V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Re-accredited with 'A' Grade (3rd Cycle) by NAAC
VIRUDHUNAGAR - 626 001

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM REGULATIONS AND SYLLABUS
(with effect from Academic Year 2020 - 2021)

V.V.Vanniaperumal College for Women, Virudhunagar established in 1962, offers 20 UG Programmes, 14 PG Programmes, 6 M.Phil. Programmes and 6 Ph.D. Programmes. The curricula for all these Programmes, except Ph.D. Programmes, have been framed as per the guidelines given by the and University Grants Commission (UGC) & Tamil Nadu State Council for Higher Education (TANSCHE) under Choice Based Credit System (CBCS) and the guidelines for Outcome Based Education (OBE).

The Departments of Commerce, English, History, Mathematics, Biochemistry and Tamil upgraded as Research Centres offer Ph.D. Programmes as per the norms and regulations of Madurai Kamaraj University, Madurai and do not come under the purview of CBCS.

A. CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed Courses. The CBCS is followed as per the guidelines formulated by the UGC. The performance of students is evaluated based on the uniform grading system. Computation of the Cumulative Grade Point Average (CGPA) is made to ensure uniformity in evaluation system.

List of Programmes in which CBCS/Elective Course System is implemented

UG PROGRAMMES

Arts & Humanities	:	History (E.M. & T.M.), English, Tamil
Physical & Life Sciences	:	Mathematics, Zoology, Chemistry, Physics, Biochemistry, Home Science - Nutrition and Dietetics, Costume Design and Fashion, Microbiology, Biotechnology, Computer Science, Information Technology and Computer Applications.
Commerce & Management	:	Commerce, Commerce (Computer Applications), Commerce (Professional Accounting), Business Administration.

PG PROGRAMMES

Arts & Humanities	:	History, English, Tamil
Physical & Life Sciences	:	Mathematics, Physics, Biochemistry, Home Science - Nutrition and Dietetics, Chemistry, Zoology, Computer Science, Information Technology, Computer Applications (MCA*)
Commerce & Management	:	Commerce, Business Administration (MBA*)
		* AICTE approved Programmes

PRE-DOCTORAL PROGRAMMES (M.Phil.)

Arts & Humanities	:	History, English, Tamil
Physical & Life Sciences	:	Mathematics, Biochemistry
Commerce & Management	:	Commerce

OUTLINE OF CHOICE BASED CREDIT SYSTEM - PG

1. Core Courses
2. Project
3. Elective Courses
   - 3.1 Discipline Specific Elective Courses (DSEC)
   - 3.2 Non Major Elective Course (NMEC)
4. Online Course – Practice for CSIR NET – General Paper
5. Extra Credit Courses (Optional)

List of Non Major Elective Courses (NMEC) Offered

PG PROGRAMMES

Name of the Course	Semester	Department
History of Freedom Movement in India (A.D. 1885 - 1947)	III	History
English for Job Aspirants	III	English
jkpOk; gpwJiwfSk;	III	Tamil
Taxation Concepts and Assessment	III	Commerce
Entrepreneurship	III	Business Administration
Mathematics for Competitive Examinations	III	Mathematics
Digital Electronics	III	Physics
Chemistry for Competitive Examinations	III	Chemistry
Apiculture	III	Zoology
Nutrition and Health	III	Home Science - Nutrition and Dietetics
Clinical Biochemistry	III	Biochemistry
Web Programming	III	Computer Science
Fundamentals of Information Technology	III	Information Technology

WebTechnology	III	Computer Applications

B. OUTCOME BASED EDUCATION (OBE) FRAMEWORK

The core philosophy of Outcome Based Education rests in employing a student - centric learning approach to measure the performance of students based on a set of pre- determined outcomes. The significant advantage of OBE is that it enables a revamp of the curriculum based on the learning outcomes, upgrade of academic resources, quality enhancement in research and integration of technology in the teaching-learning process. It also helps in bringing clarity among students as to what is expected of them after completion of the Programme in general and the Course in particular. The OBE directs the teachers to channelise their teaching methodologies and evaluation strategies to attain the Programme Educational Objectives (PEOs) and fulfill the Vision and Mission of the Institution.

Vision of the Institution

The founding vision of the Institution is to impart Quality Education to the rural womenfolk and to empower them with knowledge and leadership quality.

Mission of the Institution

The mission of the Institution is to impart liberal education committed to quality and excellence. Its quest is to mould learners into globally competent individuals instilling in them life-oriented skills, personal integrity, leadership qualities and service mindedness.

B.1 Programme Educational Objectives, Programme Outcomes and Programme Specific Outcomes

It is imperative for the Institution to set the Programme Educational Objectives (PEOs), Programme Outcomes (POs) and Course Outcomes (COs), consistent with its Vision and Mission statements. The PEOs and the POs should be driven by the Mission of the Institution and should provide distinctive paths to achieve the stated goals. The PEOs for each Programme have to fulfill the Vision and Mission of the Department offering the Programme.

Vision of the Department of Physics

To awaken the young minds and discover their talents by providing a skilful learning experience and to develop analytical and problem-solving skills and give them a wide range of career choice.

Mission of the Department of Physics

To impart theoretical and experimental knowledge in Physics as well as to infuse the spirit of inquiry and research for personal and professional development with ethical values.

B.1.1 Programme Educational Objectives (PEOs)

PEOs are broad statements that describe the career and professional achievements that the Programme is preparing the graduates to achieve within the first few years after graduation. PEOs are framed for each Programme and should be consistent with the Mission of the Institution.

Programme Educational Objectives (PEOs) of M.Sc. Physics Programme

The students will be able to

- apply obtained knowledge and wisdom in Physics to real life situations.
- think critically and practice recent methodologies for conducting research in the chosen field.
- incur values and skills for professional empowerment and social recognition.

Key Components of Mission Statement	PEO1	PEO2	PEO3
Mastery of the Subject	✓	✓	-
Research Skills	-	✓	✓
Professional Skills	✓	✓	✓
Ethical Values	✓	✓	✓

B.1.2 Programme Outcomes (POs)

POs shall be based on Graduate Attributes (GAs) of the Programme. The GAs are the attributes expected of a graduate from a Programme in terms of knowledge, skills, attitude and values. The Graduate Attributes include Disciplinary Knowledge, Communication Skills, Critical Thinking, Problem Solving, Analytical Reasoning, Research Related Skills, Co- operation/Team Work, Scientific Reasoning, Reflective Thinking, Information/Digital Literacy, Multicultural Competence, Moral and Ethical Awareness/Reasoning, Leadership Qualities and Lifelong Learning.

On successful completion of the Programme, the students will be able to

1 apply their in depth domain knowledge and practical skills in interdisciplinary fields for research-based endeavours, employment and entrepreneurship development. (*Disciplinary Knowledge)*

2 communicate proficiently and confidently with the ability to present complex ideas

in a concise manner to assorted groups. (*Communication Skills*)

3 identify, formulate and solve problems in a consistent and systematic way with updated skills using modern tools and techniques. (*Scientific Reasoning and Problem Solving*)

4 analyze the data, synthesise the findings and provide valid conclusion by critical evaluation of theories, policies and practices for the betterment of society. (*Critical Thinking and Analytical Reasoning*)

5 explore and evaluate globally competent research methodologies to apply appropriately in interdisciplinary research; Develop and sustain the research capabilities to meet the emerging needs for the welfare of the society. (*Research Related Skills*)

6 use ICT to mould themselves for lifelong learning activities to face career challenges in the changing environment. (*Digital Literacy, Self - Directed and Lifelong Learning*)

7 self-manage and function efficiently as a member or a leader in diverse teams in a multicultural society for nation building. (*Co-operation/Team Work and Multicultural Competence*)

8 uphold the imbibed ethical and moral values in personal, professional and social life for sustainable environment. (*Moral and Ethical Awareness*)

B.1.3 ProgrammeSpecific Outcomes (PSOs)

Based on the Programme Outcomes, Programme Specific Outcomes are framed for each PG Programme**.** ProgrammeSpecific Outcomes denote what the students would be able to do at the time of graduation. They are Programme-specific and it is mandatory that each PO should be mapped to the respective PSO.

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

PO 1: *Disciplinary Knowledge*

PSO 1a: Apply their academic proficiency of concepts, theories, current and emerging development in the field of Physics to meet challenges in interdisciplinary research work, teaching and government/public sector.

PSO 1b: Execute Physics related experiments in a systematic manner, analyse and interpret the results using appropriate methods and report accurately the findings/conclusions

of the experiments with relevant theories of Physics.

PO 2: *Communication Skills*

PSO 2: Communicate profoundly their acquired knowledge in the academic field of Physics through oral/written mode where assessment of their knowledge is needed and share their proficiency in diverse fields to assorted audience.

PO 3: *Scientific Reasoning and Problem Solving*

PSO 3: Develop problem solving skills that are required to solve different types of Physics related problems with well-defined solutions and tackle open ended problems that belong to disciplinary area bounded.

PO 4: *Critical Thinking and Analytical Reasoning*

PSO 4: Analyse theories/equations of physical concepts to realize their significance in emerging technical aspects, industrial applications and critically evaluate them to be beneficial for the advancement of society.

PO 5: *Research Related Skills*

PSO 5: Adapt recent developments to execute interdisciplinary research for the environmental safety in global and social context.

PO 6: *Digital Literacy, Self-directed and lifelong learning*

PSO 6a: Use programming/computational techniques to represent, evaluate and analyse physical concepts that helps to progress research effectively.

PSO 6b: Identify, access and manage wide range of online resources for self-directed lifelong learning in their field of interest to compete in the digital environment and have a successful career.

PO 7: *Co-operation/Team Work and Multi-Cultural Competence*

PSO 7: Get acquainted with cultural diversity and work as a proficient member in a globalised team, or as an individual for personal and professional development that leads to the progress of the nation.

PO 8: *Moral and Ethical Awareness*

PSO 8: Respect individuality, appreciate the accomplishment of people in every phase of life adhering to ethical standard and integrity in Physics community around the world to build a prosperous living environment.

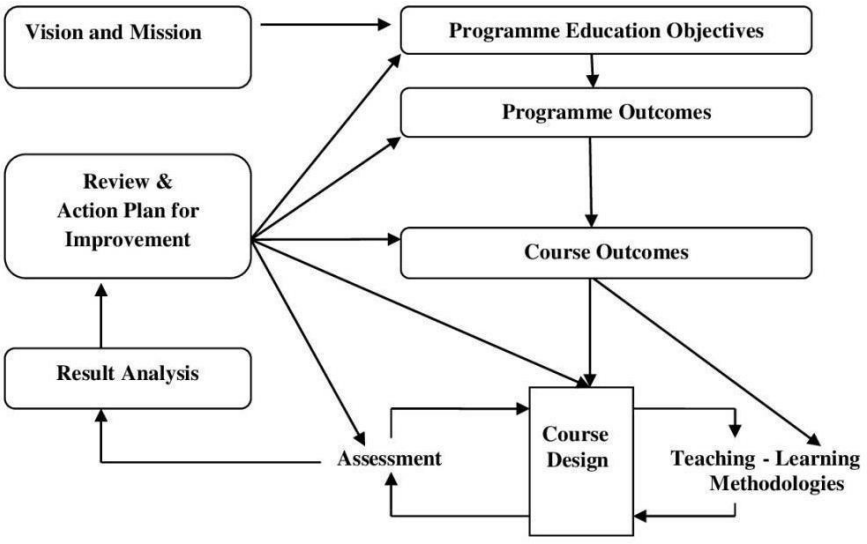
PO-PEO Mapping Matrix

Attainment of PEOs can be measured by a PO-PEO matrix. PEOs should evolve through constant feedback from alumnae, students, industry, management, *etc*. It is mandatory that each PEO should be mapped to at least one of the POs.

PEOs / POs/PSOs	PEO1	PEO2	PEO3
PO1/PSO1	✔	✔	✓
PO2/PSO2	✔	✔	✔
PO3/PSO3	✔	✔	-
PO4/PSO4	✔	✔	-
PO5/PSO5	✔	✔	✔
PO6/PSO6	✔	✔	✔
PO7/PSO7	-	✔	✔
PO8/PSO8	✔	✔	✔

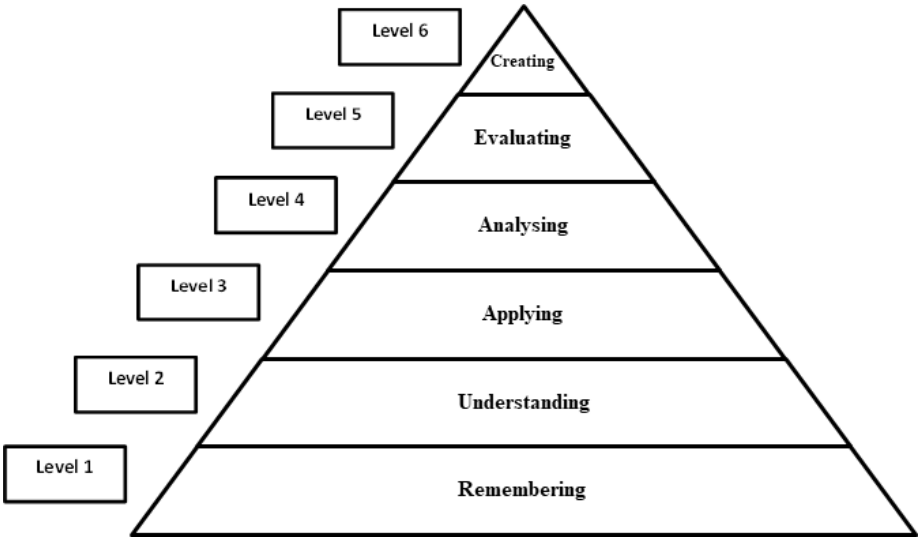
B.1.4 Course Outcomes (COs)

Course Outcomes are narrow statements restricted to the course contents given in five units. Course Outcomes describe what students would be capable of, after learning the contents of the Course. They reflect the level of knowledge gained, skills acquired and attributes developed by the students after learning of Course contents. COs are measurable, attainable and manageable in number. COs contribute to attain POs in such a way that each CO addresses at least one of the POs and also each PO is reasonably addressed by adequate number of COs.



It is important to determine the methods of assessment. A comprehensive assessment strategy may be outlined using the revised Bloom's Taxonomy levels.

BLOOM'S TAXONOMY



CO - PO Mapping of Courses

After framing the CO statements, the COs framed for each course is mapped with POs based on the relationship that exists between them. The COs which are not related toany of the POs is indicated with (-), signifying Nil. Measurement Mapping is based on Four Points Scale [High (H), Medium (M), Low (L) and Nil (-)]. For calculating weighted percentage of contribution of each Course in the attainment of the respective POs, the weights assigned for H, M and L are 3, 2 and 1 respectively.

CO-PO/PSO Mapping Table (Course Articulation Matrix)

PO/PSOs / **COs**	**PO1/ PSO1**	**PO2/ PSO2**	**PO3/ PSO3**	**PO4/ PSO4**	**PO5/ PSO5**	**PO6/ PSO6**	**PO7/ PSO7**	**PO8/ PSO8**
CO1								
CO2								
CO3								
CO4								
CO5								

ELIGIBILITY FOR ADMISSION

The candidate should have passed in B.Sc.Physics Degree from any recognized University.

DURATION OF THE PROGRAMME

The candidates shall undergo the prescribed Programme of study for a period of two academic years (four semesters).

MEDIUM OF INSTRUCTION

English

B.2 EVALUATION SCHEME

Components	Internal Assessment Marks	External Examination Marks	Total Marks
Theory	40	60	**100**
Project	60	40	**100**

B.2.1 Core Courses, Discipline Specific Elective Courses &Non Major Elective Course

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation			Marks
Periodic Test		:	25
Assignment	K5 Level	:	5
Seminar		:	10
Total		**:**	**40**

Three Periodic Tests - Average of the best two will be considered
Two Assignments - Better of the two will be considered

Practical

Mode of Evaluation		Marks
Test	:	15
Model Examination		15
Performance	:	10
Total	**:**	**40**

Test - Average of the two will be considered
Model Examination - Better of two will be considered
Performance - Attendance and Record

Question Pattern for Periodic Test **Duration: 2 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Max. Marks
A Q.No.(1 - 5)	MCQ	5	5	1	5
B Q.No.(6-10)	Internal Choice - Either Or Type	5	5	5	25
C Q.No.(11-12)	Internal Choice- Either Or Type	2	2	10	20
				Total	**50***

*The total marks obtained in the Periodic Test will be calculated for 25 marks

EXTERNAL EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q.No.(1 - 5)	MCQ	5	5	1	5
B Q.No.(6-10)	Internal Choice- Either Or Type	5	5	5	25
C Q.No.(11-13)	Internal Choice- Either Or Type	3	3	10	30
Total					**60**

B.2.2 Project

Project is compulsory for II PG Students in IV Semester.

Distribution of Marks

Mode of Evaluation		Marks
Internal Assessment	:	60
External Examination	:	40
Total	:	**100**

Evaluation Pattern (100 marks)					
Internal Assessment (60marks)				External Assessment (40 marks)	
One Periodic Test (20)	Project Report (20)	Pre-Submission Presentation (10)	One Open online Course related to the Project (10)	Project Presentation (30)	Viva Voce (10)

B.2.3 Online Course

Practice for CSIR NET - General Paper

Internal Examination only

- Online Test with Multiple Choice Questions will be conducted in III Semester.
- Model Examination will be conducted after two periodic tests.

Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	40
Model Examination	:	60
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.4 Extra Credit Courses

- Two credits are allotted for each Extra Credit Course offered by the Department.
- Extra credits are allotted for the completion of Open Online Courses offered by MOOC to the maximum of 15 credits.
  - The Courses shall be completed within the first III Semesters of the Programme.
  - The allotment of credits is as follows

    4 weeks Course - 1 credit

    8 weeks Course - 2 credits

    12 weeks Course - 3 credits

ELIGIBILITY FOR THE DEGREE

The candidate will not be eligible for the Degree without completing the prescribed Courses of study and a minimum of 50% Pass marks in all the Courses.

- No Pass minimum for Internal Assessment for other Courses.
- Pass minimum for External Examination is 27 marks out of 60 marks for Core Courses, Discipline Specific Elective Courses and Non Major Elective Course.
- Pass minimum for Practice for SET/NET - General Paper is 50 Marks.

- ATTENDANCE
  - The students who have attended the classes for 76 days (85%) and above are permitted to appear for the Summative Examinations without any condition.
  - The students who have only 60-75 days (66% - 84%) of attendance are permitted to appear for the Summative Examinations after paying the required fine amount and fulfilling other conditions according to the respective cases.

- The students who have attended the classes for 59 days and less – upto 45 days (50% - 65%) can appear for the Summative Examinations only after getting special permission from the Principal.
- The students who have attended the classes for 44 days or less (<50%) cannot appear for the Summative Examinations and have to repeat the whole semester.
- These rules are applicable to UG, PG and M.Phil. Programmes and come into effect from 2020-2021 onwards.
- For Certificate, Diploma, Advanced Diploma and Post Graduate Diploma Programmes, the students require 75% of attendance to appear for the Theory/Practical Examinations.

B.3 ASSESSMENT MANAGEMENT PLAN

An Assessment Management Plan that details the assessment strategy both at the Programme and the Course levels is prepared. The continuous assessment is implemented using an assessment rubric to interpret and grade students.

B.3.1 Assessment Process for CO Attainment

Assessment is one or more processes carried out by the institution that identify, collect and prepare data to evaluate the achievement of Course Outcomes and Programme Outcomes. Course Outcome is evaluated based on the performance of students in the Continuous Internal Assessments and in End Semester Examination of a course. Target levels of attainment shall be fixed by the Course teacher and Heads of the respective departments.

Direct Assessment (Rubric based) - Conventional assessment tools such as Term Test, Assignment, Quiz and End Semester Summative Examination are used.

Indirect Assessment - Done through Course Exit Survey.

CO Assessment Rubrics

For the evaluation and assessment of COs and POs, rubrics are used. Internal assessment contributes 40% and End Semester assessment contributes 60% to the total attainment of a CO for the theory courses. For the practical courses, internal assessment contributes 50% and Semester assessment contributes 50% to the total attainment of a CO. Once the Course Outcome is measured, the PO can be measured using a CO-PO matrix.

CO Attainment

Direct CO Attainment

Course Outcomes of all courses are assessed and the CO - wise marks obtained by all the students are recorded for all the assessment tools. The respective CO attainment level is evaluated based on set attainment rubrics.

Attainment Levels of COs

Assessment Methods	**Attainment Levels**	
Internal Assessment	Level 1	50% of students scoring more than average marks or set target marks in Internal Assessment tools
	Level 2	55% of students scoring more than average marks or set target marks in Internal Assessment tools
	Level 3	60% of students scoring more than average marks or set target marks in internal Assessment tools
End Semester Summative Examination	Level 1	50% of students scoring more than average marks or set target marks in End Semester Summative Examination
	Level 2	55% of students scoring more than average marks or set target marks in End Semester Summative Examination
	Level 3	60% of students scoring more than average marks or set target marks in End Semester Summative Examination

Target Setting for Assessment Method

For setting up the target of internal assessment tools, 55% of the maximum mark is fixed as target. For setting up the target of End Semester Examination, the average mark of the class shall be set as target.

Formula for Attainment for each CO

Attainment = Percentage of students who have scored more than the target marks

$$\text{Percentage of Attainment} = \frac{\text{Number of Students who Scored more than the Target}}{\text{Total Number of Students}} \times 100$$

Indirect CO Attainment

At the end of each Course, an exit survey is conducted to collect the opinion of the students on attainment of Course Outcomes. A questionnaire is designed to reflect the views of the students about the attainment of Course Outcomes.

