V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Reaccredited with 'A++' Grade (4th Cycle) by NAAC
VIRUDHUNAGAR
Quality Education with Wisdom and Values

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM REGULATIONS AND SYLLABUS
(with effect from Academic Year 2024 - 2025)

V.V.Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 13 UG Programmes (Aided), 15 UG Programmes (SF), 15 PG 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, Data Science, Computer Applications and Computer Applications - Graphic Design
Commerce & Management	:	Commerce, Commerce (Computer Applications), Commerce (Professional Accounting), Business Administration

PG PROGRAMMES

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

OUTLINE OF CHOICE BASED CREDIT SYSTEM - PG

1. Core Courses
2. Elective Courses
    - Discipline Specific Elective Courses (DSEC)
    - Generic Elective Courses
    - Non-Major Elective Course (NMEC)
3. Skill Enhancement Courses
4. Self Study Course (Online)
5. Extension Activity
6. Extra Credit Courses (Optional)

List of Non Major Elective Courses (NME)
(2024-2025 onwards)

PG PROGRAMMES

Name of the Course	Course Code	Department
Introduction to Epigraphy	24PHIN21	History
Functional English	24PENN21	English
தமிழ் இலக்கிய வரலாறு	24PTAN21	Tamil
Taxation Concepts and Assessment	24PCON21	Commerce
Entrepreneurship Development	24PBAN21	Business Administration
Mathematics for Life Sciences	24PMTN21	Mathematics
Solid Waste Management	24PPHN21	Physics
Chemistry in Everyday Life	24PCHN21	Chemistry
Food Preservation	24PHSN21	Home Science - Nutrition and Dietetics
Nutritional Biochemistry	24PBCN21	Biochemistry
Tissue engineering	24PBON21	Biotechnology
Web Programming	24PCSN21	Computer Science
Fundamentals of Web Design	24PCAN21	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.

