**
CO – 5	understand the theory and methods of statistical physics and thermodynamics.	**PSO – 1**	**U**

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 connectionwith thermodynamic quantities – Classical and quantum statistics – Ideal Bose andFermi gases – Principle of detailed balance – Blackbody radiation and Planck's distribution law.

Reference Book

1. W. Malemnganba Chenglei, 2018, Study Materials UGC CSIR NET/SET (JRF &LS) Physical Sciences, Arihant Publications Ltd.

Self– Learning Course Semester IV
Physics for Lectureship Exam – II (PP20S2)
(CSIR/ JRF/ SLET/ GATE)

Hours/Week	Credits	Total Hours	Marks
–	2	–	100

Learning Objective

1. To build confidence to face competitive exams and pursue research.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO – 1	understand the physical construction, working and operational characteristics of semiconductor devices	**PSO– 1**	**U**
CO – 2	attain knowledge on the structure and dynamics of the molecules through various theories	**PSO– 3**	**A**
CO – 3	develop analytical thinking to understand the phenomenon that decide various properties of solids	**PSO– 4**	**C**
CO – 4	Know the scientific, environmental and technological applications of nuclear physics	**PSO– 7**	**U**
CO – 5	Study the fundamentals of wave mechanics	**PSO– 1**	**U**

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 andDirac equations – Semi– classical theory of radiation – Bose– Einstein condensation – . Diffusion equation – Random walk and Brownian motion – Introduction to non equilibrium processes.

Reference Book

1. W. Malemnganba Chenglei, 2018, Study Materials UGC CSIR NET/SET (JRF & LS) Physical Sciences, Arihant Publications Ltd

Local

National

Regional

Global