Overall CO Attainment=75% of Direct CO Attainment + 25 % of Indirect CO Attainment

In each Course, the level of attainment of each CO is compared with the predefined targets. If the target is not reached, the Course teacher takes necessary steps for the improvement to reach the target.

For continuous improvement, if the target is reached, the Course teacher can set the target as a value greater than the CO attainment of the previous year.

B.3.2 Assessment Process for Overall PO Attainment

With the help of CO against PO mapping, the PO attainment is calculated. PO assessment is done by giving 75% weightage to direct assessment and 25% weightage to indirect assessment. Direct assessment is based on CO attainment, where 75% weightage is given to attainment through End Semester examination and 25% weightage is given to attainment through internal assessments. Indirect assessment is done through Graduate Exit Survey and participation of students in Co-curricular/Extra curricular activities.

PO Assessment Tools

Mode of Assessment	Assessment Tool	Description
Direct Attainment (Weightage -75%)	CO Assessment	This is computed from the calculated CO Attainment value for each Course
Indirect Attainment (Weightage - 25%)	Graduate Exit Survey 10%	At the end of the Programme, Graduate Exit Survey is collected from the graduates and it gives the opinion of the graduates on attainment of Programme Outcomes
	Co-curricular / Extra curricularactivities 15%	For participation in Co-curricular/Extra curricularactivities during the period of their study.

Programme Articulation Matrix (PAM)

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8
Average Direct PO Attainment									
Direct PO Attainment in									

Indirect Attainment of POs for all Courses

POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8
Graduate Exit Survey								
Indirect PO Attainment								

Attainments of POs for all Courses

POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
Direct Attainment(Weightage - 75%)								
Indirect Attainment(Weightage - 25%)								
Overall PO Attainment								

Overall PO Attainment= [75% of Direct PO Attainment +
25% of Indirect PO Attainment (Graduate Exit Survey & Participation in Co- curricular and Extra curricular Activities)]

Expected Level of Attainment for each of the Programme Outcomes

POs			Level of Attainment
Value	>=	70%	Excellent
Value	> =	60 % and Value < 70%	Very Good
Value	> =	50 % and Value < 60%	Good
Value	> =	40% and Value < 50%	Satisfactory
Value	<	40%	Not Satisfactory

Level of PO Attainment

Graduation Batch	Overall PO Attainment (in percentage)	Whether Expected Level of PO is Achieved? (Yes/No)

B.3.3 Assessment Process for PEOs

The curriculum is designed so that all the courses contribute to the achievement of PEOs. The attainment of PEOs is measured after 3 years of completion of the Programme only through Indirect methods.

Target for PEO Attainment

Assessment Criteria	Target (UG)	Target (PG)
Record of Employment	25 % of the class strength	30 % of the class strength
Progression to Higher Education	40 % of the class strength	5 % of the class strength
Record of Entrepreneurship	2 % of the class strength	5 % of the class strength

Attainment of PEOs

Assessment Criteria&Tool	Weightage
Record of Employment	10
Progression to Higher Education	20
Record of Entrepreneurship	10
Feedback from Alumnae	30
Feedback from Parents	10
Feedback from Employers	20
Total Attainment	**100**

$$\text{Percentage of PEO Attainment from Employment} = \frac{\text{Number of Students who have got Employment}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Higher Education} = \frac{\text{Number of Students who pursue Higher Education}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Entrepreneurship} = \frac{\text{Number of Students who have become Entrepreneurs}}{\text{Target}} \times 100$$

Expected Level of Attainment for each of the Programme Educational Objectives

POs			**Level of Attainment**
Value	>=	70%	Excellent
Value	> =	60 % and Value < 70%	Very Good
Value	> =	50 % and Value < 60%	Good
Value	> =	40% and Value < 50%	Satisfactory
Value	<	40%	Not Satisfactory

Level of PEO Attainment

Graduation Batch	**Overall PEO Attainment (in percentage)**	**Whether Expected Level of PEO is Achieved? (Yes/No)**

C. PROCESS OF REDEFINING THE PROGRMME EDUCATIONAL OBJECTIVES

The college has always been involving the key stake holders in collecting information and suggestions with regard to curriculum development and curriculum revision. Based on the information collected, the objectives of the Programmeare defined, refined and are inscribed in the form of PEOs. The level of attainment of PEOs defined earlier will be analysedand will identify the need for redefining PEOs. Based on identified changes in terms of curriculum, regulations and PEOs, the administrative system like Board of Studies, Academic Council and Governing Body may recommendappropriate actions. As per the Outcome Based Education Framework implemented from the Academic Year 2020 -2021, the following are the Programme Structure, the Programme Contents and the Course Contents of M.Sc. Physics Programme.

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MASTER OF SCIENCE- PHYSICS (7014)

Outcome Based Education with Choice Base Credit System

Programme Structure - Allotment of Hours and Credits

For those who join in the Academic Year 2020-21

Components	Semester				Total Number of Hours (Credits)
	I	II	III	IV	
Core Course	6 (4)	6 (4)	6 (4)	6 (5)	24 (17)
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	-	-	-	6 (5)	6 (5)
Core Course Practical	6 (3)	6 (3)	6 (3)	-	18 (9)
Project	-	-	-	6 (4)	6(4)
Discipline Specific Elective Course	6 (5)	6 (5)	-	-	12 (10)
Non Major Elective Course	-	-	5 (4)	-	5 (4)
Online Course	-	-	1 (1)	-	1 (1)
Total	**30 (22)**	**30 (22)**	**30 (22)**	**30 (24)**	**120 (90)**
Extra Credit Course(Optional) - MOOC	-	-	-	-	Limited to a maximum of 15 credits

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VIRUDHUNAGAR - 626 001

MASTER OF PHYSICS

Programme Code - 7014

PROGRAMME CONTENT

M.Sc. Physics -SEMESTER I

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-1	Mathematical Physics - I	20PPHC11	6	4	3	40	60	100
2	Core Course-2	Classical Mechanics	20PPHC12	6	5	3	40	60	100
3	Core Course-3	Advanced Electronics	20PPHC13	6	5	3	40	60	100
4	Core Practical-I	Electronics and General Physics lab-I	20PPHC11P	6	3	6	40	60	100
5	DSEC-1	DSEC - Numerical Methods & Programming in C++/ Microprocessors/ Renewable Energy Sources	20PPHE11/ 20PPHE12/ 20PPHE13	6	5	3	40	60	100
Total				**30**	**22**				**500**

DSEC - Discipline Specific Elective Course

M.Sc. Physics -SEMESTER II

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-4	Mathematical Physics - II	20PPHC21	6	4	3	40	60	100
2	Core Course-5	Statistical Mechanics	20PPHC22	6	5	3	40	60	100
3	Core Course-6	Quantum Mechanics - I	20PPHC23	6	5	3	40	60	100
4	Core Practical-II	Electronics and General Physics lab-II	20PPHC21P	6	3	6	40	60	100
5	DSEC-2	DSEC- Nuclear and Particle Physics/ Applied Optics and Laser Physics/ Fiber Optic Communication	20PPHE21/ 20PPHE22/ 20PPHE23	6	5	3	40	60	100
Total				**30**	**22**				**500**

DSEC- Discipline Specific Elective Course

M.Sc. Physics -SEMESTER III

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-7	Solid State Physics - I	20PPHC31	6	4	3	40	60	100
2	Core Course-8	Electromagnetic Theory	20PPHC32	6	5	3	40	60	100
3	Core Course-9	Quantum Mechanics - II	20PPHC33	6	5	3	40	60	100
4	Core Practical-III	Electronics and General Physics lab-III	20PPHC31P	6	3	6	40	60	100
5	NMEC	NME - Digital Electronics	20PPHN31	5	4	3	40	60	100
6	Online Course	Practice for CSIR NET – General Paper	20PGOL32	1	1	-	100		100
Total				**30**	**22**				**600**

NMEC: Non Major Elective Course

M.Sc. Physics-SEMESTER IV

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-10	Solid State Physics- II	20PPHC41	6	5	3	40	60	100
2	Core Course-11	Molecular Spectroscopy	20PPHC42	6	5	3	40	60	100
3	Core Course-12	Electronic Communications	20PPHC43	6	5	3	40	60	100
4	Core Course-13	Nano Physics	20PPHC44	6	5	3	40	60	100
5	Core Course	Project	20PPHC41PR	6	4	6	40	60	100
Total				**30**	**24**				**500**

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VIRUDHUNAGAR - 626 001

MASTER OF PHYSICS

Programme Code - 7014

REVISED PROGRAMME CONTENT

SEMESTER I

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-1	Mathematical Physics - I	20PPHC11	6	4	3	40	60	100
2	Core Course-2	Classical Mechanics	20PPHC12	6	5	3	40	60	100
3	Core Course-3	Advanced Electronics	20PPHC13	6	5	3	40	60	100
4	Core Practical-I	Electronics and General Physics lab-I	20PPHC11P	6	3	6	40	60	100
5	DSEC-1	DSEC - Numerical Methods & Programming in C++/ Microprocessors/ Renewable Energy Sources	20PPHE11/ 20PPHE12/ 20PPHE13	6	5	3	40	60	100
Total				**30**	**22**				**500**

DSEC - Discipline Specific Elective Course

M.Sc. Physics -SEMESTER II

S. No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-4	Mathematical Physics - II	20PPHC21N	6	4	3	40	60	100
2	Core Course-5	Statistical Mechanics	20PPHC22	6	5	3	40	60	100
3	Core Course-6	Quantum Mechanics - I	20PPHC23N	6	5	3	40	60	100
4	Core Practical-II	Electronics and General Physics lab-II	20PPHC21P	6	3	6	40	60	100
5	DSEC-2	DSEC- Nuclear and Particle Physics/ Applied Optics and Laser Physics/ Fiber Optic Communication	20PPHE21N/ 20PPHE22/ 20PPHE23	6	5	3	40	60	100
Total				**30**	**22**				**500**

DSEC- Discipline Specific Elective Course

M.Sc. Physics -SEMESTER III

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-7	Solid State Physics - I	20PPHC31N	6	4	3	40	60	100
2	Core Course-8	Electromagnetic Theory	20PPHC32N	6	5	3	40	60	100
3	Core Course-9	Quantum Mechanics - II	20PPHC33	6	5	3	40	60	100
4	Core Practical-II	Electronics and General Physics lab-III	20PPHC31PN	6	3	6	40	60	100
5	NMEC	NME - Digital Electronics	20PPHN31	5	4	3	40	60	100
6	Online Course	Practice For SET/NET – General Paper	20PGOL32	1	1	-	100		100
Total				**30**	**22**				**600**

NMEC: Non Major Elective Course

M.Sc. Physics-SEMESTER IV

S.No.	Components	Title of theCourse	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	CoreCourse-10	Solid State Physics- II	20PPHC41N	6	5	3	40	60	100
2	CoreCourse-11	Molecular Spectroscopy	20PPHC42	6	5	3	40	60	100
3	CoreCourse-12	Electronic Communications	20PPHC43N	6	5	3	40	60	100
4	CoreCourse-13	Nano Physics	20PPHC44N	6	5	3	40	60	100
5	Core Course	Project - Research Methodology & Ethics	22PPHC41PR	6	4	6	40	60	100
Total				**30**	**24**				**500**

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VIRUDHUNAGAR - 626 001

M.Sc. Physics
(2020-2021 onwards)

Semester I	**MATHEMATICAL PHYSICS-I**	Hours/Week: 6	
Core Course-1		Credits: 4	
Course Code **20PPHC11**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain vector operators, matrices and special functions like Legendre, Bessel and Hermite polynomials. [K2]

CO2 : solve problems using vector identities, matrices and linear differential equations using power series method. [K3]

CO3 : analyze Gauss's and Stoke's theorems in vectors, operations in matrices, Laplace's and Bessel's integrals. [K4]

CO4 : develop vector operators in orthogonal curvilinear coordinates, systems of linear equations general, generating function and recurrence relations of special functions. [K4]

CO5 : determine the equation of heat flow in solids, Trignometric series for Pn(X), Jacobi Series of Jn (x), orthogonality of special functions, eigen values and eigen vectors in matrices. [K5]

UNIT I

Vectors: Review of vector algebra – Gradiant of a scalar field – Line, Surface and Volume integrals – Divergence of a vector function – Curl of a vector function and its physical significance – Imporant vector identities – Gauss Divergence Theorem – Deductions from Gauss Divergence Theorem – Stoke's theorem – Deductions from Stoke's theorem – Orthogonal Curvilinear coordinates – Application of Vectors: The Equation of heat flow in solids. (18 Hours)

UNIT II

Matrices: Basic algebraic operations - Special matrices (I & II) - Determinants -Partitioning of matrices - Systems of linear equations- particular cases - Systems of linear equations general - Eigen value problems (I & II). (18 Hours)

UNIT III

Special Functions I: Legendre Differential Equation and Legendre functions -Generating function of Legendre polynomial - Rodrigue's formula for the Legendre Polynomials - Orthogonal properties of Legendre's polynomials - Recurrence formulae for $P_n(X)$ - Laplace's integrals for$P_n(X)$ - Trignometric series for $P_n(X)$.

(18 Hours)

UNIT IV

Special Functions II: Bessel's Differential Equation - Bessel's function of first and second kind - Recurrence formulae for $J_n(x)$ - Generating function for $J_n(x)$ - Jacobi series - Bessel's integrals - Orthonormality of Bessel's functions - Modified Bessel's function. (18 Hours)

UNIT V

Special Functions III: Hermite Differential Equation and Hermite polynomials - Generating function of Hermite polynomials - Recurrence formulae for Hermite polynomials - Rodrigue's formula for Hermite polynomials - Orthogonality of Hermite polynomials. (18 Hours)

TEXT BOOKS

1. SathyaPrakash, (2011).*Mathematical Physics*, New Delhi: Sultan Chand & Sons.
   UNIT I – CHAPTER 1- 1.1 to 1.10, 1.15, 1.19 (B)
   UNIT III – CHAPTER 7 - 7.11 to 7.17
   UNIT IV – CHAPTER 7 - 7.21, 7.25 to 7.30
   UNIT V – CHAPTER 7 - 7.33 to 7.37
2. Joshi, A.W., (1995). *Matrices and Tensors in Physics*, (Third Edition). New Age International Publishers Ltd.
   UNIT II – CHAPTER 1- 2.1 to 2.12, 3.1 to 3.4, 3.8, 4, 5.1 to 5.7, 6.1, 6.2 , 7.1, 7.2, 7.4, 7.5, 8.1 to 8.3, 9.1 to 9.3, 10.1.

REFERENCE BOOKS

1. Gupta, B.D., (2009). *Mathematical Physics*, Third Edition. Vikas Publishing House.
2. Pipes and Harvill, (1970). *Applied mathematical for Engineers and Physicists*, III Edition. McGraw Hill International Book Company.
3. Weber and Arfken, (2005). *Essential Mathematical methods for Physicists,* New Delhi: Elsevier India pvt. Ltd.

Course code 20PPHC11	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6a	PSO 6b	PSO 7	PSO 8
CO1	H	L	H	H	M	M	L	M	-	-
CO2	H	L	H	H	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	H	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

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VIRUDHUNAGAR - 626 001

M.Sc. Physics
(2020-2021 onwards)

Semester I	**CLASSICAL MECHANICS**	Hours/Week: 6	
Core Course-2		Credits: 5	
Course Code **20PPHC12**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : understand the Lagrangian, Hamiltonian, Canonical Transformation, Hamilton-Jacobi method, and the basic mechanical concepts related to advanced problems involving the dynamic motion of classical mechanical systems. [K2]

CO2 : illustrate the motion of a mechanical system using Lagrange – Hamilton formulation. [K3]

CO3 : explain canonical transformation equations, Lagrange & Poisson brackets, Action and angle variable method, the reduction of two- body problem and classification of orbits, Virial theorem, Kepler's law of planetary motion, theory of small oscillations. [K4]

CO4 : analyze principle of least action, Liouville's theorem, application of Lagrangian equation, Hamiltonian equations of motion and its functions. [K4]

CO5 : assess the various aspects of dynamics and oscillations of bodies using Lagrange & Poisson brackets, Lagrangian& Hamiltonian equations and Hamilton-Jacobi method. [K5]

UNIT I

Lagrangian and Hamiltonian Methods: Generalised Coordinates - Hamiltonsvariational principle - Deduction of Lagrangian equations of motions from Hamilton's principle - Deduction of Lagrangian equations by differential method - D'Alembert's principle - Procedure to eliminate consideration of ignorable co-ordinates - The Routhain function - Hamiltonian - Hamiltonian

canonical equations of motion - Physical significance of the Hamiltonian - Advantages of Hamiltonian approach - Deduction of canonical equations from Variational principle - Applications of Hamilton's equation of motion - Principle of least action. (18 Hours)

UNIT II

Canonical Transformations: Canonical or contact Transformations - Advantage of Canonical Transformations - Examples of canonical transformations - Condition for transformation to be canonical - Infinitesimal contact transformation - Poisson brackets: Definition - Invariance of Poisson bracket with respect to Canonical Transformation - Equation of motion in Poisson bracket form - Lagrange's brackets - Relation between Lagrange & Poisson brackets - Liouville's theorem. (18 Hours)

UNIT III

Hamilton-Jacobi Theory: Hamilton-Jacobi method - Solution of harmonic oscillator problem by Hamilton-Jacobi method - Particle falling freely - Hamilton-Jacobi equation for Hamilton's characteristic function - Kepler's problem solution by H.J method - The case of a projectile - Damped harmonic oscillator - Action & Angle variable - Solution of Harmonic oscillator problem by action angle variable method. (18 Hours)

UNIT IV

Motion under a central force two body problem: - Equivalent one body problem - General features of central force motion - Equivalent one dimensional problem: General features of the orbits - Stability of orbits and conditions for closure - Motion under inverse square force: kepler's problem - Virial theorem. (18 Hours)

UNIT V

Mechanics of Small Oscillations: Stable and Unstable equilibrium - Two coupled Oscillators - Formulation of the problem: Lagrange's equations of motion for small oscillations - Properties of T, V & ω - Normal Co-ordinates and Normal frequencies of vibration - Linear triatomic molecule. (18 Hours)

TEXT BOOK

Gupta Kumar Sharma, (2008). *Classical Mechanics*, Twenty Fourth Edition. Meerut: PragatiPrakashan.

UNIT I – CHAPTER 1- 1.6

CHAPTER 2 - 2.3, 2.4, 2.5, 2.12

CHAPTER 3 - 3.3 to 3.7, 3.9, 3.10

UNIT II – CHAPTER 3 - 3.11 to 3.13, 3.21 - 3.23, 3.28 - 3.30

UNIT III – CHAPTER 3 - 3.14 to 3.17, 3.19, 3.20

UNIT IV – CHAPTER 4 - 4.1 to 4.6

UNIT V – CHAPTER 8 - 8.1 to 8.5, 8.6 D

REFERENCE BOOKS

1. Goldstein, (1980). *Classical Mechanics,* II edition. Narosa Publishing House.
2. Gupta, B.D., SathyaPrakash, (2003). *Classical Mechanics,* Meerut: KedarnathRamnath.
3. Takwale, R.G., Puranik, P.S., (1993). *Introduction to Classical Mechanics,* New Delhi: Tata McGraw-Hill Publishing Company Limited.

Course code 20PPHC12	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	M	M	L	M	-	-
CO2	H	L	H	M	M	M	L	M	-	-
CO3	H	L	H	H	H	M	L	H	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

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M.Sc. Physics
(2020-2021 onwards)

Semester I	**ADVANCED ELECTRONICS**	Hours/Week: 6	
Core Course-3		Credits: 5	
Course Code **20PPHC13**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : understand the basic concepts of different amplifiers, modulation and 8051 microcontroller. [K2]

CO2 : illustrate various amplifier circuits, modulators and architecture of 8051.[K3]

CO3 : analyze the operations of feedback amplifiers, operational amplifiers, modulators and the instruction sets of 8051 microcontroller. [K4]

CO4 : solve simple programs using 8051 microcontroller. [K4]

CO5 : access amplifier, modulator and op-amp for various applications and explain interfacing of 8051 microcontroller. [K5]

UNIT I

Feedback Amplifiers: Classification of amplifiers - The feedback concept - General characteristics of negative feedback amplifiers - Effect of negative feedback upon output and input resistances - Voltage-series feedback - Current-series feedback - Current shunt feedback - Voltage shunt feedback.

Multistage Amplifiers: Different coupling schemes used in amplifiers - RC Coupled amplifiers - operation at low, middle, high gain frequency response - Transformer coupled amplifier - Equivalent circuit at low, medium and high frequencies. (18 Hours)

UNIT II

Operational Amplifier: Integrated Circuits - Types of Integrated Circuits -Development of Integrated Circuits - Power supplies for Integrated circuits - The ideal Op-amp - Equivalent Circuit of an Op-amp - Ideal Voltage Transfer Curve - Open loop Op- amp Configurations - Voltage Series Feedback Amplifier - Voltage-Shunt Feedback Amplifier - Differential Amplifiers.