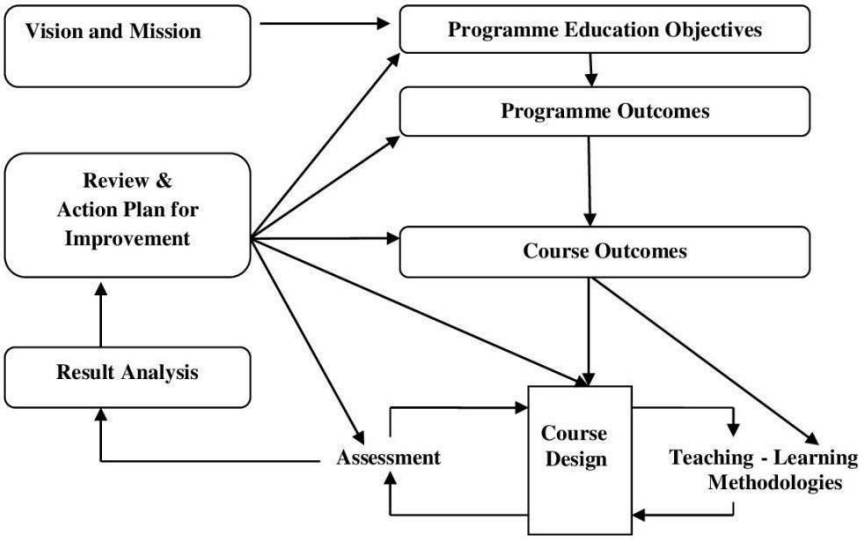
PO-PEO Mapping Matrix

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	✓	✓	✓

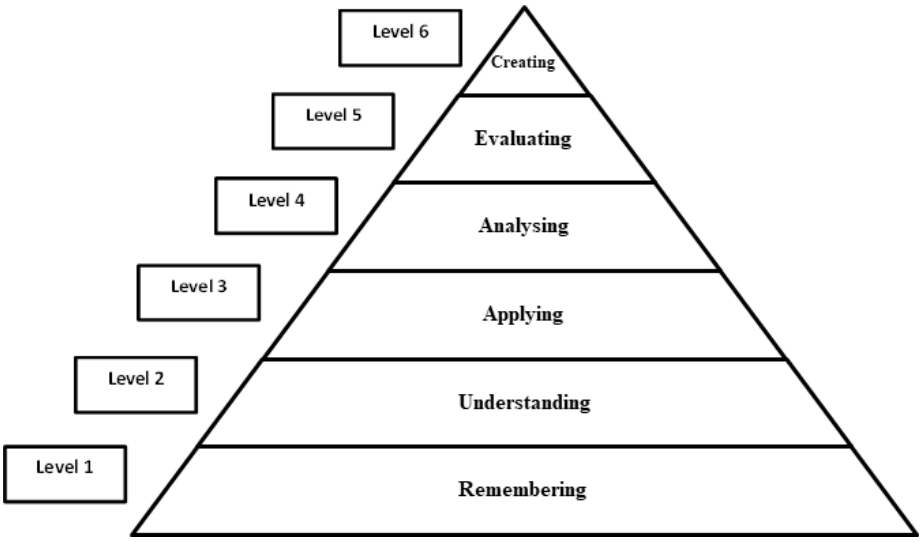
B.1.4 Course Outcomes (COs)

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	25	75	**100**

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

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	**:**	**25**

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
Periodic Test	:	30
Record Performance	:	10
Total	**:**	**40**

Periodic Test - Average of the best two will be considered
Performance - Attendance and Record

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

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6-9	Internal Choice – Either… or Type	4	4	5	20
C	10 - 11	Internal Choice – Either…. or Type	2	2	10	20
					Total	**45***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

Summative Examination

External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Summative Examination	:	60
Seminar Presentation	:	15
Total	:	**75**

Summative Examination

Question Pattern **Duration: 3 Hours**

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

B.2.2 Project

Individual Project is compulsory for II PG Students in IV Semester.

Distribution of Marks

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

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

B. 2.3 SKILL ENHANCEMENT COURSES
INTERNAL ASSESSMENT
Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	**:**	**25**

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
Periodic Test	:	30
Record Performance	:	10
Total	**:**	**40**

Periodic Test - Average of the best two will be considered
Performance - Attendance and Record

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

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 4	Internal Choice – Either… or Type	4	4	5	20
B	5	Internal Choice – Either… or Type	1	1	10	10
					Total	**30***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

Summative Examination
External Assessment
Distribution of Marks

Mode of Evaluation		Marks
Seminar Paper		10
Seminar Presentation	**:**	15
Summative Examination	**:**	50
Total	**:**	**75**

Summative Examination

Question Pattern **Duration: 3 Hours**

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

B. 2.3.1 Skill Enhancement Course - Professional Competency Skill

Types of Question – Multiple Choice Questions Only

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation		**Marks**
Periodic Test	:	20
Assignment	:	5
Total	**:**	**25**

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

Two Assignments - Better of the two will be considered

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

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6-9	Internal Choice – Either… or Type	4	4	5	20
C	10 - 11	Internal Choice – Either…. or Type	2	2	10	20
	Total					**45***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

Summative Examination
External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Summative Examination	:	60
Seminar Presentation	:	15
Total	:	**75**

Summative Examination

Question Pattern **Duration: 3 Hours**

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

B.2.4. Self Study - Online Course

Practice for CSIR NET-General Paper –Online
Internal Examination only

- Two Periodic Tests (Online) 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	:	25
Model Examination	:	75
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.5. Extension Activities

Assessment by Internal Examiner only

Distribution of Marks

Mode of Evaluation		Marks
Attendance	:	5
Performance	:	10
Report	:	10
Total	**:**	**25***

*The marks obtained will be calculated for 100 marks

B.2.6. EXTRA CREDIT COURSES (OPTIONAL)

2.6.1 Extra Credit Course offered by the Department.

Assessment by Internal Examiner Only (To be conducted along with the III Periodic Test)

Distribution of Marks

Mode of Evaluation		**Marks**
Quiz (Multiple Choice Questions)	:	25
Model Examination	:	75
Total	**:**	**100**

Question Pattern for Model Examination

Section	**Types of Question**	**No. of Questions**	**No. of Questions to be answered**	**Marks for each Question**	**Total Marks**
A Q.No.(1-5)	Internal Choice-Either or Type	5	5	7	35
B Q.No.(6-9)	Internal Choice-Either or Type	4	4	10	40
				Total	**75**

B.2.6.2 Extra Credit Course offered by MOOC (Massive Open Online Course)

- The Courses shall be completed within the first III Semesters of the Programme.
- The allotment of credits is as follows **(Maximum of 15 credits)**

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.

- 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 curricular activities 15%	For participation in Co-curricular/Extra Curricular activities during the period of their study.

Programme Articulation Matrix (PAM)

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Average Direct PO Attainment									
Direct PO Attainment in									

Indirect Attainment of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Graduate Exit Survey								
Indirect PO Attainment								

Attainments of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
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
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment 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	15% of the class strength	30 % of the class strength
Progression to Higher Education	50% 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
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment 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 Programme are defined, refined and are inscribed in the form of PEOs. The level of attainment of PEOs defined earlier will be analysed and 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 recommend appropriate 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.

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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VIRUDHUNAGAR
Quality Education with Wisdom and Values

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 2024-2025

Components	Semester				Total Number of Hours (Credits)
	I	II	III	IV	
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 (4)	6 (4)	6 (4)	-	18 (12)
Project	-	-	-	6 (5)	6(5)
Elective Course (DSEC)	6 (3)	4 (3)	3 (3)	-	13 (9)
Elective Course (Generic)	6 (3)	4 (3)	-	-	10 (6)
Elective Course(NME)	-	4 (2)	3 (2)	-	7 (4)
Elective Course- (Industry / Entrepreneurship) 20% Theory 80 % Practical	-	-		6 (3)	6 (3)
Skill Enhancement Course/ Professional Competency Skill	-	-	-	6 (3)	6 (3)
Self Study Course	-	-	0 (1)	-	0 (1)
Internship/Industrial Activity	-	-	0 (2)	-	0 (2)
Extension Activity	-	-	-	0 (1)	0 (1)
Total	**30 (20)**	**30 (22)**	**30 (27)**	**30 (22)**	**120 (91)**
Extra Credit Course(Optional) - Offered by the Department	-	-	0(2)	-	0(2)
Extra Credit Course(Optional) - MOOC	-	-	-	-	Limited to a maximum of 15 credits

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Quality Education with Wisdom and Values

MASTER OF PHYSICS
Programme Code-7014
PROGRAMME CONTENT
M.Sc. PHYSICS-SEMESTER I

S.No.	Components	Titl of the Course	Course Code	Hours Per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-1	Classical Mechanics and Relativity	24PPHC11	6	5	3	25	75	100
2	Core Course-2	Mathematical Physics	24PPHC12	6	5	3	25	75	100
3	Core Course-3	Practical I	24PPHC11P	6	4	6	40	60	100
4	Elective Course -1 (DSEC)	Energy Physics	24PPHE11	6	3	3	25	75	100
5	Elective Course-2 (Generic)	Linear & Digital ICs andApplications	24PPHE12	6	3	3	25	75	100
Total				**30**	**20**				**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	Statistical Mechanics	24PPHC21	6	5	3	25	75	100
2	Core Course-5	Quantum Mechanics-I	24PPHC22	6	5	3	25	75	100
3	Core Course-6	Practical-II	24PPHC21P	6	4	6	40	60	100
4	Elective Course -3 (DSEC)	Solar Energy Utilization	24PPHE21	4	3	3	25	75	100
5	Elective Course -4 (Generic)	Physics of Nano Science and Nano Technology	24PPHE22	4	3	3	25	75	100
6	Elective Course- 5 (NME)	Solid Waste Management	24PPHN21	4	2	3	25	75	100
Total				**30**	**22**				**600**

DSEC-Discipline Specific Elective Course ; NME – Non Major Elective

**** Internship will be carried out during the summer vacation of the first year and marks will be included in the Third Semester Marks Statement.**