(18 Hours)

UNIT III

Applications of Operational Amplifier: Op-amp DC and AC Amplifiers - Summing, Scaling, and Averaging Amplifiers - Instrumentation Amplifier - Current to Voltage Converter - The Integrator - The Differentiator - Active Filters - All Pass Filters - Phase Shift Oscillators - Wien Bridge Oscillator - Square wave Generator - Sawtooth Wave Generator - Voltage Controlled Oscillator - Schmitt Trigger - Voltage to Frequency and Frequency to Voltage Converters - Analog to Digital and Digital to Analog Converters. (18 Hours)

UNIT IV

Modulation of Signals:

Amplitude modulation: Amplitude modulation - Amplitude Modulated Transmitters - AM receivers - Single sideband modulation: Principles - SSB generation - SSB reception - Signal to noise ratio for SSB.

Angle modulation: Frequency modulation - sinusoidal FM- Frequency spectrum for sinusoidal FM - Phase modulation - Equivalence between PM and FM.

Pulse modulation: PAM - PCM. (18 Hours)

UNIT V

Intel 8051 Microcontroller: Features of 8051 - Pin configuration of 8051 Architecture of 8051 - Addressing Mode of 8051 - Instruction set of 8051 - simple programs (Addition, Subtraction, Multiplication, Division)

8051 Interfacing Functions: Interfacing of 8051 - LCD, LED, ADC and DAC Application. (18 Hours)

TEXT BOOKS

1. Jacob Millman, Halkias Christos, C., (1967). *Integrated Electronics*, McGraw Hill International Edition.
   UNIT I: CHAPTER 13 - 13.1 to 13.6
2. Salivahanan, S., Sureshkumar, N., and Vallavaraj, A., (1999). *Electronic Devices and Circuits*, New Delhi: Tata McGraw-Hill Publishing Company Ltd.
   UNIT I: Chapter 10 - 10.1, 10.2, 10.5 (Relevant Sections), 10.6 (Relevant Sections)
3. Ramakant, A., Gayakwad, (1993). *Op-Amps and Linear Integrated Circuits*, 5th edition. Pearson Publication.
   UNIT II – CHAPTER 1 - 1.6,1.7, 1.9, 1.13
   CHAPTER 2 - 2.3 to 2.6
   CHAPTER 3 - 3.3 to 3.5
   UNIT III – CHAPTER 6 - 6.2, 6.5, 6.6, 6.6.1, 6.8, 6.10.1, 6.12, 6.13
   CHAPTER 7 - 7.2, 7.10, 7.12, 7.13, 7.15, 7.17, 7.18

CHAPTER 8 - 8.4, 8.10, 8.11

4. Roddy, D., &Coolen, J., (2006). *Electronic Communications*, 4th Edition. Prentice Hall of India.

   UNIT IV – CHAPTER 8 - 8.1 to 8.5, 8.12 to 8.14

   CHAPTER 9 - 9.1, 9.2 to 9.5, 9.7

   CHAPTER 10 - 10.1 to 10.5, 10.8, 10.9

   CHAPTER 11 - 11.1 to 11.3

5. Godse, A.P., &Godse, D.A., (2009). *Microprocessor and Microcontroller*, Pune: Technical Publications.

   UNIT V – CHAPTER 15:15.2 to 15.4

   CHAPTER 16 - 16.2 to 16.10

   CHAPTER 18 - 18.2.3, 18.6, 18.7

REFERENCE BOOKS

1. Roy Choudhary, D., (2010). Linear *Integrated Circuits,* 4th edition. New age International Publishers.
2. Senthilkumaran, N., (2010). *Microprocessor&Microcontrollers*, Oxford University Press.
3. Sedha, R.S., (2008). *A Text book of Applied Electronics*, S.Chand& Company Limited.

Course code 20PPHC13	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	L	L	L	M	M	-	-
CO2	H	M	H	L	L	L	M	M	-	-
CO3	H	H	H	H	H	H	H	H	-	-
CO4	H	H	L	H	H	H	H	H	-	-
CO5	H	H	L	H	H	H	H	H	-	-

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Mrs.G.Shanmugapriya
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M.Sc. Physics
(2020-2021 onwards)

Semester I	**ELECTRONICS & GENERAL PHYSICS LAB – I**	Hours/Week: 6	
Core Practical-I		Credits: 3	
Course Code **20PPHC11P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : Apply the theoretical concepts of Physics and Electronics to formulate the experiment. [K3]

CO2 : Sketch/write the circuit diagram, tabular column, model graph, C++ program to calculate the required physical parameters. [K3]

CO3 : Use the technical skills to efficiently handle the instruments, measure the required physical parameters, obtain the result and complete the records. [K3]

CO4 : Analyze the accuracy of the obtained result and assess the experimental results. [K4]

CO5 : Justify the observations of the experiment under different conditions. [K5]

CORE PRACTICAL

1. Hyperbolic fringes
2. Emitter Follower
3. Wave Shaping Circuits using IC 741
4. Waveform Generators using IC 741
5. Active Filter Circuits – Low, High and Band Pass Filters
6. Edser–Butler Fringes
7. Determination of Capacitance using Wein's Bridge

C++ Program

8. Solution of an equation by Newton – Raphson method
9. Evaluation of definite integrals using Trapezoidal rule & Simpson's rule
10. Solution of first order differential equation by Runge – Kutta IV order method

Course code 20PPHC11P	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	M	H	H	M	H	M	L	L
CO2	H	H	L	H	H	H	H	M	L	L
CO3	H	H	L	H	M	H	M	H	L	-
CO4	H	H	L	H	H	H	H	H	L	-
CO5	H	H	L	H	H	H	H	H	L	-

Mrs.G.Shanmugapriya

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M.Sc. Physics

(2020-2021 onwards)

Semester I	**NUMERICAL METHODS AND PROGRAMMING IN C++**	Hours/Week: 6	
DSEC-1		Credits: 5	
Course Code **20PPHE11**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain direct, iterative and least square methods, numerical differentiation and integration, operators, control statements and functions in C++. [K2]

CO2 : apply the concepts in numerical methods to solve problems. [K3]

CO3 : compute the C++ programs using operators, control statements and functions. [K3]

CO4 : analyze the principles and practices of numerical methods and C++ programs. [K4]

CO5 : evaluate the simultaneous equation, least square approximation of functions, numerical differentiation & integration and C++ programs. [K5]

UNIT I

Solution of Simultaneous Algebraic Equations: The Gauss Elimination method - Pivoting - Ill conditioned equations - refinement of the solution obtained by Gauss Elimination - The Gauss Seidal iterative method.

Least Squares Approximation of Functions: Linear regression - Polynomial regression - Fitting exponential and trigonometric functions. (18 Hours)

UNIT II

Differentiation and Integration: Formulae for numerical differentiation - Numerical integration - Simpson's rule - Trapezoidal rule.

Numerical Solutions for Differential equations: Euler's methods - RungeKutta methods - RungeKutta Fourth order formulae - Predictor Corrector method - Higher order differential equations. (18 Hours)

UNIT III

Programming in C++: Data types, operators and statements: Identifiers and Keywords - Constants - C++ operators - Type conversion - Summary of C++ operators - Declaration of variables - Statements - Simple C++ programs - Features of iostream.h - Manipulation functions - Input and Output (I/O) stream flags. (18 Hours)

UNIT IV

Control Statements: Conditional expressions – if statement - if-else statement -Switch statement - Loop statements - for loop - while loop - do-while loop- Breaking control statement - break statement - continue statement- goto statement. (18 Hours)

UNIT V

Function and Program statements: Defining a function - Return statement - Types of functions - Actual and formal arguments - Local and global variables - Default arguments - Recursive functions. (18 Hours)

TEXT BOOKS

1. Rajaraman,V., (2005). *Computer Oriented Numerical Methods*, 3rd Edition. New Delhi: PHI.
   UNIT I – CHAPTER 4 - 4.1 to 4.6
   CHAPTER 6 - 6.1, 6.2, 6.4, 6.5
   UNIT II – CHAPTER 8 - 8.2 to 8.4
   CHAPTER 9 - 9.2, 9.4 to 9.6, 9.7
2. Ravichandran, D., (2002). *Programming in C++*, 18th Reprint. New Delhi: Tata McGraw – Hill Publishing Company Ltd.
   UNIT III – CHAPTER 1 - 1.1 to 1.5
   CHAPTER 2 - 2.1 to 2.6
   UNIT IV – CHAPTER 3 - 3.1 to 3.4
   UNIT V – CHAPTER 4 - 4.1 to 4.7, 4.10

REFERENCE BOOKS

1. Venkataraman, M.K., (1999). *Numerical Methods in Science and Engineering*, The National Publishing Company.
2. Balagurusamy, E., (2006). *OOP with C++*, New Delhi: Tata McGraw – Hill Publishing Company Ltd.
3. YeshwantKanetkar, (1999). *Let us C++*, New Delhi: BPB Publications.

Course code 20PPHE11	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	H	H	H	M	M	M	-	-
CO2	H	H	H	H	H	M	M	M	-	-
CO3	H	H	H	H	H	H	H	H	-	-
CO4	H	H	L	H	H	H	H	H	-	-
CO5	H	H	L	H	H	H	H	H	-	-

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M.Sc. Physics

(2020-2021 onwards)

Semester I	**MICROPROCESSORS**	Hours/Week: 6	
DSEC-1		Credits: 5	
Course Code **20PPHE12**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain the architecture of 8085, Instruction set and programming techniques. [K2]

CO2 : discuss about the counters, time delays, stack and stack subroutines. [K3]

CO3 : develop an assembly language program for arithmetic operations 8 bit and 1 data conversion, code conversion, binary conversion, BCD arithmetic opera interfacing devices ADC, DAC, 8255 PPI, waveform generator. [K3]

CO4 : summarize the applications of 8085, 8085 interrupts and waveform generation. [K4]

CO5 : construct assembly language programs. [K5]

UNIT I

Architecture: A detailed look at the 8085 MPU and its architecture - 8085 programming - Instruction classification - Instruction format - How to write, assemble and execute a simple program - Introduction to 8085 instructions - Data transfer operations - Arithmetic operations - Logic operations - Branch operations - Writing assembly language program - Debugging a program.

(18 Hours)

UNIT II

Programming techniques: Programming techniques with additional instructions - Looping, counting and indexing - Additional data transfer and 16 bit arithmetic instructions - Arithmetic operations related to memory - Logic operations; Rotate and compare - Dynamic debugging.

(18 Hours)

UNIT III

Counters and time delays: Counters and time delays - Illustrative programs – Hexadecimal Counters - Zero to nine counters - Generating pulse waveform - Debugging counters and time delay programs

Stack and subroutines: Stack - Subroutine - Conditional call and Return instructions - Advanced and subroutine concepts. (18 Hours)

UNIT IV

Applications: Code conversion, BCD arithmetic and 16 bit data operations - BCD to binary conversion - Binary to BCD conversion - BCD to seven segment LED code conversion - BCD addition - BCD subtraction - Introduction to advanced instructions and applications - Multiplication - Subtraction with carry- Interrupts - The 8085 interrupts - 8085 vectored interrupts - Restart as software instructions. (18 Hours)

UNIT V

Interfacing data converters: Digital to analog converters - Analog to digital Converters - 8255A programmable peripheral interface. (18 Hours)

TEXT BOOK

Ramesh, S., Gaonkar, (1997).M*icroprocessor-Architecture, Programming and application with 8085*, III Edition. India: Penram International Publishing.

UNIT I – CHAPTER 3 - 3.1 to 3.5
CHAPTER 5 - 5.1 to 5.5
CHAPTER 6 - 6.1 to 6.6

UNIT II – CHAPTER 7 - 7.1 to 7. 6

UNIT III – CHAPTER 8 - 8.1 to 8.5
CHAPTER 9 - 9.1 to 9.4

UNIT IV – CHAPTER 10 - 10.1 to 10.9
CHAPTER 12 - 12.1 to 12.3

UNIT V – CHAPTER 13 - 13.1to13.2
CHAPTER 15 - 15.1

REFERENCE BOOKS

1. Ram, B., (2005). *Fundamentals of Microprocessor and Microcomputers*, DhanpatRai Publications.
2. Godse, A.P., and Godse, D.A., (2005). *Microprocessors*, Pune: Technical Publications.
3. Mathur, A.P., (1989). *Introduction to Microprocessors, III* Edition. New Delhi: Tata McGraw Hill Company.

Course code 20PPHE12	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	H	L	H	M	H	M	-	-
CO2	H	H	H	L	H	M	H	M	-	-
CO3	H	H	H	H	H	H	H	H	-	-
CO4	H	H	L	H	H	H	H	H	-	-
CO5	H	H	L	H	H	H	H	H	-	-

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V.V.VANNIAPERUMAL COLLEGE FOR WOMEN

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VIRUDHUNAGAR - 626 001

M.Sc. Physics
(2020-2021 onwards)

Semester I	**Renewable Energy Sources**	Hours/Week: 6	
DSEC-1		Credits: 5	
Course Code **20PPHE13**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : describe conventional and renewable energy sources, Solar thermal and Photovoltaic systems, types of energies (wind, biomass, geothermal, ocean) and non – conventional energy technologies. [K2]

CO2 : explain energy sources, solar thermal and photovoltaic systems, types of energies, hydro resources and non – conventional energy technologies. [K3]

CO3 : demonstrate new energy technologies, solar thermal and photovoltaic system. [K3]

CO4 : analyze commercial and renewable energy sources, solar thermal and photovoltaic systems, types of energies, miscellaneous non – conventional energy technologies. [K4]

CO5 : evaluate energy sources and their availability, new energy technologies, solar photovoltaic systems, types of energies and small hydro resources. [K5]

UNIT I

An Introduction to Energy Sources:

General – Energy Consumption as a measure of prosperity – World Energy features – Energy sources and their availability – Introduction – Commercial or Conventional Energy Sources – New Energy Technologies - Renewable Energy Sources – Prospects of Renewable Energy Sources.

(18 Hours)

UNIT II

Solar Thermal Systems:

Introduction – Solar collectors – Solar water heater – Solar industrial heating systems – Solar cooker – Solar distillation.

Solar Photovoltaic Systems:

Introduction – Solar cell fundamentals – Solar cell classification – Solar cell module and array construction – Solar PV systems. (18 Hours)

UNIT III

Wind Energy:

Introduction – origin of winds – wind turbine setting – major applications of wind power – wind turbine types and their construction – wind energy conversion systems.

Biomass Energy:

Introduction – Photosynthesis process- usable forms of biomass, their composition and fuel properties – Biomass resources – Biomass gasification – Biomass liquefaction.

(18 Hours)

UNIT IV

Geothermal Energy:

Introduction – Applications – Types of Geothermal resources – Exploration and development of Geothermal resources – Environmental considerations.

Ocean Energy:

Introduction – Tidal energy – Origin and nature of tidal energy – Ocean thermal energy.

(18 Hours)

UNIT V

Small Hydro Resources:

Introduction – Advantages and disadvantages of small hydro schemes – Water turbines.

Miscellaneous Non – Conventional Energy Technologies:

Introduction – Thermo electric power conversion – Thermionic power conversion.

(18 Hours)

TEXT BOOKS:

1.G.D. Rai ,*Non Conventional energy sources*, Fourth Edition ,Khanna Publications

UNIT I: CHAPTER 1 – 1.1 to 1.6

2.B.H.Khan, (2005) *Non - Conventional Energy Sources*, McGraw Hill Education (India) Private Limited, Chennai.

UNIT II: CHAPTER 5 – 5.1 to 5.3, 5.5, 5.7, 5.11

CHAPTER 6 – 6.1, 6.2, 6.4, 6.6, 6.10

UNIT III: CHAPTER 7 – 7.1, 7.2, 7.4, 7.5, 7.8, 7.9

CHAPTER 8 – 8.1 to 8.4, 8.7, 8.8

UNIT IV: CHAPTER 9 – 9.1, 9.2, 9.4, 9.5 to 9.7

CHAPTER 10 – 10.1, 10.2, 10.4

UNIT V: CHAPTER 11 – 11.1, 11.2, 11.4

CHAPTER 13 – 13.1, 13.3, 13.4

Reference Books:

1. G.D.Rai, *Solar energy utilization*, Khanna publications
2. S.P. Sukhatme,(1998) *Solar Energy*, Tata McGraw Hill
3. Robert Foster, (2009) *Solar Energy* : *Renewable energy and the Environment*, CRCPress

Course code 20PPHE13	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	-	M	M	-	M	-	-
CO2	H	L	H	-	M	M	-	M	-	-
CO3	H	L	H	-	H	H	L	H	-	-
CO4	H	L	L	-	H	H	L	H	-	-
CO5	H	L	L	-	H	H	L	H	-	-

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M.Sc. Physics
(2020-2021 onwards)

Semester II	**MATHEMATICAL PHYSICS-II**	Hours/Week: 6	
Core Course-4		Credits: 4	
Course Code **20PPHC21**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : illustrate tensors, complex variables, Fourier series & transform, probability and group. [K2]

CO2 : solve problems using tensors, complex variables & residues, Fourier series, probability distribution and group theory. [K3]

CO3 : explain covariant differentiation of vectors, Cauchy Riemann differential equation, Fourier transform of function of two or three variables, probability distribution function and symmetry operation of square & triangle. [K3]

CO4 : discuss the algebraic operations in tensor, Fourier series & transform of a function, theorems in complex variables & residues, probability distribution and group theory. [K4]

CO5 : evaluate fundamental & associated tensor, definite integrals using Cauchy's residue theorem, finite Fourier transform, probability distribution function and character table. [K5]

UNIT I

Tensors: n-dimensional Space - Superscript and Subscript - Co-ordinate transformation - Indicial and summation conventions - Dummy and Real indices – Kronecker delta symbol - Scalars, Contravariant and Co-variant Vectors - Tensors of Higher ranks - Algebraic operation of tensors - Symmetric and Anti symmetric tensors - Fundamental tensors - Raising and lowering of indices; Associated tensors - Co-variant differentiation of vectors. (18 Hours)

UNIT II

Complex Variables: Complex numbers – Review of algebraic operations of complex numbers – Complex conjugates – Modulus and argument of a complex number – Functions of a complex variable – Analytic function – Cauchy Riemann differential equations – Laplace's equation – Line Integral of a complex function – Cauchy's integral theorem – Cauchy's integral formula.

Residues: Singularities of an analytic function - Residues and their evaluation - Cauchy Residue theorem - Evaluation of definite integrals. (18 Hours)

UNIT III

Fourier series and Fourier Transform: Fourier series - Dirichlet's theorem and Dirichlet's conditions - Examples of Fourier expansions of functions - Uses of Fourier Series - Fourier Transform - Properties of Fourier Transform - Fourier Sine & Cosine transforms of derivatives - Fourier transform of functions of two or three variables - Finite Fourier transforms.

(18 Hours)

UNIT IV

Probability: Definition - Sample space - Mutually exclusive events - Theorem of total probability - Compound event and theorem of compound probability - Binomial theorem of probability - Measures of central tendency: Averages – Theoretical distributions - Binomial distribution - Poisson distribution - Normal distribution. (18 Hours)

UNIT V

Group Theory: Concept of a group - Abelian group - Generators of finite group - Cyclic group - Group multiplication table - Rearrangement theorem - Sub group - Cosets - Conjugate elements and Classes - Isomorphism and Homomorphism - Group of symmetry of an equilateral triangle and square - Representation of a groups - Reducible and irreducible representations - The orthogonality theorem - Character Table. (18 Hours)

TEXT BOOK

1. SathyaPrakash, (2011). *Mathematical Physics*, New Delhi: Sultan Chand & Sons.

   UNIT I – CHAPTER 3 - 3.1 to 3.11, 3.17, 3.18, 3.23

   UNIT II – CHAPTER 6 - 6.1 to 6.4, 6.7, 6.9 to 6.12, 6.14, 6.16, 6.22 to 6.25(a)

   UNIT III – CHAPTER 8 - 8.1 to 8.8

   CHAPTER 10 - 10.1, 10.2, 10.3, 10.5 to 10.7

   UNIT IV – CHAPTER 12 - 12.1 to 12.7, 12.10, 12.19 to 12.22

   UNIT V – CHAPTER 13 - 13.1to13.9, 13.13, 13.16 to 13.19, 13.21, 13.22

REFERENCE BOOKS

1. Gupta, B.D., (2009). *Mathematical Physics*, Third Edition. Vikas Publishing House.
2. Dass, H.K., (2004). *Mathematical Physics,* Fourth Edition. New Delhi: S.Chand& Company Ltd.
3. Pipes, Harvill, *(1970). Applied mathematics for Engineers and Physicists,* III Edition. McGraw Hill International Book Company.
4. Cotton, A., *Chemical Applications of Group Theory*, II Edition. Eastern Ltd.

Course code 20PPHC21	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO2	PSO3	PSO4	PSO5	PSO 6.a	PSO 6.b	PSO7	PSO8
CO1	H	L	H	H	M	M	L	M	-	-
CO2	H	L	H	H	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	M	-	-
CO4	H	L	L	H	H	H	L	M	-	-
CO5	H	L	L	H	H	H	L	M	-	-

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VIRUDHUNAGAR - 626 001

M.Sc. Physics
(2022-2023 onwards)

Semester II	**MATHEMATICAL PHYSICS-II**	Hours/Week: 6	
Core Course-4		Credits: 4	
Course Code **20PPHC21N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: illustrate tensors, complex variables, Fourier series & transform, probability and group. [K2]

CO2: solve problems using tensors, complex variables & residues, Fourier series, probability distribution and group theory. [K3]

CO3 : explain covariant differentiation of vectors, Cauchy Riemann differential equation, Fourier transform of function of two or three variables, probability distribution function and symmetry operation of square & triangle. [K3]

CO4 : discuss the algebraic operations in tensor, Fourier series & transform of a function, theorems in complex variables & residues, probability distribution and group theory. [K4]

CO5 : evaluate fundamental & associated tensor, definite integrals using Cauchy's residue theorem, finite Fourier transform, probability distribution function, character table and application. [K5]

UNIT I

Tensors: n-dimensional Space - Superscript and Subscript - Co-ordinate transformation - Indicial and summation conventions - Dummy and Real indices – Kronecker delta symbol - Scalars, Contravariant and Co-variant Vectors - Tensors of Higher ranks - Algebraic operation of tensors - Symmetric and Anti symmetric tensors - Fundamental tensors - Raising and lowering of indices; Associated tensors Co-variant differentiation of vectors. (18 Hours)

UNIT II

Complex Variables: Complex numbers – Review of algebraic operations of complex numbers – Complex conjugates – Modulus and argument of a complex number – Functions of a complex variable – Analytic function – Cauchy Riemann differential equations – Laplace's equation – Line Integral of a complex function – Cauchy's integral theorem – Cauchy's integral formula.