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	Quantum Mechanics -II	24PPHC31	6	5	3	25	75	100
2	Core Course-8	Condensed Matter Physics	24PPHC32	6	5	3	25	75	100
3	Core Course-9	Electromagnetic Theory	24PPHC33	6	5	3	25	75	100
4	Core Course-10	Practical-III	24PPHC31P	6	4	6	40	60	100
5	Elective Course -6 (DSEC)	Medical Physics	24PPHE31	3	3	3	25	75	100
6	Elective Course-7 (NME)	Sewage and Waste Water Treatment and Reuse	24PPHN31	3	2	3	25	75	100
7	Self-Study Course	Practice for CSIR-NETGeneral Paper-Online	24PGOL32	-	1	2	100	-	100
8		Internship / IndustrialActivity	24PPHI31	-	2	-	100	-	100
Total				**30**	**27**				**800**
9	Extra Credit Course	Remote Sensing & GIS Applications	24PPHO31	-	2	3	100		100

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-11	Nuclear and Particle Physics	24PPHC41	6	5	3	25	75	100
2	Core Course-12	Spectroscopy	24PPHC42	6	5	3	25	75	100
3	Core Course-13	Project with Viva Voce	24PPHC41PR	6	5	-	40	60	100
4	Elective Course -8 (Industry/ Entrepreneurship) 20 % Theory 80% Practical	Characterization of Materials	24PPHE41P	6	3	3	25	75	100
5	Skill Enhancement Course/ Professional Competency Skill	Physics for Competitive Examinations	24PPHS41	6	3	3	25	75	100
6		Extension Activity		-	1	-	100	-	100
Total				**30**	**22**				**600**

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M.Sc. Physics

(for those who Join in 2024-2025)

Semester I	**CLASSICAL MECHANICS AND RELATIVITY**	Hours/Week:6	
CoreCourse-1		Credits:5	
Course Code **24PPHC11**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: explain the fundamentals of classical mechanics, conservation laws, constraints, generalized co-ordinates, virtual work and relativity [K2]

CO2: apply the principles of Lagrangian and Hamiltonian mechanics to solve equations of motion of physical systems. [K3]

CO3: use relativity theory to study the mechanical systems in inertial and non-inertial frames. [K3]

CO4: analyze the theory of small oscillations in systems and determine their normal modes of oscillations. [K4]

CO5: examine the solutions of various mechanical systems. [K4]

UNIT I Principles Of Classical Mechanics: Mechanics of a single particle – mechanics of a system of particles – conservation laws for a system of particles – constraints – holonomic & non-holonomic constraints – generalized coordinates – configuration space – transformation equations – principle of virtual work. (18 Hours)

UNIT II Lagrangian Formulation: D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion. (18 Hours)

UNIT III Hamiltonian Formulation: Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – Hamilton's canonical equations of motion – applications: (i) simple pendulum (ii) one dimensional simple harmonic oscillator (iii) motion of particle in a central force field. (18 Hours)

UNIT IV Small Oscillations: Formulation of the problem – transformation to normal coordinates –frequencies of normal modes – linear triatomic molecule**.** (18Hours)

UNIT V Relativity : Inertial and non-inertial frames – Lorentz transformation equations – length contraction and time dilation – relativistic addition of velocities – Einstein's mass-energy relation – Minkowski's space – four vectors – position, velocity, momentum, acceleration and force in for vector notation and their transformations**.** (18 Hours)

BOOKS FOR STUDY:

1. Upadhyaya.J.C,(2014), Classical Mechanics, HimalayaPublshing. Co.New Delhi. UNIT I, UNIT II, UNIT III, UNIT V
2. Gupta Kumar Sharma, (2008). Classical Mechanics, Twenty Fourth Edition. Meerut:PragatiPrakashan. UNIT IV

BOOKS FOR REFERENCE :

1. Symon.K.R,(1971). Mechanics, Addison, Wesley, London.
2. Goldstein.H, (2002). Classical Mechanics, 3rd Edition, Pearson Edu.
3. Biswas.S.N, (1999). Classical Mechanics, Books & Allied, Kolkata.
4. Gupta and Kumar, Classical Mechanics, KedarNath.
5. Kibble.T.W.B, Classical Mechanics, ELBS.
6. Greenwood, Classical Dynamics, PHI, New Delhi.