Residues: Singularities of an analytic function - Residues and their evaluation - Cauchy Residue theorem - Evaluation of definite integrals. (18 Hours)

UNIT III

Fourier series and Fourier Transform: Fourier series - Dirichlet's theorem and Dirichlet's conditions - Examples of Fourier expansions of functions - Uses of Fourier Series

- Fourier Transform - Properties of Fourier Transform - Fourier Sine & Cosine transforms of derivatives - Fourier transform of functions of two or three variables - Finite Fourier transforms. (18 Hours)

UNIT IV

Probability: Definition - Sample space - Mutually exclusive events - Theorem of total probability - Compound event and theorem of compound probability - Binomial theorem of probability - Measures of central tendency: Averages – Theoretical distributions - Binomial distribution - Poisson distribution - Normal distribution.

(18 Hours)

UNIT V

Group Theory: Concept of a group - Abelian group - Generators of finite group - Cyclic group - Group multiplication table - Rearrangement theorem - Sub group - Cosets - Conjugate elements and Classes- The Product of classes- complexes - Isomorphism and Homomorphism - Group of symmetry of an equilateral triangle and square - Representation of a groups - Reducible and irreducible representations - The orthogonality theorem - Character Table- Application of Group theory (18 Hours)

TEXT BOOK

Book 1. Sathya Prakash, (2011). *Mathematical Physics*, New Delhi: Sultan Chand & Sons.

UNIT I – CHAPTER 3 - 3.1 to 3.11, 3.17, 3.18, 3.23

UNIT II – CHAPTER 6 - 6.1 to 6.4, 6.7, 6.9 to 6.12, 6.14, 6.16, 6.22 to 6.25(a)

UNIT III – CHAPTER 8 - 8.1 to 8.8, 10.1, 10.2, 10.3, 10.5 to 10.7

UNIT IV – CHAPTER 12 - 12.1 to 12.7, 12.10, 12.19 to 12.22

UNIT V – CHAPTER 13 - 13.1to 13.11,13.13, 13.16 to 13.19, 13.21, 13.22

REFERENCE BOOKS

1. Gupta, B.D., (2009). *Mathematical Physics*, Third Edition. Vikas Publishing House.
2. Dass, H.K., (2004). *Mathematical Physics,* Fourth Edition. New Delhi: S.Chand& Company Ltd.
3. Pipes, Harvill, *(1970). Applied mathematics for Engineers and Physicists,* III Edition. McGraw Hill International Book Company.
4. Cotton, A., *Chemical Applications of Group Theory,* II Edition. Eastern Ltd.

Course code 20PPHC21N	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO7	PSO8
CO1	H	L	H	H	M	M	L	M	-	-
CO2	H	L	H	H	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	M	-	-
CO4	H	L	L	H	H	H	L	M	-	-
CO5	H	L	L	H	H	H	L	M	-	-

Mrs. P. Kanmani
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Mrs. T. S. Lalitha
Course Designer

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VIRUDHUNAGAR - 626 001

M.Sc. Physics

(2020-2021 onwards)

Semester II	**STATISTICAL MECHANICS**	Hours/Week: 6	
Core Course-5		Credits: 5	
Course Code **20PPHC22**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : internalize ideas on thermodynamics, ensembles, classical and quantum statistics. [K2]

CO2 : explain second and third law of thermodynamics, classical and quantum statistics, various ensemble theories to calculate the thermodynamic functions, Einstein & Debye theory of the specific heat capacity of a solid. [K3]

CO3 : analyze black body radiation, statistical distribution law, ensembles, F-D, M-B & B-E Statistics, M-B speed distribution and ideal gas in a gravitational field. [K4]

CO4 : deduce Wien's displacement law, Rayleigh Jeans law, distribution theory for classical and quantum statistics, partition function for ensembles, theory of specific heat of a solid using quantum statistics. [K4]

CO5 : evaluate thermodynamic potential, thermodynamic probability, partition function, energy and pressure of ideal gas, specific heat capacity of diatomic gas and linear oscillator using quantum statistics. [K5]

UNIT I

Thermodynamics & its application: Second law of thermodynamics - Entropy and second law of thermodynamics - Entropy and disorder - Thermodynamic potential and reciprocity relations - Nernst's heat theorem (Third law of thermodynamics) - Chemical potential - Radiant energy - Black body radiation - Stefan's Boltzmann law - Wiens displacement law - Planck's radiation law - Rayleigh Jean's law. (18 Hours)

UNIT II

Classical Statistics: Phase space - Volume in phase space - Ensembles - uses of ensembles - Density of distribution in phase space - Liouville's theorem - Micro and Macro states - Stirling's approximation - Thermodynamical probability - General statistical distribution law - Most probable distribution - Division of phase space into cells - Maxwell Boltzmann distribution law.

(18 Hours)

UNIT III

Method of Ensembles: Micro canonical ensemble - Gibb's paradox - Partition function and its correlation with thermodynamic quantities - Gibb's canonical ensemble - Probability density for canonical ensemble - Partition function for canonical ensemble - Thermodynamic functions for canonical ensemble - Partition function and its properties – Grand canonical ensemble - Partition function and thermodynamic functions for grand canonical ensemble - comparison of ensembles.

(18 Hours)

UNIT IV

Quantum Statistics: Transition from classical statistical mechanics to quantum statistical mechanics - Indistinguishability and quantum statistics - Bose-Einstein statistics - Fermi-Dirac statistics - Maxwell Boltzmann statistics - Results and comparison of three statistics - Energy and pressure of ideal Bose - Einstein gas - Liquid Helium - Energy and pressure of ideal Fermi-Dirac gas - Compressibility of Fermi gas - Electron gas. (18 Hours)

UNIT V

Applications of Quantum Statistics: The monoatomic ideal gas- The distribution of molecular velocities- Experimental verification of the Maxwell - Boltzmann speed distribution - molecular beams - Ideal gas in a gravitational field - The principle of equipartition of energy - The Quantized linear oscillator - Specific heat capacity of a diatomic gas – The Einstein theory of the specific heat capacity of a solid – The Debye theory of the specific heat capacity of a solid.

(18 Hours)

TEXT BOOKS

1. Gupta Kumar, (2015). *Statistical Mechanics*, 28th Edition. PrakathiPrakashan Publishers.
   UNIT I – CHAPTER A - A-1 to A-4, A-6, A-7,
   CHAPTER B -B-1, B-5 to B-9
   UNIT II – CHAPTER 1 - 1.1, 1.1-1, 1.3, 1.4, 1.5, 1.7
   CHAPTER 2 - 2.1 to 2.7
   UNIT III – CHAPTER 3 -3.0, 3.0-3, 3.0-4, 3.1, 3.1-1, 3.1-2, 3.1-3, 3.1-4, 3.2, 3.2-1, 3.2-3

UNIT IV – CHAPTER 5 - 5.2, 5.3
CHAPTER 6 - 6.2, 6.3, 6.4, 6.6
CHAPTER 8 - 8.0, 8.4
CHAPTER 9 - 9.0, 9.2, 9.3

2. Sears, F.W., Salinger, G.L., (1998). *Thermodynamics, kinetic theory and Statistical Thermodynamics*, 3rd Edition. Narosa Publishing House.

UNIT V – CHAPTER 12 - 12.1 to 12.7
CHAPTER 13 - 13.1, 13.2

REFERENCE BOOKS

1. SatyaPraksh, Agarwal, J.P., (1994*). Statistical Mechanics,* 7th Edition. KedarnathRamnath& Co.
2. Gopal, E.S.R., (1974*). Statistical Mechanics and Properties of Matter,* John Wiley and Sons.
3. Suresh Chandra, Mohit Kumar Sharma, (2016). *A Textbook of Statistical Mechanics*, 2nd Edition. CBS Publishers & Distributers Pvt Ltd.

Course code 20PPHC22	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	L	M	L	L	-	-
CO2	H	L	H	M	L	M	L	L	-	-
CO3	H	L	H	H	H	H	L	M	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

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M.Sc. Physics

(2020-2021 onwards)

Semester II	**QUANTUM MECHANICS - I**	Hours/Week: 6	
Core Course-6		Credits: 5	
Course Code **20PPHC23**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : understand the inadequacy of classical concepts, Schrodinger equation and stationary states, quantization of angular momentum and general formalism of wave mechanics. [K2]

CO2 : illustrate the macroscopic statistical phenomena, Schrodinger equation, Dirac delta function, simple harmonic oscillator, perturbation theory for discrete levels. [K3]

CO3 : explain electromagnetic radiation- wave-particle duality, stationary states and energy spectra, physical interpretation of eigenvalues and eigen functions and expansion coefficients, angular momentum, perturbation theory, parity and variation method in Quantum mechanics. [K4]

CO4 : summarize the concepts of atomic structure and atomic spectra, square well potential, operatorsand approximation methods in Stationary states. [K5]

CO5 : evaluate eigenvalue problems, matter waves, operators and approximation methods in Stationary states. [K5]

UNIT I

Inadequacy of classical concepts: Black body radiation - Planck's quantum hypothesis - Specific heat of solids - The photoelectric effect - The Compton effect - The Rutherford atom Model - Bohr's postulates- Bohr's theory of the Hydrogen spectrum - Bohr's sommerfield Quantum Rules; Degeneracy - Space Quantization - Limitations of the old Quantum theory - De Broglie hypothesis - The motion of a free wave packet - Uncertainties introduced in the process of measurement - Diffraction phenomena - Interpretation of the wave particle dualism - Complementarity - The Formulation of quantum mechanics. (18 Hours)

UNIT II

Schrodinger Equation and Stationary States: A free particle in one dimension - Generalization to three dimension - The operator correspondence and the Schrodinger equation for a particle subject to forces - Normalization and Probability Interpretation - Non-normalizable wave function and box normalization - Conservation of probability - Expectation values - Ehrenfest's Theorem - Admissibility conditions on the wave functions - Stationary states: The time independent Schrodinger equation - A particle in a square well potential - Bound states in a square well ($E<0$) - The square well: Non localized states ($E>0$) Square Potential Barrier. (18 Hours)

UNIT III

General Formalism of Wave Mechanics: The fundamental postulates of wave mechanics - The adjoint of an operator and self adjointness - The Eigenvalue problem; degeneracy - Eigen values and eigen functions of self adjoint operators - Dirac Delta function - Observable: Completeness and Normalization of eigenfunctions - Closure - Physical interpretation of eigenvalues, eigenfunctions and expansion coefficients - Momentum eigen functions: Wave function in momentum space - The Uncertainty Principle - States with minimum value for Uncertainty product - Commuting Observables; Removal of Degeneracy - Evolution of system with time; Constants of motion - Non-interacting and interacting systems - Systems of identical Particles.

(18 Hours)

UNIT IV

Exactly Soluble EigenValue Problem: The Schrödinger Equation and energy eigen values - The Energy Eigenfunctions, properties of Stationary states - The abstract operator method –Coherent States - The angular momentum operators - The eigenvalue equation for L^2; separation of variables admissibility conditions on solutions; eigenvalues - The eigenfunctions; spherical harmonics - physical interpretation - Parity - Angular Momentum in stationary states of systems with spherical symmetry. (18 Hours)

UNIT V

Approximation Methods for Stationary States: Equations in various orders of Perturbation theory - The non-degenerate case - The degenerate case - Removal of degeneracy - The effect of an electric field on the energy levels of an atom (Stark effect) - Two electron atoms - Upper bound on ground state energy - Application to excited states - Trial function linear in variational parameters - The Hydrogen molecule - Exchange interaction - WKB Approximation - The one dimensional Schrodinger equation - The Bohr - Sommerfeld Quantum Condition - WKB solution of radial wave equation. (18 Hours)

TEXT BOOK

Mathews, P.M., Venkatesan, K., (1997). *A text book of Quantum Mechanics,*Tata McGraw Hill Publishing Company Ltd.

UNIT I – CHAPTER 1 - 1.3 to 1.15, 1.17 to 1.19

UNIT II – CHAPTER 2 - 2.1 to 2.13

UNIT III – CHAPTER 3 - 3.2 to 3.16

UNIT IV – CHAPTER 4 - 4.1 to 4.12

UNIT V – CHAPTER 5 - 5.1 to 5.13

REFERENCE BOOKS

1. Aruldhas, G., (2004*). Quantum Mechanics,* New Delhi: Prentice – Hall of India Private Limited.
2. *A*joyGhatak, (1996). *Introduction to Quantum Mechanics, 5*th edition. Macmillan India Ltd.
3. Gupta,Kumar&Sharma, (2015).*Quantum Mechanics,* JaiPrakashNath Publications

Course code 20PPHC23	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	M	M	L	M	-	-
CO2	H	L	H	M	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	M	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

Dr.M.Sankareswari
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Dr.R.Hemalatha
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M.Sc. Physics

(2022-2023 onwards)

Semester II	**QUANTUM MECHANICS - I**	Hours/Week: 6	
Core Course-6		Credits: 5	
Course Code **20PPHC23N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : understand the inadequacy of classical concepts, wave mechanics, Schrodinger Equation, angular momentum operators and perturbation theory. [K2]

CO2 : explain about uncertainties, removal of degeneracy and Ehrenfest's theorem.[K3]

CO3 : derive Schrodinger wave equation and equations for Eigen value & Eigen function of various 1D & 3D problems, J^2, J_z , $L^2$and L_z operator. [K3]

CO4 : solve simple problems related to learnt concepts. [K4]

CO5 : Interpret equation motion in various pictures, LHO problem, Zeeman and Start effect. [K5]

UNIT I

Inadequacy of classical concepts: Black body radiation - Planck's quantum hypothesis - Specific heat of solids - The photoelectric effect - The Compton effect - The Rutherford atom Model - Bohr's postulates- De Broglie hypothesis - The motion of a free wave packet - Uncertainties introduced in the process of measurement - Diffraction phenomena -Interpretation of the wave particle dualism - The Formulation of quantum mechanics. (18 Hours)

UNIT II

Schrodinger Equation and Stationary States: A free particle in one dimension - Generalization to three dimension - The operator correspondence and the Schrodinger equation for a particle subject to forces - Normalization and Probability Interpretation - Non-normalizable wave function and box normalization - Conservation of probability - Expectation values - Ehrenfest's Theorem - Admissibility conditions on the wave functions - Stationary

states: The time independent Schrodinger equation - A particle in a square well potential - Bound states in a square well (E<0) - Square Potential Barrier (18 Hours)

UNIT III

General Formalism of Wave Mechanics: The fundamental postulates of wave mechanics - The adjoint of an operator and self adjointness - The Eigenvalue problem; degeneracy - Eigen values and eigen functions of self adjoint operators - Dirac Delta function Observable: Completeness and Normalization of eigenfunctions - Closure - Physical interpretation of eigenvalues, eigenfunctions and expansion coefficients - Momentum eigen functions: Wave function in momentum space - The Uncertainty Principle. (18 Hours)

UNIT IV

Exactly Soluble EigenValue Problem: The Schrödinger Equation and energy eigen values - The Energy Eigenfunctions, properties of Stationary states - The abstract operator method – Coherent States - The angular momentum operators - The eigenvalue equation for L^2; separation of variables admissibility conditions on solutions; eigenvalues - The eigenfunctions; spherical harmonics - physical interpretation - Parity - Angular Momentum in stationary states of systems with spherical symmetry. (18 Hours)

UNIT V

Approximation Methods for Stationary States: Equations in various orders of Perturbation theory - The non-degenerate case - The degenerate case - Removal of degeneracy - The effect of an electric field on the energy levels of an atom (Stark effect) -Two electron atoms - Upper bound on ground state energy - Application to excited states - Trial function linear in variational parameters - The Hydrogen molecule - Exchange interaction - WKB Approximation - The one dimensional Schrodinger equation. (18 Hours)

TEXT BOOK

Mathews, P.M., Venkatesan, K., (1997). *A text book of Quantum Mechanics*,Tata McGraw Hill Publishing Company Ltd.

UNIT I – CHAPTER 1 - 1.3 to 1.8, 1.13 to 1.17, 1.17

UNIT II – CHAPTER 2 - 2.1 to 2.11, 2.13

UNIT III – CHAPTER 3 - 3.2 to 3.11

UNIT IV – CHAPTER 4 - 4.1 to 4.12

UNIT V – CHAPTER 5 - 5.1 to 5.11

REFERENCE BOOKS

1. Aruldhas, G., (2004*). Quantum Mechanics,* New Delhi: Prentice – Hall of India Private Limited.
2. *A*joy Ghatak, (1996). *Introduction to Quantum Mechanics, 5*th edition. Macmillan India Ltd.
3. Gupta, Kumar & Sharma, (2015).*Quantum Mechanics,* JaiPrakashNath Publications

Course code 20PPHC23N	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	M	M	L	M	-	-
CO2	H	L	H	M	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	M	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

Mrs. P. Kanmani
Head of the Department

Mrs.S.M.Mahalakshmi
Course Designer

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VIRUDHUNAGAR - 626 001

M.Sc. Physics

(2020-2021 onwards)

Semester II	**ELECTRONICS & GENERAL PHYSICS LAB – II**	Hours/Week: 6	
Core Practical-II		Credits: 3	
Course Code **20PPHC21P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : apply the theoretical concepts of Physics and Electronics to formulate the experiment. [K3]

CO2 : sketch the circuit diagram, tabular column, model graph to calculate the required physical parameters. [K3]

CO3 : use the technical skills to efficiently handle the instruments, measure the required physical parameters, obtain the result and complete the records. [K3]

CO4 : analyze the accuracy of the obtained result and assess the experimental errors. [K4]

CO5 : justify the observations of the experiment under different conditions. [K5]

CORE PRACTICAL

1. Phase Shift Oscillator
2. Wien's Bridge Oscillator
3. Saw Tooth Generator
4. Two Stage RC Coupled Amplifier – With & Without Feedback
5. Solving Simultaneous Equations using IC 741
6. Diode Characteristics at different temperature
7. Elliptical Fringes
8. Michelson Interferometer
9. Determination of Mutual Inductance using Carey Foster's Bridge
10. Cauchy's constant

Course code 20PPHC21P	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	M	H	H	M	H	M	L	L
CO2	H	H	L	H	H	H	H	M	L	L
CO3	H	H	L	H	M	H	M	H	L	L
CO4	H	H	L	H	H	H	H	H	L	L
CO5	H	H	L	H	H	H	H	H	L	L

Mrs.M.Sugapriya

Dr. M. Sankareswari — Mrs.G.Shanmugapriya

Head of the Department — Course Designers

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M.Sc. Physics

(2020-2021 onwards)

Semester II	**NUCLEAR AND PARTICLE PHYSICS**	Hours/Week: 6	
DSEC-2		Credits: 5	
Course Code **20PPHE21**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : identify nuclei properties ,various nuclear detectors, decay modes, nuclear reactions, binding energy & fundamental particles. [K2]

CO2 : explain mass energy relation & Q equations, decay modes, deuteron properties and particle interactions. [K3]

CO3 : analyse nuclear detectors, consequences of decay, nuclear force & energy, and interaction theory. [K4]

CO4 : summarizecentre of mass frame, nuclear spin theory, decay probabilities for spontaneous fission, meson theory, conservation laws in particle interactions.[K5]

CO5 : Support particle & matter interaction, nuclear models, quantum chromo dynamics and Grand Unification theory. [K5]

UNIT I

Physical tools: Interaction between Particles and Matter - A brief survey - Detectors for nuclear particles.

The Q Equation: Types of nuclear reaction - The balance of mass and energy in nuclear reactions - The Q Equation - Solution of the Q Equation - Centre of mass frame in Nuclear Physics.

(18 Hours)

UNIT II

Constituents of the Nucleus and Some of Their Properties: Rutherford scattering and estimation of the nuclear size - Measurement of nucleus radius - Constituents of the nucleus and their properties - Nuclear spin , Moments and statistics.

Alpha Rays: Range of α-particles - Disintegration energy of spontaneous α-Decay - Alpha decay paradox - barrier penetration.

Beta Rays: Continuous Beta Ray spectrum - Pauli's neutrino hypothesis - The detection of neutrino -Parity Non-conservation in beta decay.

Introduction to Gamma Emission: γ - Ray Emission - Selection rules - Internal conversion - Nuclear isomerism. (18 Hours)

UNIT III

The Liquid Drop Model of Nucleus: Binding energies of nuclei: plot of B/A against A - Weizsacher's semi-empirical mass formula - Mass parabolas: prediction of stability against β-decay for members of an isobaric family - Stability limits against spontaneous fission - barrier penetration - Decay probabilities for spontaneous fission - Nucleon emission.

Nuclear Energy: Neutron induced fission - Asymmetrical fission mass yield - Emission of delayed neutrons by fission fragments - Energy released in the fission of ^{235}U - Fission of lighter nuclei - Fission chain reaction. (18 Hours)

UNIT IV

The Shell Model of Nucleus: The evidence that led to the shell model - Main assumptions of the single-particle shell model - Spin-orbit coupling in nuclei, for a single particle shell model - The single-particle shell model - Square well potential - Prediction of the shell model - Collective nuclear model.

Nuclear Force: The ground state of the deuteron - Magnetic dipole and electric quadrupole moments of the deuteron - Square well solution for the deuteron - Central and non-central forces: The tensor forces as an example of non central forces - Exchange forces: Meson theory of nuclear force – A qualitative discussion. (18 Hours)

UNIT V

Elementary Particles: Classification of elementary particles – Fundamental interactions – Conservation laws – Quarks - Isospin of Quarks - Quantum chromo dynamics – Electro weak interaction theory - Grand Unification theory - Cosmology and Particle Physics.

(18 Hours)

TEXT BOOKS

1. Patel, S.B., (2012). *Nuclear Physics - An Introduction*, 2nd Edition, New Age International (P) Limited.

UNIT I – CHAPTER 1 - 1.I.1 to 1.I.3

CHAPTER 3 - 3.1 to 3.6

UNIT II – CHAPTER 4 - 4.I.1 to 4.I.5, 4.II.1 to 4.II.3, 4.III.1to 4.III.3, 4.III.5, 4.III.6,

4.IV.1 to 4.IV.4

UNIT III – CHAPTER 5 - 5.1 to 5.7

CHAPTER 6 - 6.1 to 6.7

UNIT IV – CHAPTER 7 - 7.1 to 7.3, 7.5, 7.7 to 7.8

CHAPTER 8 - 8.1 to 8.6

2. Tayal, D.C., (2015), *Nuclear Physics*, 5th Revised Edition, Himalaya Publishing House.

UNIT IV – CHAPTER 9 - 9.5

UNIT V – CHAPTER 18 - 18.1 to 18.4, 18.19,18.20, 18.24, 18.25, 18.26,18.28

REFERENCE BOOKS

1. Roy, R.R., Nigam, B.P., (1986). *Nuclear Physics (Theory and experiment),* Willey Eastern Ltd.
2. Sharma, R.C., (1992. *Nuclear Physics*, 5th edition. K.Nath& Co.
3. Griffiths, D., (1987). *Introduction to elementary particles*,Newyork: Wiley International.

Course code 20PPHE21	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	M	M	L	M	-	-
CO2	H	L	H	M	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	H	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

Mrs.R.Hemalatha
Mrs.P.Kanmani
Course Designers

Dr. M. Sankareswari
Head of the Department

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M.Sc. Physics
(2022-2023 onwards)

Semester II	**NUCLEAR AND PARTICLE PHYSICS**	Hours/Week: 6	
DSEC-2		Credits: 5	
Course Code		Internal	External
20PPHE21N		40	60

COURSE OUTCOMES

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

CO1 : identify nuclei properties ,various nuclear detectors, decay modes, nuclear reactions, binding energy & fundamental particles. [K2]

CO2 : explain mass energy relation & Q equations, decay modes, deuteron properties and particle interactions. [K3]

CO3 : analyse nuclear detectors, consequences of decay, nuclear force & energy, and interaction theory. [K4]

CO4 : summarize centre of mass frame, nuclear spin theory, decay probabilities for spontaneous fission, meson theory, conservation laws in particle interactions.[K5]

CO5 : Support particle & matter interaction, nuclear models, quantum chromo dynamics and Grand Unification theory. [K5]

UNIT I

Physical tools: Interaction between Particles and Matter - A brief survey - Detectors for nuclear particles - Geiger Counter - Scintillation counter - Semiconductor detectors - Cloud and Bubble chamber

The Q Equation: Types of nuclear reaction - The balance of mass and energy in nuclear reactions - The Q Equation - Solution of the Q Equation - Centre of mass frame in Nuclear Physics. (18 Hours)

UNIT II

Constituents of the Nucleus and Some of Their Properties: Rutherford scattering and estimation of the nuclear size - Measurement of nucleus radius - Constituents of the nucleus and their properties - Nuclear spin , Moments and statistics.

Alpha Rays: Range of α-particles - Disintegration energy of spontaneous α-Decay - Alpha decay paradox - barrier penetration.

Beta Rays: Continuous Beta Ray spectrum - Pauli's neutrino hypothesis - The detection of neutrino -Parity Non-conservation in beta decay.

Introduction to Gamma Emission: γ - Ray Emission - Selection rules - Internal conversion - Nuclear isomerism. (18 Hours)

UNIT III

The Liquid Drop Model of Nucleus: Binding energies of nuclei: plot of B/A against A - Weizsacher's semi-empirical mass formula - Mass parabolas: prediction of stability against β-decay for members of an isobaric family - Stability limits against spontaneous fission - barrier penetration - Decay probabilities for spontaneous fission - Nucleon emission. Nuclear Energy: Neutron induced fission - Asymmetrical fission mass yield - Emission of delayed neutrons by fission fragments - Energy released in the fission of ^{235}U - Fission of lighter nuclei - Fission chain reaction. (18 Hours)

UNIT IV

The Shell Model of Nucleus: The evidence that led to the shell model - Main assumptions of the single-particle shell model - Spin-orbit coupling in nuclei, for a single particle shell model - The single-particle shell model - Square well potential - Prediction of the shell model - Collective nuclear model.

Nuclear Force: The ground state of the deuteron - Magnetic dipole and electric quadrupole moments of the deuteron - Square well solution for the deuteron - Central and non- central forces: The tensor forces as an example of non central forces - Exchange forces: Meson theory of nuclear force – A qualitative discussion. (18 Hours)

UNIT V

Elementary Particles: Classification of elementary particles – Fundamental interactions – Conservation laws – Quarks - Isospin of Quarks - Quantum chromo dynamics – Electro weak interaction theory - Grand Unification theory - Cosmology and Particle Physics. (18 Hours)

TEXT BOOKS

Book 1 : Patel, S.B., (2012). *Nuclear Physics - An Introduction*, 2nd Edition, New Age International (P) Limited.

UNIT I – CHAPTER 1 -1.I.1 to 1.I.3 - (ii), (iii), (iv), (vi) CHAPTER 3 - 3.1 to 3.6

UNIT II – CHAPTER 4 - 4.I.1 to 4.I.5, 4.II.1 to 4.II.3, 4.III.1to 4.III.3,

4.III.5, 4.III.6, 4.IV.1 to 4.IV.4

UNIT III – CHAPTER 5 - 5.1to 5.7 CHAPTER 6 - 6.1 to 6.7

UNIT IV – CHAPTER 7 - 7.1 to 7.3, 7.5, 7.7 to 7.8

CHAPTER 8 - 8.1 to 8.6

Book 2:

Tayal, D.C., (2015), *Nuclear Physics,* 5th Revised Edition, Himalaya Publishing House.

UNIT IV – CHAPTER 9 - 9.5

UNIT V – CHAPTER 18 - 18.1 to 18.4, 18.19,18.20, 18.24, 18.25, 18.26,18.28

REFERENCE BOOKS

1. Roy, R.R., Nigam, B.P., (1986). *Nuclear Physics (Theory and experiment),* Willey Eastern Ltd.
2. Sharma, R.C., (1992. *Nuclear Physics,* 5th edition. K.Nath& Co.
3. Griffiths, D., (1987). *Introduction to elementary particles,*Newyork: Wiley International.

Course code 20PPHE21N	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	M	M	L	M	-	-
CO2	H	L	H	M	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	H	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

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VIRUDHUNAGAR - 626 001

M.Sc. Physics

(2020-2021 onwards)

Semester II	**APPLIED OPTICS AND LASER PHYSICS**	Hours/Week: 6	
DSEC-2		Credits: 5	
Course Code **20PPHE22**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : describe the concepts of Gaussian optics, Fourier optics, non-linear optics, Fourier analysis of imaging systems, and laser production. [K2]

CO2 : illustrate image formation process, Fourier transforming properties of lenses, frequency response, parametric generation of light, principles and operation of laser. [K3]

CO3 : infer interference by reflection, imaging by lens, coherent transfer function, self focusing of light and laser operation. [K4]

CO4 : discriminate Matrix representation in polarization, Fresnel and Fraunhofer diffraction pattern, spatial and temporal coherence, harmonic generations, laser oscillation. [K5]

CO5 : develop refraction and translation matrices, filtering systems, fourier response of incoherent systems, second and third harmonic generations and theory of various laser types. [K5]

UNIT I

Matrix methods in Gaussian Optics: Refraction and translation matrices - Image formation Process - Combination of image forming systems - Matrix representation in polarization - Jones calculus Anisotropic medium - Interference by reflections from non - identical interfaces - Interference by multiple reflections. (18 Hours)

UNIT II

Fourier optics: Scalar diffraction theory - Kirchoff's formulation of diffraction pattern by a plane screen - Fresnel and Fraunhoffer diffraction pattern - Fourier transformation and imaging properties of lenses - Thin lenses as a phase transformation - FT properties of lenses - Spatial filtering - Introduction to Fourier optics Frequency - Domain synthesis - The Vander Laugt. Filter - Concept of spatial and temporal coherence. (18 Hours)

UNIT III

Frequency analysis of imaging system: Frequency response of a diffraction - Limited coherence imaging system - Coherent transfer functions - Frequency response of a diffraction limited incoherent - imaging system. (18 Hours)

UNIT IV

Non-linear optics: Harmonic generations - Second harmonic generation and Phase matching – Third Harmonic generation - Optical mixing - Parametric generation of light - Self focusing of light. (18 Hours)

UNIT V

Laser: Introduction – Condition for large stimulated emission - Conditions for light amplification - Population inversion – Pumping methods - Laser oscillation - Optical resonator theory - Gas lasers - Optically pumped Solid State lasers - Dye lasers - Semiconductor diode lasers - Q switching and mode locking. (18 Hours)

TEXT BOOKS

1. Douglas, S., Goodman, *Introduction to Fourier Optics,* Polaroid, Cambridge, Masschausetts.
   UNIT I – CHAPTER 2 – 2.1 to 2.5
   UNIT II – CHAPTER 3 – 3.1 to 3.4
   CHAPTER 4 – 4.1, 4.2
   CHAPTER 7 – 7.1, 7.4, 7.5
   UNIT III – CHAPTER 6 – 6.1 to 6.3
2. Laud, B.B., (2008). *Lasers and nonlinear optics*, New Age International Publishers (P) Ltd.
   UNIT IV – CHAPTER 13 – 13.1 to 13.7
3. Avadhanulu, M.N., (2001). *An Introduction to Lasers Theory and Applications*, S.Chand& Company Ltd.
   UNIT V – Chapter 1– 1.12, 1.13, 1.15, 1.17, 1.23, 1.24
   Chapter 2– 2.1 to 2.5, Chapter 4– 4.7, 4.9, 4.10

REFERENCE BOOKS

1. AjoyGhatak, (1992). *Optics*, second edition. New Delhi: Tata McGraw Hill Publishing Company Limited.
2. Ariel Lipson, Stephen Lipson and Henry Lipson, (2010). *Optical Physics*, 4th Edition. Cambridge University Press.
3. Govind, P., Agarwal, (2001*). Nonlinear Fiber Optics*, 3rd Edition. Academic press.

Course code 20PPHE22	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	M	H	M	L	M	L	M	-	-
CO2	H	M	H	M	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	H	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

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M.Sc. Physics

(2020-2021 onwards)

Semester II	**FIBER OPTICS COMMUNICATION**	Hours/Week: 6	
DSEC-2		Credits: 5	
Course Code **20PPHE23**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain optical fiber theory, losses and attenuation in fibers, fiber optic communication systems, fiber optic sensors. [K2]

CO2 : solve problems related to fibre optic communication system. [K3]

CO3 : distinguish between various CVD processes for fiber fabrication, scattering losses, analog and digital transmitters, link power and rise time budget, laser instrumentation techniques for material processing. [K4]

CO4 : evaluate light propagation through fibers, scattering and absorption losses, different modulation techniques, repeaters & generators, holographic techniques. [K5]

CO5 : assess fiber materials, dispersion measurements, preamplifier, optical amplifier and multiplexers, intensity and phase modulated fiber optic sensors. [K5]

UNIT I

Introduction: Basic optical fiber communication system – Advantages of optical fiber communication system. **Fiber optics**: Introduction – Optical fibers – Different types of fibers – Ray theory of step index fibers – Total internal reflection – Light propagation through step index fiber.

Fabrication of fibers: Fiber materials – Dopants used for cladding – Advantages of silica as the fiber material – Fiber fabrication – Vapor phase axial deposition – Modified chemical vapor deposition – Plasma activated CVD – Comparison between MCVD and PCVD process (18 Hours)

UNIT II

Signal degradation in fibers: Introduction – Attenuation – Absorption – Scattering losses – Linear scattering losses – Non-linear scattering losses – Bending losses – Core and cladding losses – Dispersion in fibers – Dispersion in different fibers – Theory of dispersion.

Fiber measurements:

Introduction – Measurement of attenuation – Optical time domain reflectometer – Fiber scattering loss measurement – Fiber absorption measurement – Fiber dispersion measurement.

(18 Hours)

UNIT III

Transmitter and receiver circuits: Introduction – General form of optical fiber communication system – Transmitter design – Flow chart for optical fiber transmitter design – Types of transmitter – Analog LED transmitter, Analog Laser transmitter, Analog laser transmitter with A/D conversion and digital multiplexing – Comparison between analog transmitter and digital transmitter, digital LED transmitter – Design of fiber optic receiver – Flow chart for receiver design – Fiber optic link receiver – The preamplifier – Low impedance preamplifier, High impedance preamplifier , Transimpedance pre amplifier – Introduction to modulation and demodulation – Different types of modulation methods – Analog modulation, digital modulation, pulse code modulation, modulation formats . (18 Hours)

UNIT IV

Fiber optic communication systems: Introduction – Necessity of repeaters and regenerators – point to point links – Loss limited fiber optic link, pulse broadening by frequency chirping, Link power budget – Line coding – Rise time budget – Multiplexer – Optical amplifiers – Soliton based optical fiber communication – Unguided optical communication – Advantages of unguided optical communication, Disadvantages of unguided optical communication, Lidar – Local area network.

(18 Hours)

UNIT V

Laser applications and fiber optic sensors: Introduction – Material processing using lasers – Industrial lasers and their uses, Laser instrumentation for material processing, Mechanism of laser heating, Laser surface treatments, Laser welding, cutting and drilling – Medical applications of lasers – Holography – Recording and reconstruction of a hologram, Theory of Holography, Positions of the reconstructed images, Uses of holography, Different types of holographic techniques,

Acoustical holography – Fiber optic sensor – Types of fiber optic sensors, Basic forms of Intensity modulated and phase modulated sensors, Temperature sensor, Displacement sensor, Displacement sensor based on reflective concept – Microbending displacement sensor – Pressure sensor – Acceleration sensors. (18 Hours)

Text Books for study

1. Dr. Arumugam, M., (2002). *Optical Fiber Communication and Sensors*, 1st Edition, Chennai: Sankar Printers Pvt. Ltd.

UNIT I: CHAPTER 1 – 1.6, 1.8

CHAPTER 2 – 2.1, 2.2, 2.3-2.3.1, 2.3.2

CHAPTER 3 – 3.1, 3.2, 3.3, 3.4 – 3.4.3, 3.4.4, 3.4.5, 3.4.6

UNIT II: CHAPTER 4 – 4.1 to 4.6, 4.10

CHAPTER 7 – 7.1 to 7.6

UNIT III: CHAPTER 8 – 8.1 to 8.11.4

UNIT IV: CHAPTER 9 – 9.1 to 9.9

UNIT V: CHAPTER 10 – 10.1 – 10.5.8

Books for Reference

1. Gerd Keiser, (1991), *Optical fiber communications*, 2nd Edition, McGraw Hill International Edition.
2. SubirkumarSarkar (1997), *Optical fibers and fiber optic communication system*, New Delhi, S. Chand & Company Ltd., Ram Nagar.
3. John. M.Senior, *Optical fiber communication*, 2nd Edition, New Delhi, Prentice Hall of India Private Ltd.

Course code 20PPHE23	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	M	H	L	L	L	-	M	-	-
CO2	H	L	H	H	M	L	-	M	-	-
CO3	H	L	H	M	M	M	L	H	-	-
CO4	H	L	L	M	H	M	L	H	-	-
CO5	H	L	L	M	H	M	L	H	-	-

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M.Sc. Physics
(2020-2021 onwards)

Semester III	**SOLID STATE PHYSICS - I**	Hours/Week: 6	
Core Course-7		Credits: 4	
Course Code **20PPHC31**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain crystal structure, crystal binding, crystal vibration, fermi gas, energy band and semiconductor crystals. [K2]

CO2 : illustrate various types of crystal structure, crystal binding, phonon properties, thermal & electrical conductivities of metals. [K3]

CO3 : Determine properties, energy states and energy band of crystal. [K3]

CO4 : analyze crystal structure, elastic constants in cubic crystal, crystal vibrations of n-atomic basis, free electron gas, quantization of orbits and impurity energy states in semiconductors. [K4]

CO5 : evaluate structure factor for bcc and fcc lattices, elastic waves in cubic crystals, thermal properties of crystals, wave equation of electron in periodic potential, electrical properties of semiconductor crystals and fermi surfaces. [K5]

UNIT I

Crystal structure: Periodic arrays of atoms - Lattice translation vectors - Basis and Crystal structure - Primitive lattice cell - Fundamental types of lattices - Two and three dimensional lattice types - Index system for crystal planes - Simple crystal structures - Sodium Chloride Structure - Cesium Chloride Structure - Hexagonal Close-packed Structure (hcp) - Diamond structure - Cubic Zinc Sulfide structure.

Reciprocal lattice: Bragg's law - Reciprocal lattice vectors - Brillouin Zones - Reciprocal lattice to sc, bcc and fcc lattices - Fourier analysis of the basis - Structure factors of bcc and fcc lattices - Atomic form factor. (18 Hours)

UNIT II

Crystal Binding and Elastic constants: Crystals of inert gases - Vanderwaal's London interaction - Repulsive interaction - Cohesive energy - Ionic crystals - Electrostatic or Madelung energy - Evaluation of Madelung constant - Covalent crystals - Metallic crystals - Hydrogen bonds - Analysis of elastic strains - Dilation - Stress components - Elastic compliance and stiffness constants - Elastic energy density - Elastic stiffness constants of cubic crystals - Bulk modulus and compressibility - Elastic waves in cubic crystals - Waves in [1 0 0] direction - Waves in [1 1 0] direction. (18 Hours)

UNIT III

Phonons I. Crystal Vibrations: Vibrations of crystals with monoatomic basis - First Brillouin zone - Group velocity - Two atoms per primitive basis - Quantization of elastic waves - Phonon momentum - Inelastic scattering by phonons.

Phonons II. Thermal Properties: Phonon heat capacity - Planck distribution -Density of states in one and three dimensions - Debye model for density of states - Debye T^3 law - Einstein model of the density of the states - Anharmonic crystal interactions - Thermal conductivity - Thermal resistivity of phonon gas - Umklapp processes. (18 Hours)

UNIT IV

Free electron Fermi gas: Energy levels in one dimension - Effect of temperature on the Fermi Dirac distribution - Free electron gas in three dimensions - Heat capacity of the electron gas - Experimental heat capacity of metals - Electrical conductivity and ohm's law - Experimental electrical resistivity of metals - Hall effect - Thermal conductivity of metals -Ratio of thermal to electrical conductivity.

Energy Bands: Nearly free electron model - Origin and magnitude of energy gap - Bloch functions - Kronig-penney model - Wave equation of an electron in a periodic potential - Approximate solution near a zone boundary. (18 Hours)

UNIT V

Semiconductor crystals: Band gap - Equations of motion - Holes - Effective mass - Effective masses in semiconductor - Intrinsic carrier concentration - Intrinsic mobility - Impurity conductivity - Donor states - Acceptor states - Thermal ionization of Donors and Acceptors.

Fermi Surfaces and Metals: Reduced and periodic zone schemes - Construction of Fermi surfaces - Electron orbits, Hole orbits and Open orbits - Calculation of energy bands - Tight binding method for energy bands - Wigner-Seitz method - Cohesive energy -Experimental methods in Fermi surface studies - Quantization of orbits in a magnetic field - De Hass-van Alphen effect.

(18 Hours)

TEXT BOOKS

Charles Kittel, (2018). *Introduction to Solid State Physics*, Eighth Edition.New Delhi: John Wiley & Sons Pvt. Ltd.

UNIT I - CHAPTER 1 and 2 (1-18, 25, 26, 29, 30, 33-43)

UNIT II - CHAPTER 3 (48-70, 73-85)

UNIT III - CHAPTER 4 and 5 (91-102, 107-117, 119-126)

UNIT IV - CHAPTER 6 and 7 (133-151, 153-157, 163-173, 177-180)

UNIT V - CHAPTER 8 and 9 (187-192, 194-202, 205-214, 223-228, 230-238, 242-252)

REFERENCE BOOKS

1. Pillai, S.O., (1997). *Solid State Physics*, New Age International private Limited.
2. Gupta, S.L., Kumar,V., (2005). *Solid State Physics*, 9th Edition. Meerut: K.Nath& Co.
3. Saxena Gupta Saxena, (1995). *Solid State Physics*, 13th Edition. Meerut: PragatiPrakashan.