Web sources:

1.http://poincare.matf.bg.ac.rs/~zarkom/Book_Mechanics_Goldstein_Classical_Mechanics_optimized.pdf
2. https://pdfcoffee.com/classical-mechanics-j-c-upadhyay-2014-editionpdf-pdf-free.html
3. https://nptel.ac.in/courses/122/106/122106027/
4. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/
5. https://www.britannica.com/science/relativistic-mechanics

Course code 24PPHC11	**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	3	1	1	2	3	2	1	2	-	-
CO2	3	1	3	2	2	2	1	1	-	-
CO3	3	1	3	3	3	2	1	3	-	-
CO4	3	2	1	3	3	3	1	3	-	1
CO5	3	2	1	3	3	3	1	3	-	1

Strong (3) Medium (2) Low (1)

Mrs.P.Kanmani
Head of the Department

Dr.M.Reka devi
course Designer

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M.Sc. Physics

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Semester I	**MATHEMATICAL PHYSICS**	Hours/Week:6	
Core Course-2		Credits:5	
Course Code **24PPHC12**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: explain the basic concepts of vectors, analytic functions, matrices, Fourier & Laplace transforms, differential equations. [K2]

CO2: solve problems using vector, complex variable functions, integral theorem and formula.[K3]

CO3: use matrices, transforms, differential equations and Green's theorem to solve physical problems. [K3]

CO4: analyze solutions of various physical problems. [K4]

CO5: assess the parameters involved in physical systems. [K4]

UNIT I

Linear Vector Space : Basic concepts – Definitions- examples of vector space – Linear independence - Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure – linear operators – Dual space- ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator –Eigen values and Eigen functions – Direct sum and invariant subspace – orthogonal transformations and rotation (18 Hours)

UNIT II

Complex Analysis: Review of Complex Numbers -de Moivre's theorem-Functions of a Complex Variable- Differentiability -Analytic functions- Harmonic Functions- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue theorem and its Application: Potential theory - (1) Electrostatic fields and complex potentials - Parallel plates, coaxial cylinders and an annular region (2) Heat problems - Parallel plates and coaxial cylinders (18 hours)

UNIT III

Matrices: Types of Matrices and their properties, Rank of a Matrix -Conjugate of a matrix - Adjoint of a matrix - Inverse of a matrix - Hermitian and Unitary Matrices -Trace of a matrix- Transformation of matrices - Characteristic equation - Eigen values and Eigen vectors - Cayley–Hamilton theorem –Diagonalization (18 hours)

UNIT IV

Fourier Transforms & Laplace Transforms: Definitions -Fourier transform and its inverse - Transform of Gaussian function and Dirac delta function -Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium - Wave equation: Vibration of an infinite string and of a semi - infinite string.

Laplace transform and its inverse - Transforms of derivatives and integrals – Differentiation and integration of transforms - Dirac delta functions - Application - Laplace equation: Potential problem in a semi - infinite strip (18 Hours)

UNIT V

Differential Equations: Second order differential equation- Sturm-Liouville's theory - Series solution with simple examples - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations – Legendre polynomials - Generating function - Rodrigue formula – Orthogonality properties - Dirac delta function- One dimensional Green's function and Reciprocity theorem -Sturm-Liouville's type equation in one dimension & their Green's function.

BOOKS FOR STUDY: (18 Hours)

1. SathyaPrakash, (2011). *Mathematical Physics*, New Delhi: Sultan Chand & Sons.
2. Gupta B.D., (2009). *Mathematical Physics*, Fourth Edition, New Delhi: Vikas Publishing House.

BOOKS FOR REFERENCE :

1. Joshi. A .W., (2017). *Matrices and Tensors in Physics*, Fourth Edition , New Age International Pvt. Ltd.
2. Kreyszig E., (1983). *Advanced Engineering Mathematics*, New Delhi: Wiley Eastern.
3. Zill D. G. and Cullen M. R., (2006). *Advanced Engineering Mathematics*, Third Eition. New Delhi: Narosa.