Course code 20PPHC31	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	L	H	L	M	-	-
CO2	H	L	H	M	M	H	L	M	-	-
CO3	H	L	H	H	M	H	L	M	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	H	L	H	H	H	L	H	-	-

Mrs.P.Kanmani
Dr.R.Vidhya
Course Designers

Dr. M. Sankareswari
Head of the Department

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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Re-accredited with 'A' Grade (3rd Cycle) by NAAC
VIRUDHUNAGAR - 626 001

M.Sc. Physics
(2023-2024 onwards)

Semester III		Hours/Week: 6	
Core Course-7	**SOLID STATE PHYSICS - I**	Credits: 4	
Course Code **20PPHC31N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain crystal structure,crystal diffraction, crystal binding, crystal vibration, fermi gas, energy band and semiconductor crystals. [K2]

CO2 : illustrate various types of crystal structure, crystal binding, phonon properties, thermal & electrical conductivities of metals. [K3]

CO3 : Determine properties, energy states and energy band of crystal. [K3]

CO4 : analyze crystal structure, elastic constants in cubic crystal, crystal vibrations of n-atomic basis, free electron gas, quantization of orbits and impurity energy states in semiconductors. [K4]

CO5 : evaluate structure factor for bcc and fcc lattices, elastic waves in cubic crystals, thermal properties of crystals, wave equation of electron in periodic potential, electrical properties of semiconductor crystals and fermi surfaces. [K5]

UNIT I

Crystal structure: Periodic arrays of atoms - Lattice translation vectors - Basis and Crystal structure - Primitive lattice cell - Fundamental types of lattices - Two and three dimensional lattice types - Index system for crystal planes - Simple crystal structures - Sodium Chloride Structure - Cesium Chloride Structure - Hexagonal Close-packed Structure (hcp) - Diamond structure - Cubic Zinc Sulfide structure.

Reciprocal lattice: Bragg's law -Scattered Wave amplitude - Fourier analysis- Diffraction Conditions -Laue Equations- Reciprocal lattice vectors - Brillouin Zones - Reciprocal lattice to sc, bcc and fcc lattices - Fourier analysis of the basis - Structure factors of bcc and fcc lattices - Atomic form factor. (18 Hours)

UNIT II

Crystal Binding and Elastic constants: Crystals of inert gases - Vanderwaal's London interaction - Repulsive interaction -Equilibrium Lattice constants-Atomic radii-crystal radii- Cohesive energy - Ionic crystals - Electrostatic or Madelung energy - Evaluation of Madelung constant - Covalent crystals - Metallic crystals - Hydrogen bonds - Atomic radii - crystal radii- Analysis of elastic strains - Dilation - Stress components - Elastic compliance and stiffness constants - Elastic energy density - Elastic stiffness constants of cubic crystals - Bulk modulus and compressibility - Elastic waves in cubic crystals - Waves in [1 0 0] direction - Waves in [1 1 0] direction. (18 Hours)

UNIT III

Phonons I. Crystal Vibrations: Vibrations of crystals with monoatomic basis - First Brillouin zone - Group velocity - Two atoms per primitive basis - Quantization of elastic waves - Phonon momentum - Inelastic scattering by phonons.

Phonons II. Thermal Properties: Phonon heat capacity - Planck distribution - Density of states in one and three dimensions - Debye model for density of states - Debye T^3 law - Einstein model of the density of the states - Anharmonic crystal interactions - Thermal conductivity - Thermal resistivity of phonon gas - Umklapp processes. (18 Hours)

UNIT IV

Free electron Fermi gas: Energy levels in one dimension - Effect of temperature on the Fermi Dirac distribution - Free electron gas in three dimensions - Heat capacity of the electron gas - Experimental heat capacity of metals - Electrical conductivity and ohm's law - Experimental electrical resistivity of metals - Hall effect - Thermal conductivity of metals - Ratio of thermal to electrical conductivity.

Energy Bands: Nearly free electron model - Origin and magnitude of energy gap - Bloch functions - Kronig-penney model - Wave equation of an electron in a periodic potential - Approximate solution near a zone boundary. (18 Hours)

UNIT V

Semiconductor crystals: Band gap - Equations of motion - Holes - Effective mass - Effective masses in semiconductor - Intrinsic carrier concentration - Intrinsic obility -

Impurity conductivity - Donor states - Acceptor states - Thermal ionization of Donors and Acceptors.

Fermi Surfaces and Metals: Reduced and periodic zone schemes - Construction of surfaces - Electron orbits, Hole orbits and Open orbits - Calculation of energy bands - Tight binding method for energy bands - Wigner-Seitz method - Cohesive energy - Experimental methods in Fermi surface studies - Quantization of orbits in a magnetic field - De Hass-van Alphen effect. (18 Hours)

TEXT BOOKS

Charles Kittel, (2018). *Introduction to Solid State Physics*, Eighth Edition. New Delhi: John Wiley & Sons Pvt. Ltd.

UNIT I - CHAPTER 1 and 2 (1-18, 25- 43)

UNIT II - CHAPTER 3 (48-85)

UNIT III - CHAPTER 4 and 5 (91-102, 107-117, 119-126)

UNIT IV - CHAPTER 6 and 7 (133-151, 153-157, 163-173, 177-180)

UNIT V - CHAPTER 8 and 9 (187-192, 194-202, 205-214, 223-228, 230-238, 242-252)

REFERENCE BOOKS

1. Pillai, S.O., (1997). *Solid State Physics*, New Age International private Limited.
2. Gupta, S.L., Kumar,V., (2005). *Solid State Physics*, 9th Edition. Meerut: K.Nath& Co.
3. Saxena Gupta Saxena, (1995). *Solid State Physics*, 13th Edition. Meerut: PragatiPrakashan.

Course code 20PPHC31N	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PS O 1.a	PS O 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PS O 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	L	H	L	M	-	-
CO2	H	L	H	M	M	H	L	M	-	-
CO3	H	L	H	H	M	H	L	M	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	H	L	H	H	H	L	H	-	-

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Head of the Department

Mrs.P.Kanmani
Course Designer

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VIRUDHUNAGAR - 626 001

M.Sc. Physics
(2020-2021 onwards)

Semester III	**ELECTROMAGNETIC THEORY**	Hours/Week: 6	
Core Course-8		Credits: 5	
Course Code **20PPHC32**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain electrostatic fields, magnetic fields, electromagnetic induction, propagation and radiation of electromagnetic waves. [K2]

CO2 : apply the basic laws of electromagnetic fields to calculate the intensities of electric & magnetic fields. [K3]

CO3 : Use Maxwell's equation to find propagating modes, average power of electromagnetic waves in different media, average power of EM waves radiated from dipole & Half wave antenna. [K3]

CO4 : analyse the electrostatic fields due to electric dipole, quadrupole, polar and nonpolar dielectrics, solution of Laplace equation in rectangular & spherical coordinates,magnetic fields, propagation and radiation of electromagnetic waves. [K4]

CO5 : evaluate the equations involved in calculation of static & induced field intensities, propagating modes and radiated power. [K5]

UNIT I

Electrostatic Fields I: Electrostatic fields in a Vacuum - The Equations of Poisson and Laplace - Conductors - Calculation of the Electric field produced by a simple charge distribution - The Electric dipole - The Linear electric Quadrupole - Electric multipoles.

Electrostatic Fields II: Dielectric Materials - The Electric polarization - Electric field at an exterior point - Electric field at an interior point - Local field - Electric susceptibility - The Divergence of E - The electric displacement D - Calculation of electric fields involving dielectrics - The ClausiusMossotti Equation - Polar Dielectrics - Frequency dependence, Anisotropy and Non Homogeneity - Potential Energy of a Charge distribution in the presence of Dielectrics.

(18 Hours)

UNIT II

Electrostatics Fields III: Continuity of V, D, E at the Interface between two different media - The Uniqueness theorem - Solution of Laplace's Equation in Rectangular Co-ordinates, Solution of Laplace's Equation in spherical Co-ordinates, Legendre's Equation, Legendre Polynomials**.**

Magnetic Fields I: Steady current and non magnetic materials - Magnetic forces - The Magnetic Induction B - The Biotsavart Law - The Divergence of a point charge moving in a magnetic field - The Divergence of the Magnetic Induction B - The vector potential - The curl of the Magnetic Induction B - Ampere's circuital Law. (18 Hours)

UNIT III

Magnetic Fields: The Faraday Induction Law - The Induced Electric field Intensity E in terms of the vector Potential A - Induced Electromotance in a moving system - Maxwell's Equations - The conservation of electric charge - The potentials V and A - The Lorentz Condition - The Divergence of E and the Non homogeneous wave equation for A - The curl of B - Maxwell's Equations.

(18 Hours)

UNIT IV

Propagation of Electromagnetic Waves: Plane wave in infinite media - Plane electromagnetic waves in free space - The E and H Vectors in homogeneous, Isotropic, Linear and stationary media - Propagation of plane electromagnetic waves in nonconductors - Propagation of plane electromagnetic waves in good conductors.

Guided Electromagnetic Waves: Propagation in a straight line - The coaxial line - The hollow rectangular wave guides. (18 Hours)

UNIT V

Radiation of electromagnetic waves: Electric Dipole radiation - The scalar potential - The vector potential A and the magnetic field Intensity - The Electric field intensity E - The Average poynting vector and the radiation power - The Electric and Magnetic lines of force - The Kλ surface - Radiation from a Half-wave Antenna - Electric field intensity - Magnetic field intensity - Average poynting vector and radiated power. (18 Hours)

TEXT BOOK

Paul Lorain, and Dale R., Corson, (Reprint 2003). *Electromagnetic fields and waves*, CBS Publication Ltd.

UNIT I - CHAPTER 2 - 2.6 to 2.11

CHAPTER 3 - 3.1 to 3.11

UNIT II - CHAPTER 4 - 4.1, 4.2, 4.4, 4.5

CHAPTER 7 - 7.1 to 7.7

UNIT III - CHAPTER 8 - 8.1 to 8.3

CHAPTER 10 - 10.1 to 10.7

UNIT IV - CHAPTER 11 - 11.1 to 11.5, 13.1 to 13.3

UNIT V - CHAPTER 14 - 14.1.1 to14.1.6, 14.2.1, 14.2.2, 14.2.3

REFERENCE BOOKS

1. Rama Reddy.S., (2002). *Electromagnetic Theory*, Chennai: Scitech Publications (India) Pvt Ltd.
2. Macmillan, (Reprint 1988). *Electromagnetic Theory*, Chennai: S.P. Talwar Macmillan (India) Pvt Ltd.
3. Edward, C., Jordan, Keith, G., balmain, (1995). *Electromagnetic Waves and Radiating Systems*, 2nd Edition. New Delhi: Prentice Hall of India Private Ltd.
4. Griffiths, David J., (2017). *Introduction to Electrodynamics*, Cambridge University Press.

Course code 20PPHC32	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	L	L	L	M	-	-
CO2	H	L	H	H	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	H	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

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Mrs.P.Kanmani
Mrs.M.Sugapriya
Course Designers

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Re-accredited with 'A' Grade (3rd Cycle) by NAAC
VIRUDHUNAGAR - 626 001

M.Sc. Physics
(2023-2024 onwards)

Semester III	**ELECTROMAGNETIC THEORY**	Hours/Week: 6	
Core Course-8		Credits: 5	
Course Code **20PPHC32N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain electrostatic fields, magnetic fields, electromagnetic induction, propagation and radiation of electromagnetic waves. [K2]

CO2 : apply the basic laws of electromagnetic fields to calculate the intensities of electric & magnetic fields. [K3]

CO3 : Use Maxwell's equation to find propagating modes, average power of electromagnetic waves in different media, average power of EM waves radiated from dipole & Half wave antenna. [K3]

CO4 : analyse the electrostatic fields due to electric dipole, quadrupole, polar and nonpolar dielectrics, solution of Laplace equation in rectangular & spherical coordinates,magnetic fields, propagation and radiation of electromagnetic waves. [K4]

CO5 : evaluate the equations involved in calculation of static & induced field intensities, propagating modes and radiated power. [K5]

UNIT I

Electrostatic Fields I: Electrostatic fields in a Vacuum - The Equations of Poisson and Laplace - Conductors - Calculation of the Electric field produced by a simple charge distribution - The Electric dipole - The Linear electric Quadrupole - Electric multipoles.

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The Clausius Mossotti Equation - Polar Diel\ectrics – Frequency dependence, Anisotropy and Non Homogeneity - Potential Energy of a Charge distribution in the presence of Dielectrics.

(18 Ho**urs)**

UNIT II

Electrostatics Fields III: Continuity of V, D, E at the Interface between two different media - The Uniqueness theorem - Solution of Laplace's Equation in Rectangular Co-ordinates, Solution of Laplace's Equation in spherical Co-ordinates, Legendre's Equation, Legendre Polynomials**.**

Magnetic Fields I: Steady current and non magnetic materials - Magnetic forces - The Magnetic Induction B - The Biot savart Law - The Divergence of a point charge moving in a magnetic field - The Divergence of the Magnetic Induction B - The vector potential - The curl of the Magnetic Induction B - Ampere's circuital Law. (18Hours)

UNIT III

Magnetic Fields: The Faraday Induction Law - The Induced Electric field Intensity E in terms of the vector Potential A - Induced Electromotance in a moving system - Maxwell's Equations - The conservation of electric charge - The potentials V and A - The Lorentz Condition - The Divergence of E and the Non homogeneous wave equation for A - The curl of B - Maxwell's Equations. (18 Hours)

UNIT IV

Propagation of Electromagnetic Waves: Plane wave in infinite media - Plane electromagnetic waves in free space - The E and H Vectors in homogeneous, Isotropic, Linear and stationary media - Propagation of plane electromagnetic waves in nonconductors - Propagation of plane electromagnetic waves in good conductors.

Guided Electromagnetic Waves: Propagation in a straight line - The coaxial line - The hollow rectangular wave guides. (18 Hours)

UNIT V

Radiation of electromagnetic waves: Electric Dipole radiation - The scalar potential The vector potential A and the magnetic field Intensity - The Electric field intensity E - The Average poynting vector and the radiation power - The Electric and Magnetiy6jc lines of force - The Kλ surface - Radiation from a Half-wave Antenna - Electric field intensity - Magnetic field intensity - Average poynting vector and radiated power-Antenna array. (18 Hours)

TEXT BOOK

Paul Lorain, and Dale R., Corson, (Reprint 2003). *Electromagnetic fields and waves*,CBS Publication Ltd.

UNIT I - CHAPTER 2 - 2.6 to 2.11
CHAPTER 3 - 3.1 to 3.11

UNIT II - CHAPTER 4 - 4.1, 4.2, 4.4, 4.5
CHAPTER 7 - 7.1 to 7.7

UNIT III - CHAPTER 8 - 8.1 to 8.3
CHAPTER 10 - 10.1 to 10.7

UNIT IV - CHAPTER 11 - 11.1 to 11.5, 13.1 to 13.3

UNIT V - CHAPTER 14 - 14.1.1 to14.1.6, 14.2.1, 14.2.2, 14.2.3,14.3

REFERENCE BOOKS

1. Rama Reddy.S., (2002). *Electromagnetic Theory*, Chennai: Scitech Publications (India) Pvt Ltd.
2. Macmillan, (Reprint 1988). *Electromagnetic Theory*, Chennai: S.P. Talwar Macmillan (India) Pvt Ltd.
3. Edward, C., Jordan, Keith, G., balmain, (1995). *Electromagnetic Waves and Radiating Systems*, 2nd Edition. New Delhi: Prentice Hall of India Private Ltd.
4. Griffiths, David J., (2017). *Introduction to Electrodynamics*, Cambridge University Press.

Course code 20PPHC32N	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	L	L	L	M	-	-
CO2	H	L	H	H	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	H	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

Mrs. P.Kanmani
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Mrs .K.Yogalakshmi
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VIRUDHUNAGAR - 626 001
M.Sc. Physics
(2020-2021 onwards)

Semester III	**QUANTUM MECHANICS - II**	Hours/Week: 6	
Core Course-9		Credits: 5	
Course Code **20PPHC33**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : understand scattering theory, representations, transformations, symmetries, angular momentum, evolution with time and relativistic wave equations. [K2]

CO2 : illustrate scattering cross section, Born and Eikonal approximation, partial wave analysis, Klein- Gordon and Dirac equation. [K3]

CO3 : explain representations, transformations, symmetries, eigenvalue spectrum, Clebsch Gordon coefficients and perturbation theory. [K3]

CO4 : analyze scattering cross section, Born series, partial waves, unitary transformations, addition of angular momenta, constant perturbations and relativistic wave equations. [K4]

CO5 : assess Born and Eikonal approximations, behavior of partial waves, Clebsch – Gordon coefficients, perturbation theory and relativistic wave equations. [K5]

UNIT I

The Scattering Cross Section: Kinematics of the scattering process: Differential and total cross-sections - Wave mechanical picture of scattering: The scattering amplitude - Green's Functions; Formal expression for scattering amplitude.

The Born and Eikonal approximations: The Born approximation - Validity of the Born approximation - The Born series - The Eikonalapproximation.**Partial wave analysis:** Asymptotic behaviour of partial waves: Phase shifts - The Scattering amplitude in terms of phase shifts - The

differential and total cross sections; Optical theorem - Phase shifts: Relation to the potential - Low energy Scattering. (18 Hours)

UNIT II

Representations, Transformations and Symmetries: Quantum states; state vectors and wave functions - The Hilbert space of state vectors; Dirac notation - Dynamical variables and linear operators - Representations - Continuous basis - The Schrodinger representation - Degeneracy; labeling by commuting observables - Change of basis; Unitary transformations - Unitary transformations induced by change of co-ordinate systems: Translations - Unitary transformation induced by rotation of co-ordinate system - The algebra of rotation generators - Transformation of dynamical variables - Symmetries and conservation laws. (18 Hours)

UNIT III

Angular Momentum: The Eigen value spectrum - Matrix representation of J in the |jm> basis - Spin angular momentum - Non relativistic Hamiltonian with spin; Diamagnetism - Addition of angular momenta – ClebschGordan Coefficients - Spin wave functions for a system of two spin ½ particles - Identical particles with spin. (18 Hours)

UNIT IV

Perturbation theory for time Evolution problems: Perturbation solutions for transition amplitude - Selection rules - First order Transitions: Constant perturbation -Transitions in the second order: Constant perturbation - Scattering of particle by a potential - Harmonic perturbations - Interaction of an atom with Electromagnetic Radiation - The Dipole Approximation: selection rules - The Einstein coefficients: spontaneous Emission. **Alternative pictures of time Evolution**:

The Schrodinger picture - The Heisenberg picture - The interaction picture.

(18 Hours)

UNIT V

The Klein – Gordon Equation: Plane wave solutions; charge and current densities – Interaction of an atom with Electromagnetic fields; Hydrogen like atom – Non relativistic limit.

The Dirac equation: Dirac's Relativistic Hamilton - Position probability density; Expectation values - Dirac matrices - Plane wave solutions of the Dirac equation; energy spectrum - The spin of the Dirac particle - Significance of Negative Energy states; Dirac particle in Electromagnetic fields - Relativistic Electron in a central potential: Total Angular Momentum.

(18 Hours)

TEXT BOOK

Mathews, P.M., &Venkatesan, K., (1997). *A text book of Quantum Mechanics,* Tata McGraw Hill Publishing Company Ltd.

UNIT I – CHAPTER 6 - 6.1 – 6.11, 6.13

UNIT II – CHAPTER 7 - 7.1 – 7.12

UNIT III – CHAPTER 8 - 8.1 – 8.8

UNIT IV – CHAPTER 9 - 9.7 – 9.11, 9.14 – 9.19, 9.23

UNIT V – CHAPTER 10 - 10.2 – 10.11

REFERENCE BOOKS

1. Aruldhas, G., (2004). *Quantum Mechanics,* New Delhi: Prentice – Hall of India Private Limited.
2. AjoyGhatak, (1996). *Introduction to Quantum Mechanics,* 5th Edition. Macmillan India Ltd.
3. Gupta,Kumar&Sharma,(2015).*Quantum Mechanics,* Jai PrakashNath Publications.
4. Leonard, I., Schiff, (1968). *Quantum Mechanics,* 3rd Edition. McGraw – Hill International Editions, Physics Series.

Course code 20PPHC33	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	M	M	M	L	M	-	-
CO2	H	L	H	M	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	H	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

Mrs.G.Shanmuga Priya
Dr.R. Hemalatha
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M.Sc. Physics
(2020-2021 onwards)

Semester III	**ELECTRONICS AND GENERAL PHYSICS LAB - III**	Hours/Week: 6	
Core Practical-III		Credits: 3	
Course Code **20PPHC31P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : apply the theoretical concepts of Physics and Electronics to formulate the experiment. [K3]

CO2 : sketch/write the circuit diagram, tabular column, model graph, micro controller 8051 programs to calculate the required physical parameters. [K3]

CO3 : use the technical skills to efficiently handle the instruments, measure the required physical parameters, obtain the result and complete the records. [K3]

CO4 : analyze the accuracy of the obtained result and assess the experimental results. [K4]

CO5 : justify the observations of the experiment under different conditions. [K5]

CORE PRACTICAL

1. Construct an Amplitude Modulation and Demodulation circuit and calculate the percentage of modulation & trace the respective waveforms.
2. Construct a Frequency Modulation circuit and calculate the modulation index & trace the respective waveforms.
3. Study Pulse code modulation and demodulation.
4. Write an assembly language program for addition & subtraction of two 8 bit ,16 bit using 8051 microcontroller
5. Write an assembly language program for ADC & DAC interfacing using 8051 microcontroller
6. Determination of susceptibility of a liquid using Quincke's method
7. Determination of dielectric constants of a given liquid.