WEB SOURCES

1. www.khanacademy.org
2. https://youtu.be/LZnRlOA1_2I
3. http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath
4. https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qaZ
5. https://archive.nptel.ac.in/courses/115/106/115106086/

Course code 24PPHC12	**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	3	-	3	2	2	1	-	3	-	1
CO2	3	-	3	3	2	1	-	3	-	1
CO3	3	-	3	3	3	1	-	3	-	-
CO4	3	1	1	3	3	1	2	3	-	-
CO5	3	1	1	3	3	1	2	3	-	-

Strong (3) Medium (2) Low (1)

Mrs.P.Kanmani — **Head of the Department**

Mrs.T.S.Lalitha — **Course Designer**

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M. Sc. Physics

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Semester I	**PRACTICAL – I**	Hours/Week:6	
Core Course-3 Practical -1		Credits:4	
Course Code **24PPHC11P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: understand the theoretical concepts of Physics and Electronics to formulate the experiment. [K2]

CO2: explain the procedure to carry out the experiment.[K2]

CO3: Sketch/write the circuit diagram, tabular column, model graph to calculate the required physical parameters [K3]

CO4: use the technical skills to efficiently handle the instruments, measure the required physical Parameters, obtain the result and complete the records. [K3]

CO5: analyze the accuracy of the obtained result and assess the experimental errors. [K4]

CORE PRACTICAL

(Any Twelve Experiments)

1. Determination of Young's modulus and Poisson's ratio by hyperbolic fringes.
2. Measurement of Band gap energy- Thermistor
3. Determination of Wavelength, Separation of wavelengths - Michelson Interferometer
4. Determination of Compressibility of a liquid using Ultrasonics
5. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
6. Construction of relaxation oscillator using UJT
7. V- I Characteristics of different colours of LED.

8. Construction of square wave Triangular wave generator using IC 741
9. Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
10. Study of Binary to Gray and Gray to Binary code conversion.
11. Study of R-S, clocked R-S and D-Flip flop using NAND gates
12. Study of J-K, D and T flip flops using IC 7476/7473
13. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
14. Study of Arithmetic logic unit using IC 74181.
15. Determination of specific rotatory power- Polarimeter.

BOOKS FOR STUDY:

1.S.L. Gupta, V.K. Kumar, (2018). Practical Physics, Pragati Prakasan.

2.K A. Navas, (2015). Electronic lab manual Volume I, PHI Learning Pvt. Ltd.

3.K A. Navas, (2018). Electronic lab manual Volume II, PHI Learning Pvt. Ltd.

BOOKS FOR REFERENCE :

1. S.P Singh, (2015). Advanced Practical Physics, Pragati Prakasan.
2. Ramakanth A Gaykwad, (2000). Op-Amps and Linear Integrated Circuit, Pearson Education, New Delhi.

Course code 24PPHC11P	**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	3	3	2	3	3	2	3	2	1	1
CO2	3	3	1	3	3	3	3	2	1	1
CO3	3	3	1	3	2	3	2	3	1	1
CO4	3	3	1	3	3	3	3	3	1	1
CO5	3	3	1	3	3	3	3	3	1	1

Strong (3) Medium (2) Low (1)

Mrs T S Lalitha

Mrs P Kanmani Dr .M. Reka devi

Head of the Department **Course Designers**

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M.Sc. Physics

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Semester I	**ENERGY PHYSICS**	Hours/Week: 6	
Elective Course -1 (DSEC)		Credits: 3	
Course Code **24PPHE11**		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : identify different forms of energy resources and their classification, basic laws/principles of energy conversion. [K2]

CO2 : apply the basic laws/principles to convert various forms of energy into electrical energy. [K3]

CO3 : apply concepts of physics for storage, distribution and utilization of energy resources. [K3]

CO4 : evaluate the parameters involved in efficient energy conversion [K4]

CO5 : examine the efficiency of energy conversion in view of commercial and domestic applications [K4]

UNIT I

Introduction to Energy Sources: Conventional and non-conventional energy sources and their availability–prospects of Renewable energy sources– Energy from other sources–chemical energy–Nuclear energy– Energy storage and distribution. (18 Hours)

UNIT II

Energy from the Oceans: Energy utilization–Energy from tides–Basic principle of tidal power–utilization of tidal energy – Principle of ocean thermal energy conversion systems. (18 Hours)