8. Laser based diffraction experiments.
9. Determination of refractive index of a liquid using Newton's ring.
10. Characteristics of solar cell.
11. Determination of band gap of given semiconducting material by four probe setup.

Course code	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
20PPHC31P	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	M	H	H	M	H	M	L	L
CO2	H	H	L	H	H	H	H	M	L	L
CO3	H	H	L	H	M	H	M	H	L	-
CO4	H	H	L	H	H	H	H	H	L	-
CO5	H	H	L	H	H	H	H	H	L	-

Mrs.P.Kanmani
Mrs.G.ShanmugaPriya
Course Designers

Dr. M. Sankareswari
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M.Sc. Physics

(2023-2024 onwards)

Semester III	**ELECTRONICS AND GENERAL PHYSICS LAB - III**	Hours/Week: 6	
Core Practical-III		Credits: 3	
Course Code **20PPHC31PN**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : apply the theoretical concepts of Physics and Electronics to formulate the experiment. [K3]

CO2 : sketch/write the circuit diagram, tabular column, model graph and programs to calculate the required physical parameters. [K3]

CO3 : use the technical skills to efficiently handle the instruments, measure the required physical parameters, obtain the result and complete the records. [K3]

CO4 : analyze the accuracy of the obtained result and assess the experimental results or numerical results. [K4]

CO5 : justify the observations of the experiment under different conditions. [K5]

CORE PRACTICAL

1. Construct an Amplitude Modulation and Demodulation circuit and calculate the percentage of modulation & trace the respective waveforms.
2. Microwave Oscillator using UJT.
3. Study Pulse code modulation and demodulation.
4. Write an assembly language program for addition & subtraction of two 8 bit ,16 bit using 8051 microcontroller
5. Write an assembly language program for ADC & DAC interfacing using 8051 microcontroller.
6. Determination of susceptibility of a liquid using Quincke's method

7. Determination of dielectric constants of a given liquid.
8. Laser based diffraction experiments.
9. Determination of refractive index of a liquid using Newton's ring.
10. Characteristics of solar cell.
11. Determination of band gap of given semiconducting material by four probe setup.

Course code 20PPHC31PN	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	M	H	H	M	H	M	L	L
CO2	H	H	L	H	H	H	H	M	L	L
CO3	H	H	L	H	M	H	M	H	L	-
CO4	H	H	L	H	H	H	H	H	L	-
CO5	H	H	L	H	H	H	H	H	L	-

Mrs.P.Kanmani
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Mrs.M.Sri Niveetha
Course Designer

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VIRUDHUNAGAR - 626 001

M.Sc. Physics

(2021 -22 onwards)

Semester III	**PRACTICE FOR CSIR NET – GENERAL PAPER**	Hours/Week:1	
Course Code		Credits: 1	
20PGOL32		Internal 100	External -

COURSE OUTCOMES

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

CO1 : explian various concepts related to numbers, quantitative comparison, monetary problems and logical reasoning. [K2]

CO2 : apply the analytical skills and logical reasoning in solving problems related to competitive examinations. [K3]

CO3 : solve typical problems, geometrical type problems, daily life problems in a effective manner. [K3]

CO4 : analyze the techniques used in solving complicated real life problems. [K4]

CO5 : interpret the data using logical reasoning and observational ability. [K5]

UNIT I

Typical Problems- Series formation

Numerical Ability- Numbers

UNIT II

Geometrical Type Problems

Mensuration and quantitative comparison

UNIT III

Typical Problems- Moving locomotive problem

Numerical Ability- Distance and Directions

UNIT IV

Daily Life Problems

Finding the X – Average - Monetary problems

UNIT V

Logical Reasoning

Data interpretation – Observational ability – Logical puzzles

BOOKS FOR STUDY:

Christy Varghese (2016).,*CSR – NET, General aptitude –A new outlook*, Lilly publishing house, Changanacherry, Kerala

REFERENCE BOOKS

1. Pradip Kumar Ray, General Aptitude Theory ,CSIR NET, Previous question and answer with

explanation and hint to solve, Notion Press, India

2. Ram Mohan Pandey (2021).,*CSIR-UGC-NET General Aptitude Theory and Practice*, Pathfinder

Publication, a unit of Pathfinder Academy Pvt. Ltd., India.

Unit	Chapter	Section/Page Number
1	4	142-162
	5	163-192
2	12	272-294
3	3	132-141
	7	206-220
4	8	221-230
	9	231-239
	10	240-249
5	13	295-309
	14	310-323
	15	324-332

Course code 20PGOL32	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	H	M	M	-	M	-	-
CO2	H	H	H	H	-	M	-	-
CO3	H	H	H	H	-	H	-	-
CO4	H	M	H	H	-	H	-	-
CO5	H	M	H	H	-	H	-	-

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Tmty.T.Anitha
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M.Sc. Physics
(2020-2021 onwards)

Semester IV	**SOLID STATE PHYSICS - II**	Hours/Week: 6	
Core Course-10		Credits: 5	
Course Code **20PPHC41**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : understand the concepts of electric & magnetic properties of materials, quasi particles, surface & interface physics and defects in crystals. [K2]

CO2 : explain the parameters of superconductors, surface crystallography, dielectrics, quasi particles and magnetic resonance. [K3]

CO3 : illustrate the types of superconductors, magnetic materials, ferroelectric crystals and defects & dislocations in crystals. [K3]

CO4 : discuss the screening in quasi particles, theories of electric & magnetic materials, magnetic resonance, surface physics, defects & dislocations in crystals. [K4]

CO5 : evaluate the interactions of quasi particles, electric & magnetic effects on materials and defects & dislocations in crystals. [K5]

UNIT I

Plasmons, Polaritons and Polarons: Dielectric function of the electron gas - Definitions of the dielectric function - Plasma optics - Dispersion relation for electromagnetic waves - Transverse optical modes in plasma - Longitudinal plasma oscillations - Plasmons -Electrostatic screening - Screened coulomb potential - Pseudo potential component U(0) - Mott Metal - Insulator transition - Screening and phonons in metals - Polaritons - LST relation - Electron-Electron interaction - Fermi liquid - Electron-Electron collisions - Electron-Phonon interaction - Polarons.

Optical Processes and Excitions: Optical reflectance –KramersKronig relations - Electronic interband transitions - Excitons–Frenkelexcitons - Weakly bound (Mott-Wannier) excitons.

(18 Hours)

UNIT II

Superconductivity: Occurrence of superconductivity - Destruction of superconductivity by magnetic fields - Meissner effect - London equation - Coherence length - BCS theory of superconductivity - BCS ground state - Flux quantization in a superconducting ring - Type II superconductors - Vortex state - Estimation of H_{c1} and H_{c2} - Single particle tunneling - Josephson superconductor tunneling - DC and AC Josephson effects.

Dielectrics and Ferroelectrics: Polarisation - Macroscopic electric field - Depolarization field - Local electric field at an atom - Lorentz field - Field of dipoles inside cavity - Dielectric constant and polarizability - Electronic polarizability - Ferro electric crystals - Soft optical phonon - Landau theory of phase transition- first and second orders. (18 Hours)

UNIT III

Diamagnetism and Paramagnetism: Langevin diamagnetism equation - Quantum theory of diamagnetism - Paramagnetism - Quantum theory of paramagnetism - Rare earth ions - Hund's rules -Iron group ions - Crystal field splitting - VanVleck Temperature-Independent paramagnetism.

Ferromagnetism and Antiferromagnetism: Ferromagnetic order - Curie point and exchange integral - Magnons - Quantization of spin waves - Thermal excitation of magnons- Ferrimagnetic order - Curie temperature and susceptibility of Ferrimagnets - Antiferromagnetic order - Ferromagnetic domains - Anisotropy energy - Transition region between domains - Origin of domains - Coercivity and Hysteresis. (18 Hours)

UNIT IV

Magnetic Resonance: Nuclear magnetic resonance - Equations of motion - Line width - Motional narrowing - Hyperfine splitting - Knight shift - Ferromagnetic resonance- Shape effects in FMR - Antiferromagnetic resonance - Electron paramagnetic resonance.

Point defects: Lattice vacancies - Schottky defect - Frenkel defect - Diffusion - Color centers - F centers - Other centers in Alkali halides. (18 Hours)

UNIT V

Surface and Interface Physics: Reconstruction and relaxation - surface crystallography - Work function - Thermionic emission - Surface states - Tangential surface transport - Integral Quantized Hall effects - IQHE in real system - FQHE - p-n junctions - Rectifications - Solar cells and photovoltaic detectors.

Dislocations: Slip - Edge and Screw dislocations - Burgers vectors - Stress fields of dislocations.

(18 Hours)

TEXT BOOKS

Charles Kittel, (2018). *Introduction to Solid State Physics*, 8th Edition. New Delhi: John Wiley & Sons Pvt. Ltd.

UNIT I - CHAPTER 14 and 15 (395-422, 429-441)

UNIT II - CHAPTER 10 and 16 (259-264, 273-292, 455-471, 473-478)

UNIT III - CHAPTER 11 and 12 (299-308, 311, 312, 323-326, 330-343, 346-354)

UNIT IV - CHAPTER 13 and 20 (363-386, 585-595)

UNIT V - CHAPTER 17 and 21 (489-506, 599-606)

REFERENCE BOOKS

1. Pillai, S.O., (1997). *Solid State Physics*, New Age International private limited.
2. Gupta, S., Land Kumar, V., (2005). *Solid state Physics*, 9th Edition. Meerut: K.Nath& Co.
3. Saxena Gupta Saxena, (1995). *Solid State Physics*, 13thEdition.Meerut: PragatiPrakashan.

Course code 20PPHC41	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	L	L	M	L	M	-	-
CO2	H	L	H	H	M	M	L	M	-	-
CO3	H	L	H	H	M	H	L	M	-	-
CO4	H	M	L	H	H	H	L	H	-	-
CO5	H	H	L	H	H	H	L	H	-	-

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M.Sc. Physics
(2022-2023 onwards)

Semester IV	**SOLID STATE PHYSICS - II**	Hours/Week: 6	
Core Course-10		Credits: 5	
Course Code **20PPHC41N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : understand the concepts of electric & magnetic properties of materials, quasi particles, surface & interface physics and defects in crystals. [K2]

CO2 :explain the parameters of superconductors, surface crystallography, dielectrics and quasi particles. [K3]

CO3 : illustrate the types of superconductors, magnetic materials, ferroelectric crystals and defects & dislocations in crystals. [K3]

CO4 : discuss the screening in quasi particles, theories of electric & magnetic materials, surface physics, defects & dislocations incrystals. [K4]

CO5 : evaluate the interactions of quasi particles, electric & magnetic effects on materials and defects & dislocations in crystals. [K5]

UNIT I

Plasmons, Polaritons and Polarons: Dielectric function of the electron gas - Definitions of the dielectric function - Plasma optics - Dispersion relation for electromagnetic waves - Transverse optical modes in plasma - Longitudinal plasma oscillations - Plasmons - Electrostatic screening - Screened coulomb potential - Pseudo potential component U(0) - Mott Metal - Insulator transition - Screening and phonons in metals - Polaritons – LST relation - Electron-Electron interaction - Fermi liquid - Electron-Electron collisions - Electron-Phonon interaction - Polarons. (18 Hours)

UNIT II

Optical Processes and Excitions: Optical reflectance – Kramers Kronig relations - Electronic interband transitions - Excitons – Frenkel excitons - Weakly bound (Mott-Wannier) excitons.

Superconductivity: Occurrence of superconductivity - Destruction of superconductivity by magnetic fields - Meissner effect – Heat capacity – Energy gap - Microwave and infrared properties – Isotope effect - London equation - Coherence length - BCS theory of superconductivity - BCS ground state - Flux quantization in a superconducting ring - Type II superconductors - Vortex state - Estimation of H_{c1} and H_{c2} - Single particle tunneling - Josephson superconductor tunneling - DC and AC Josephson effects.

(18 Hours)

UNIT III

Diamagnetism and Paramagnetism: Langevin diamagnetism equation - Quantum theory of diamagnetism - Paramagnetism - Quantum theory of paramagnetism - Rare earth ions - Hund's rules -Iron group ions - Crystal field splitting - VanVleck Temperature-Independent paramagnetism.

Ferromagnetism and Antiferromagnetism: Ferromagnetic order - Curie point and exchange integral - Magnons - Quantization of spin waves - Thermal excitation of magnons- Ferrimagnetic order - Curie temperature and susceptibility of Ferrimagnets - Antiferromagnetic order - Ferromagnetic domains - Anisotropy energy - Transition region between domains - Origin of domains - Coercivity and Hysteresis. (18 Hours)

UNIT IV

Dielectrics and Ferroelectrics: Polarisation - Macroscopic electric field - Depolarization field - Local electric field at an atom - Lorentz field - Field of dipoles inside cavity - Dielectric constant and polarizability - Electronic polarizability - Ferro electric crystals - Soft optical phonon - Landau theory of phase transition- first and second orders.

Surface and Interface Physics: Reconstruction and relaxation - surface crystallography - Work function - Thermionic emission - Surface states - Tangential surface transport - Integral Quantized Hall effects - IQHE in real system - FQHE - p-n junctions - Rectifications - Solar cells and photovoltaic detectors.

UNIT V

Point defects: Lattice vacancies - Schottky defect - Frenkel defect – Diffusion – Color centers - F centers - Other centers in Alkali halides. (18 Hours)

Dislocations: Slip - Edge and Screw dislocations - Burgers vectors - Stress fields of dislocations. (18 Hours)

TEXT BOOKS

Charles Kittel, (2018). *Introduction to Solid State Physics*, 8th Edition. New Delhi: JohnWiley & Sons Pvt. Ltd.

Unit I – Chapter 14 (395-422)

Unit II – Chapter 15 and 10 (429-441, 259-270, 273-292)

Unit III – Chapter 11 and 12 (299-308, 311, 312, 323-326, 330-343, 346-354)

Unit IV – Chapter 16 and 17 (455-471, 473-478, 489-506)

Unit V – Chapter 20 and 21 (585-595, 599-606)

REFERENCE BOOKS

1. Pillai, S.O., (1997). *Solid State Physics*, New Age International private limited.
2. Gupta, S., Land Kumar, V., (2005). *Solid state Physics*, 9th Edition. Meerut: K.Nath& Co.
3. Saxena Gupta Saxena, (1995). *Solid State Physics*, 13thEdition.Meerut:PragatiPrakashan.

Course code 20PPHC41N	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO2	PSO 3	PSO4	PSO5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	L	L	M	L	M	-	-
CO2	H	L	H	H	M	M	L	M	-	-
CO3	H	L	H	H	M	H	L	M	-	-
CO4	H	M	L	H	H	H	L	H	-	-
CO5	H	H	L	H	H	H	L	H	-	-

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M.Sc. Physics
(2020-2021 onwards)

Semester IV	**MOLECULAR SPECTROSCOPY**	Hours/Week: 6	
Core Course-11		Credits: 5	
Course Code **20PPHC42**		Internal 40	External 60

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

CO1 : understand the basics of electromagnetic radiation interaction with matter applied in various spectroscopic techniques. [K2]

CO2 : apply the physics principles to understand the instrumentation techniques in rotational, vibrational &raman spectroscopic methods and figure out the structural and compositional information of molecules. [K3]

CO3 : illustrate the electronic, nuclear magnetic resonance &mossbauer spectroscopic methods and its applications. [K3]

CO4 : analyze the rotational, vibrational, raman, electronic, nuclear magnetic resonance and mossbauer spectra of molecules. [K4]

CO5 : appraise the energy level diagram and wave number expression of rotational, vibrational and rotation-vibration spectra of molecules. [K5]

UNIT I

Microwave Spectroscopy: The rotation of molecules - Rotational spectra - Diatomic molecules - The rigid diatomic molecules - The intensities of spectral lines - The effect of isotopic substitution - The non - rigid rotator - The spectrum of non - rigid rotator - Polyatomic molecules - Linear molecules - Symmetric top molecules - Asymmetric top molecules - Techniques and instrumentation. (18 Hours)

UNIT II

Infrared Spectroscopy: The vibrating diatomic molecule - The energy of a diatomic molecule - The simple harmonic oscillator - The anharmonic oscillator - The diatomic vibrating rotator - The vibrations of polyatomic molecules - Fundamental vibrations and wave symmetry - The

influence of rotation on the spectra of polyatomic molecules - Linear molecules - Symmetric top molecules - Techniques and instrumentation. (18 Hours)

UNIT III

Raman Spectroscopy: Introduction - Quantum theory of Raman Effect - Classical theory of Raman effect - Molecular polarizability - Pure rotational Raman spectra - Linear molecules - Symmetric top molecules - Spherical top molecules: Asymmetric top molecules - Rule of mutual exclusion - Vibrational Raman spectra –Rotational fine structure - Techniques and instrumentation. (18 Hours)

UNIT IV

Electronic spectra of molecules: The Born-Oppenheimer approximation - Vibrational coarse structure - Progression - Intensity of vibrational electronic spectra - The Franck-Condon Principle - Dissociation energy and dissociation products - Rotational fine structure of electronic - vibration transitions - The Fortrat diagram – Pre-dissociation. (18 Hours)

UNIT V

Spin Resonance Spectroscopy: Spin and an applied field - The nature of spinning particles - Interaction between spin andmagnetic field - Relaxation times - Fourier transform spectroscopy in NMR - Multiple pulse FT: Spin - spin relaxation - Spin - lattice relaxation.

Mossbauer Spectroscopy: Principles of Mossbauer spectroscopy - Applications of Mossbauer spectroscopy - The chemical shift - Quadrapole effects - The effect of a magnetic field. (18 Hours)

TEXT BOOKS

Banwell, C.N., and Mccash, E.M., (2004), *Fundamentals of Molecular Spectroscopy*, 4th Edition. New Delhi: Tata McGraw – Hill Publishing Company Limited.

UNIT I - CHAPTER 2 - 2.1 - 2.5

UNIT II - CHAPTER 3 - 3.1, 3.2, 3.5, 3.5.1, 3.6, 3.6.1, 3.6.3, 3.8

UNIT III - CHAPTER 4 - 4.1 - 4.3, 4.6

UNIT IV - CHAPTER 6 - 6.1.1 - 6.1.7

UNIT V - CHAPTER 7 - 7.1 - 7.1.2, 7.1.5 - 7.1.8

CHAPTER 9 - 9.1, 9.2

REFERENCE BOOKS

1. Aruldhas, G., (2004*). Molecular Structure and Spectroscopy,* New Delhi: Prentice Hall of India Private Limited.

2. GurdeepChatwal, Sham Anand, (1996*). Spectroscopy (Atomic & Molecular),* Bombay: Himalaya Publishing House.
3. Sharma, B.K., (1993). *Spectroscopy,* Meerut: Goel Publishing House.

Course code 20PPHC42	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	H	M	M	L	M	-	-
CO2	H	L	H	H	M	M	L	M	-	-
CO3	H	L	H	H	H	H	L	H	-	-
CO4	H	L	L	H	H	H	L	H	-	-
CO5	H	L	L	H	H	H	L	H	-	-

Mrs.M.Sugapriya
Dr.M.Sankaresari Mrs.G.Shanmugapriya
Head of the Department Course Designers

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M.Sc. Physics
(2020-2021 onwards)

Semester IV	**ELECTRONIC COMMUNICATIONS**	Hours/Week: 6	
Core Course-12		Credits: 5	
Course Code **20PPHC43**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : understand the basic principles and concepts of various digital communication systems, wave guides and antennas. [K2]

CO2 : illustrate the methods, types, modes of propagation of communication systems, transmission lines, cables, wave guides and antennas. [K3]

CO3 : examine the losses, reduction and errors occurs in digital communication system. [K3]

CO4 : analyze the parameters used in satellite, mobile, optical fiber communication systems, antennas, transmission lines and cables. [K4]

CO5 : assess the transmitters, receivers and other devices for digital communication system. [K5]

UNIT I

Digital Communications and Transmission Lines: Synchronization - Asynchronous Transmission - Probability of Bit Error in Baseband Transmission - Bit - timing recovery Circuits - Differential Phase Shift Keying (DPSK) - Hard and Soft Decision Decoders - Error control coding.

Transmission lines: Primary line constants - Phase velocity and Line wavelength - Characteristic Impedance - Propagation Coefficient - Phase and Group velocities - Telephone lines and cables - Radio frequency lines - Micro strip transmission lines - Use of Mathcad in transmission line calculation. (18 Hours)

UNIT II

Waveguides and Antennas : Rectangular waveguides - Other modes -Antenna Equivalent Circuits - Coordinate System - Radiation fields - Polarization - Isotropic Radiator - Power gain of an antenna - Effective area of an antenna - Effective length of an antenna - Hertzian Dipole - Half - Wave Dipole - Vertical Antennas - Folded elements - Loop and ferrite rod receiving antennas - Non resonant Antenna - VHF & UHF antenna - Microwave antenna. (18 Hours)

UNIT III

Mobile Communication : Cell Mobile Telephone system - Tuning efficiency - Frequency reuse concept - Co-channel interference reduction - Hand-off mechanism -Frequency spectrum utilization - Cell splitting - Gaussian minimum FSK (GMFSK) - Differential quadrature phase shift keying (DQPSK) - Mobile Radio Propagation - Antennas at cell site - Tilting effect - Parasitic elements - Diversity techniques - Digital speech - Group of special mobile (GSM) - Multiple access techniques (TDMA, FDMA, CDMA) - Advanced systems (GPRS, WAP & UMT).

(18 Hours)

UNIT IV

Satellite Communication : Kepler's laws - Orbits - Geostationary orbit - Power systems - altitude control - Satellite station keeping - Antenna look angles - Limits of visibility - Frequency plans and polarization - Transponders - Uplink, Downlink and Overall power Budget calculations - Digital Carrier Transmission. (18 Hours)

UNIT V

Fiber Optic Communication : Principles of light transmission in a fiber - Losses in fibers - Dispersion -Light Sources for Fiber Optics - Photo Detectors - Connectors and Splices - Fiber Optic Communication link. (18 Hours)

TEXT BOOK

1. Roddy, D., &Coolen, J., (2006). *Electronic Communications*, IV Edition. Prentice Hall of India Private Limited.

UNIT I - CHAPTER 12 - 12.1 - 12.4, 12.7, 12.11 -12.13
CHAPTER 13 - 13.1 - 13.6, 13.14 - 13.17
UNIT II -CHAPTER 14 - 14.1 - 14.3
CHAPTER 16 - 16.1 - 16.15, 16.18, 16.19
UNIT IV- CHAPTER 19 - 19.1 - 19.17
UNIT V - CHAPTER 20 - 20.1 - 20.8

2. JeyasriArokiamary, V., (2009). *Mobile Communication*, First Edition. Pune: Technical Publications.

UNIT III- CHAPTER 1 - 1.2, 1.3, 1.5, 1.6, 1.13

CHAPTER 2 - 2.2.1 - 2.2.3, 2.6.1 - 2.6.7

CHAPTER 3 - 3.2.1 - 3.2.4, 3.4.1 - 3.4.4, 3.5, 3.6, 3.7

CHAPTER 4 - Relevant Sections

REFERENCE BOOKS

1. Sam Shanmugam, K., (1996*). Digital and Analog Communication Systems,* Singapore: Prentice - Hall of India Private Limited John Wiley & Sons (Asia) Pvt. Ltd.
2. Richharia, M., (2008). *Satellite Communication Systems*, 2nd Edition. London: Macmillan Press Ltd.
3. Gerd Keiser, (2000). *Optical Fiber Communications*, 3rd Edition. McGraw – Hill International Editions.

Course code 20PPHC43	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	L	L	L	L	M	-	-
CO2	H	M	H	L	M	M	L	M	-	-
CO3	H	M	H	L	M	M	L	M	-	-
CO4	H	H	L	H	H	H	L	H	-	-
CO5	H	H	L	H	H	H	L	H	-	-

Mrs.S.M.Mahalakshmi
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M.Sc. Physics
(2022-2023 onwards)

Semester IV	**ELECTRONIC COMMUNICATIONS**	Hours/Week: 6	
Core Course-12		Credits: 5	
Course Code **20PPHC43N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : understand the basic principles and concepts of Various digital communication systems, wave guides and antennas. [K2]

CO2 : illustrate the methods, types, modes of propagation of communication systems, transmission lines, cables, wave guides and antennas. [K3]

CO3 : examine the losses, reduction and errors occurs in digital communication system. [K3]

CO4 : analyze the parameters used in satellite, mobile, optical fiber communication systems, antennas, transmission lines and cables. [K4]

CO5 : assess the transmitters, receivers and other devices for digital communication system. [K5]

UNIT I

Digital Communications and Transmission Lines: Synchronization - Asynchronous Transmission - Probability of Bit Error in Baseband Transmission - Bit - timing recovery Circuits - Differential Phase Shift Keying (DPSK) - Hard and Soft Decision Decoders - Error control coding.

Transmission lines: Primary line constants - Phase velocity and Line wavelength - Characteristic Impedance - Propagation Coefficient - Phase and Group velocities - Telephone lines and cables - Radio frequency lines - Micro strip transmission lines.

(18Hours)

UNIT II

Waveguides and Antennas : Rectangular waveguides - Other modes -Antenna Equivalent Circuits - Coordinate System - Radiation fields - Polarization - Isotropic Radiator

- Power gain of an antenna - Effective area of an antenna - Effective length of an antenna - Hertzian Dipole - Half - Wave Dipole - Vertical Antennas - Folded elements - Loop and ferrite rod receiving antennas - Non resonant Antenna - VHF & UHF antenna - Microwave antenna. (18 Hours)

UNIT III

Mobile Communication : Cell Mobile Telephone system - Tuning efficiency - Frequency reuse concept - Co-channel interference reduction - Hand-off mechanism - Frequency spectrum utilization - Cell splitting - Gaussian minimum FSK (GMFSK) - Differential quadrature phase shift keying (DQPSK) - Mobile Radio Propagation - Antennas at cell site - Tilting effect - Parasitic elements - Diversity techniques - Digital speech - Group of special mobile (GSM) - Multiple access techniques (TDMA, FDMA, CDMA) - Advanced systems (GPRS, WAP & UMT). (18 Hours)

UNIT IV

Satellite Communication : Kepler's laws - Orbits - Geostationary orbit - Power systems - altitude control - Satellite station keeping - Antenna look angles - Limits of visibility - Frequency plans and polarization - Transponders - Uplink, Downlink and Overall power Budget calculations - Digital Carrier Transmission. (18 Hours)

UNIT V

Fiber Optic Communication : Principles of light transmission in a fiber - Losses in fibers - Dispersion -Light Sources for Fiber Optics - Photo Detectors - Connectors and Splices - Fiber Optic Communication link. (18 Hours)

TEXT BOOK

1. Roddy, D., &Coolen, J., (2006). *Electronic Communications*, IV Edition. Prentice Hall of India Private Limited.

UNIT I - CHAPTER 12 - 12.1 - 12.4, 12.7, 12.11 -12.12

CHAPTER 13 - 13.1 - 13.6, 13.14 - 13.17

UNIT II -CHAPTER 14 - 14.1 - 14.3

CHAPTER 16 - 16.1 - 16.15, 16.18, 16.19

UNIT IV- CHAPTER 19 - 19.1 - 19.17

UNIT V - CHAPTER 20 - 20.1 - 20.8

2. JeyasriArokiamary, V., (2009). *Mobile Communication*, First Edition. Pune: Technical Publications.

UNIT III- CHAPTER 1 - 1.2, 1.3, 1.5, 1.6, 1.13
CHAPTER 2 - 2.2.1 - 2.2.3, 2.6.1 - 2.6.7
CHAPTER 3 - 3.2.1 - 3.2.4, 3.4.1 - 3.4.4, 3.5, 3.6, 3.7
CHAPTER 4 - Relevant Sections

REFERENCE BOOKS

1. Sam Shanmugam, K., (1996*). Digital and Analog Communication Systems,* Singapore: Prentice - Hall of India Private Limited John Wiley & Sons (Asia) Pvt. Ltd.
2. Richharia, M., (2008). *Satellite Communication Systems,* 2nd Edition. London: Macmillan Press Ltd.
3. Gerd Keiser, (2000). *Optical Fiber Communications,* 3rd Edition. McGraw – Hill International Editions.

Course code 20PPHC43N	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	L	H	L	L	L	L	M	-	-
CO2	H	M	H	L	M	M	L	M	-	-
CO3	H	M	H	L	M	M	L	M	-	-
CO4	H	H	L	H	H	H	L	H	-	-
CO5	H	H	L	H	H	H	L	H	-	-

Mrs.P.Kanmani
Head of the Department

Mrs.M.Sri Niveetha
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Re-accredited with 'A' Grade (3rd Cycle) by NAAC
VIRUDHUNAGAR - 626 001

M.Sc. Physics
(2020-2021 onwards)

Semester: IV	**NANO PHYSICS**	Hours/Week: 6	
Core Course - 13		Credits: 5	
Course Code **20PPHC44**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain characterization & synthesis of nanoparticles, CNT's and quantum nanostructures. [K2]

CO2 : apply the relevant physics theories to characterize and synthesize nanoparticles, understand properties of nanomaterials. [K3]

CO3 : illustrate the structure and properties of CNT's, MEM's, NEM's and quantum nanostructures. [K3]

CO4 : analyze the characterization & synthesis methods, properties of nanomaterials, nanomachines& devices and behaviour of quantum nanostructures. [K4]

CO5 : appraise the characterization & synthesis methods, improved properties of nanomaterials, applications of nanomachines& quantum nanodevices. [K5]

UNIT I

Methods of Measuring Properties: Structure: Atomic structures - Crystallography - Particle size determination - Surface structure - Microscopy: Transmission electron microscopy - Field ion microscopy - Scanning microscopy - Spectroscopy: Infrared and Raman spectroscopy - Photoemission and X-ray spectroscopy - Magnetic resonance. (18 Hours)

UNIT II

Nanopowders and Nanomaterials: Preparation of Nanomaterials - Plasma arcing - Chemical Vapour deposition - Sol-gels method - Electro depostion- Ball milling - Using natural nanoparticles. (18 Hours)

UNIT III

Properties of Individual Nanoparticles: Metal nanoclusters: Magic numbers - Theoretical modeling of nanoparticles - Geometric structure - Electronic structure - Reactivity - Fluctuations - Magnetic clusters - Bulk to nano transition - Semiconducting nanoparticles: Optical properties - Photo fragmentation - Coulombic explosion. (18 Hours)

UNIT IV

Carbon Nanotubes and Nanomachines: Fabrication and Structure of Carbon nanaotubes - Electrical properties - Vibrational properties - Mechanical properties - Applications of carbon nanotubes: Field emission and shielding - Computers - Fuel cells - Chemical sensors - Catalysis - Mechanical reinforcement.

Nanomachines and Nanodevices: Micro Electro Mechanical systems (MEMs) –Nano Electro Mechanical systems (NEMs) - Fabrication - Nanodevices and Nanomachines- Molecular and Supramolecular switches. (18 Hours)

UNIT V

Quantum Wells, Wires and Dots: Preparation of quantum nanostructures - Size and dimensionality effects - Size effects - Conduction electrons and dimensionality - Fermi gas and density of states - Potential wells - Partial confinement - Properties dependent on density of states - Excitons - Single electron tunneling - Applications: Infrared detectors - Quantum dot lasers - Superconductivity. (18 Hours)

TEXT BOOKS

1. Charles. P, Poole Jr and Frank J, Owens, (2016). *Introduction to Nanotechnology*, John Wiley & Sons, INC.

UNIT I - CHAPTER 3 - 3.1 - 3.4

UNIT III - CHAPTER 4 - 4.1 - 4.3

UNIT IV - CHAPTER 5 - 5.4, 5.5

CHAPTER 13 - 13.1 - 13.3

UNIT V - CHAPTER 9 - 9.1 - 9.7

2. Mick Wilson and KamaliKannangara Geoff Smith, (2008). *Nano Technology*, Overseas Press (India) Private Limited.

UNIT II - CHAPTER 3 - 3.1 - 3.8.

REFERENCE BOOKS

1. Pradeep,T., (2008). *Nano The Essentials,* Tata McGraw - Hill Publishing Company Limited.
2. William Illsey Atkinson, (2007). *Nanotechnology,* Jaico Publishing House.
3. Chandra Banu, T.K. and Batnagar, V., (2009). *Nanoscience and Technology,* Campus Book International.

Course code 20PPHC44	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	H	M	M	H	M	M	-	-
CO2	H	H	H	H	H	H	H	M	-	-
CO3	H	M	H	H	H	H	H	H	-	-
CO4	H	M	L	H	H	H	H	H	-	-
CO5	H	M	L	H	H	H	H	H	-	-

Mrs.P.Kanmani
Dr.M.Sankareswari Mrs.M.Sugapriya
Head of the Department Course Designers

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M.Sc. Physics
(2022-2023 onwards)

Semester: IV	**NANO PHYSICS**	Hours/Week: 6	
Core Course - 13		Credits: 5	
Course Code **20PPHC44N**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : explain characterization & synthesis of nanoparticles, CNT's and quantum nanostructures. [K2]

CO2 : apply the relevant physics theories to characterize and synthesize nanoparticles, understand properties of nanomaterials. [K3]

CO3 : illustrate the structure and properties of CNT's, MEM's, NEM's and quantum nanostructures. [K3]

CO4 : analyze the characterization & synthesis methods, properties of nanomaterials, nanomachines & devices and behaviour of quantum nanostructures. [K4]

CO5 : appraise the characterization & synthesis methods, improved properties of nanomaterials, applications of nanomachines & quantum nanodevices. [K5]

UNIT I

Methods of Measuring Properties: Structure: Atomic structures - Crystallography - Particle size determination - Surface structure - Microscopy: Transmission electron microscopy - Field ion microscopy - Scanning microscopy - Spectroscopy: Infrared and Raman spectroscopy - Photoemission and X-ray spectroscopy - Magnetic resonance. (18 Hours)

UNIT II

Nanopowders and Nanomaterials: Preparation of Nanomaterials - Plasma arcing - Chemical Vapour deposition - Sol-gels method - Electro depostion- Ball milling - Using natural nanoparticles. (18 Hours)

UNIT III

Properties of Individual Nanoparticles: Metal nanoclusters: Magic numbers - Theoretical modeling of nanoparticles - Geometric structure - Electronic structure -

Reactivity - Fluctuations - Magnetic clusters - Bulk to nano transition - Semiconducting nanoparticles: Optical properties - Photo fragmentation - Coulombic explosion-Rare gas and molecular clusters (18 Hours)

UNIT IV

Carbon Nanotubes and Nanomachines: Fabrication and Structure of Carbon nanaotubes - Electrical properties - Vibrational properties - Mechanical properties - Applications of carbon nanotubes: Field emission and shielding - Computers - Fuel cells - Chemical sensors - Catalysis - Mechanical reinforcement.

Nanomachines and Nanodevices: Micro Electro Mechanical systems (MEMs) – Nano Electro Mechanical systems (NEMs) - Fabrication - Nanodevices and Nanomachines- Molecular and Supramolecular switches. (18 Hours)

UNIT V

Quantum Wells, Wires and Dots: Preparation of quantum nanostructures - Size and dimensionality effects - Size effects - Conduction electrons and dimensionality - Fermi gas and density of states - Potential wells - Partial confinement - Properties dependent on density of states - Excitons - Single electron tunneling - Applications: Infrared detectors - Quantum dot lasers - Superconductivity. (18 Hours)

TEXT BOOKS

1. Charles. P, Poole Jr and Frank J, Owens, (2016). *Introduction to Nanotechnology*, John Wiley & Sons, INC.

UNIT I - CHAPTER 3 - 3.1 - 3.4

UNIT III - CHAPTER 4 - 4.1 - 4.3,4.4

UNIT IV - CHAPTER 5 - 5.4, 5.5

CHAPTER 13 - 13.1 - 13.3

UNIT V - CHAPTER 9 - 9.1 - 9.7

2. Mick Wilson and KamaliKannangara Geoff Smith, (2008). *Nano Technology*, Overseas Press (India) Private Limited.

UNIT II - CHAPTER 3 - 3.1 - 3.8.

REFERENCE BOOKS

1. Pradeep,T., (2008). *Nano The Essentials,* Tata McGraw - Hill Publishing Company Limited.
2. William Illsey Atkinson, (2007). *Nanotechnology,* Jaico Publishing House.
3. Chandra Banu, T.K. and Batnagar, V., (2009). *Nanoscience and Technology,* Campus Book International.

Course code 20PPHC44N	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	H	M	M	H	M	M	-	-
CO2	H	H	H	H	H	H	H	M	-	-
CO3	H	M	H	H	H	H	H	H	-	-
CO4	H	M	L	H	H	H	H	H	-	-
CO5	H	M	L	H	H	H	H	H	-	-

Mrs.P.Kanmani
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Mrs.K.Yogalakshmi
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M.Sc. Physics
(2020-2021 onwards)

Semester IV	**PROJECT**	Hours/Week: 6	
Core Course-13		Credits: 4	
Course Code **20PPHC41PR**		Internal 40	External 60

COURSE OUTCOMES

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

CO1 : use literature review to formulate the project work. [K3]
CO2 : apply inter disciplinary knowledge to carry out project work. [K3]
CO3 : analyze the results of the work carried. [K4]
CO4 : conclude the findings with the existing results. [K5]
CO5 : assess the project work to fulfil the needs of society. [K5]

- Project will be done by the final year students in the fourth semester under the guidance of respective guides.
- For projects internal marks will be awarded by the respective guide and external marks will be awarded in the external examinations held at the end of the semester.
- Only team project should be allotted. A project team should contain only two student members
- The report of the project must be in the prescribed form. It should be typed neatly in MS word (12 pt, Times New Roman, 1.5 spacing)
- The format of the project report should have the following components.
  - ❖ First page should contain:

    Title of the project report
    Name of the candidate
    Register number
    Name of the supervisor
    Address of the institution
    Month & year of submission

- ❖ Contents
- ❖ Certificate by supervisor
- ❖ Declaration by candidate
- ❖ Acknowledgement
- ❖ Chapter 1 – Preliminaries
- ❖ Other chapters
- ❖ References

- The project report should be written in 30 - 40 pages.
- Four copies of the project report with binding should be submitted.

Course code 20PPHC41PR	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	H	H	L	H	H	M	L	L
CO2	H	H	H	H	M	H	H	M	L	L
CO3	H	H	H	H	H	H	H	H	L	-
CO4	H	H	L	H	H	H	H	H	L	-
CO5	H	H	L	H	H	H	H	H	L	-

Evaluation	Internal Assessment	: 40 marks
	External Examination	: 60 marks
Internal Assessment:	Pre-submission Presentation	: 10 Marks
	Review Report	: 20 Marks
	One Open Online Course related to the Project	: 10 Marks
External Examination:	Project Report	: 40 Marks
	Viva Voce	: 20 Marks

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M.Sc. Physics

(2022-2023onwards)

Semester IV	**PROJECT – Research Methodology & Ethics**	Hours/Week: 6	
Core Course-13		Credits: 4	
Course Code **22PPHC41PR**		Internal 60	External 40

COURSE OUTCOMES

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

CO1 : apply research methodologies to formulate the project work. [K3]

CO2 : apply inter disciplinary knowledge and research ethics to carry out project work. [K3]

CO3 : analyze the results of the work carried upholding research ethics. [K4]

CO4 : conclude the findings with the existing results. [K5]

CO5 : develop the project work to fulfill the needs of society. [K5]

Unit - I: Research Methodology

Research and Scientific method – selecting the problem - necessity of defining the problem - technique involved in defining a problem - technique of interpretation- precaution in interpretation - significance of report writing - different steps in writing report -layout of the research report - types of reports - oral presentation - mechanics of writing a research report -precautions for writing research reports

Unit-II: Publication Ethics

Misconduct in research - accidental text-plagiarism - steps to avoid accidental text-plagiarism - plagiarism of results or ideas - precautions against 'self-plagiarism' - precautions with submissions at conferences - precautions while pursuing a problem, with a series of papers - ensuring visibility by publishing in suitable journals - enhancing visibility using the internet Presentation at conferences: advantages & cautions: obtaining feedback - ensuring priority and avoiding being scooped - avoiding self-plagiarism concerns

Text Books:

1. C.R. Kothari (2008). Research Methodology Methods & Techniques, New Age International Publishers, Reprint.
2. P.Chandah. (2018). Ethics in Competitive Research: Do not get Scooped; do not get plagiarized, ISBN 9789387480865

Reference Books:

1. Rajammall, P. Devadoss and K. Kulandaivel,(1976) A Hand Book of Methodology of Research, RMM Vidyalaya press,.
2. J. Anderson, Wiley 1997) Thesis and Assignment Writing, Eastern Ltd.,
3. Mukul Gupta, Deepa Gupta Research(2011) Methodology, PHI Learning Private Ltd., New Delhi,.
4. Bird,A. (2006). Philosophy of Sciences. Routledge
5. MacIntyre, Alasdair (1967). A Short History of Ethics. London

- Project will be done by the final year students in the fourth semester under the guidance of respective guides.
- Course comprises two units Research Methodology theory paper and Project Completion.
- An Internal Assessment for a maximum of 20 marks will be carried out for the theory paper.
- For Project internal marks will be awarded by the respective guide and external marks will be awarded in the external examinations held at the end of the semester.
- Only team project should be allotted. A project team should contain only two student members
- The report of the project must be in the prescribed form. It should be typed neatly in MS word (12 pt, Times New Roman, 1.5 spacing)
- The format of the project report should have the following components.
    - First page should contain:

      Title of the project
      report Name of the
      candidate

      Register number

      Name of the supervisor
      Address of the institution
      Month & year of
      submission
- Contents

- Certificate by supervisor
- Declaration by candidate
- Acknowledgement
- Chapter 1 – Preliminaries
- Other chapters
- References

- The project report should be written in 30 - 40 pages.
  - Four copies of the project report with binding should be submitted.

Course code 22PPHC41PR	PO1		PO2	PO3	PO4	PO5	PO6		PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6.a	PSO 6.b	PSO 7	PSO 8
CO1	H	H	H	H	L	H	H	M	L	L
CO2	H	H	H	H	M	H	H	M	L	L
CO3	H	H	H	H	H	H	H	H	L	-
CO4	H	H	L	H	H	H	H	H	L	-
CO5	H	H	L	H	H	H	H	H	L	-

Evaluation Pattern (100 marks)					
Internal Assessment (60marks)				External Assessment (40 marks)	
One Periodic Test (20)	Project Report (20)	Pre-Submission Presentation (10)	One Open online Course related to the Project (10)	Project Presentation (30)	Viva Voce (10)

Mrs.P.Kanmani
Head of the Department

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