UNIT III

Wind Energy Sources: Basic principles of wind energy conversion–power in the wind–forces in the Blades– Wind energy conversion–Advantages and disadvantages of wind energy conversion systems (WECS) - Energy storage–Applications of wind energy. (18 Hours)

UNIT IV

Energy from Biomass: Biomass conversion Technologies– wet and dry process– Photosynthesis -Biogas Generation: Introduction–basic process: Aerobic and anaerobic digestion – Advantages of anaerobic digestion–factors affecting bio digestion and generation of gas- bio gas from waste fuel– properties of biogas-utilization of biogas. (18 Hours)

UNIT V

Solar Energy Sources: Solar radiation and its measurements–solar cells: Solar cells for direct conversion of solar energy to electric powers–solar cell parameter–solar cell electrical characteristics– Efficiency–solar water Heater –solar distillation– solar cooking–solar greenhouse – Solar Pond and its applications. (18 Hours)

BOOKS FOR STUDY:

1. G.D. Rai, (2002). Non – convention sources of, 4th edition, Khanna publishers, New Delhi.
2. B.H.Khan,(2006). Non – convention energy resources of, 3rd edition, Mcgraw Hill Education India PVT limited.

BOOKS FOR REFERENCE :

1. A.B. Meinel, M.P. Meinel, (1976) Applied Solar Energy. An Introduction, Addison-Wesley Pub. Co., Michigan.
2. John Twidell, Tony Weir, (2006). Renewable Energy Resources, Taylor and Francis group, London and New York.

WEB SOURCES

1. https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=2411&printable
2. https://www.nationalgeographic.org/encyclopedia/tidal-energy/
3. https://www.ge.com/renewableenergy/wind-energy/what-is-wind-energy
4. https://www.reenergyholdings.com/renewable-energy/what-is-biomass/
5. https://www.acciona.com/renewable-energy/solar-energy/

Course code 24PPHE11	**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	3	2	3	1	1	1	1	2	-	-
CO2	3	2	3	1	1	1	1	2	-	-
CO3	3	3	3	2	2	2	2	2	1	1
CO4	3	3	3	2	2	2	2	2	1	1
CO5	3	3	3	3	3	3	2	3	1	1

Strong (3) Medium (2) Low (1)

Mrs.P.Kanmani
Head of the Department

Mrs.P.Kanmani
Course Designer

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M. Sc. Physics

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Semester I	**LINEAR AND DIGITAL ICs & APPLICATIONS**	Hours/Week: 6	
Elective Course- 2 (Generic)		Credits:3	
Course Code **24PPHE12**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: explain the features and characteristics of linear and digital ICs. [K2]

CO2: use linear ICs to construct amplifiers, filters, converters, wave form generators, PLL, voltage regulators and solve simultaneous equations. [K3]

CO3: use digital ICs to construct combinational and sequential circuits. [K3]

CO4: analyze operation of amplifiers, filters, converters, wave form generators, PLL, voltage regulators [K4]

CO5 analyze the working of combinational and sequential circuits. [K4]

UNIT I

Integrated Circuits And Operational Amplifier: Introduction, Classification of IC's, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit and Op-Amp. Characteristics. (18 Hours)

UNIT II

Applications of Op-Amp: Solution to simultaneous equations and differential equations, Instrumentation amplifiers, V to I and I to V converters.

Non-Linear Applications Of Op-Amp: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators. (18 Hours)

UNIT III

Active Filters &Timer and Phase Locked Loops active filters: Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters.

Timer And Phase Locked Loops: Introduction to IC 555 timer, description of functional diagram, nonstable and astable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage controlled oscillator (IC 566), low pass filter, monolithic PLL and applications of PLL (18 Hours)

UNIT IV

Voltage Regulator & D To A And A To D Converters voltage Regulator: Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator.

D To A AND A To D Converters: Introduction, basic DAC techniques -weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters -parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications. (18 Hours)

UNIT V

CMOS Logic, Combinational Circuits Using TTL 74xx ICs & Sequential Circuits Using TTL 74xx ICs CMOS Logic: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates,
implementation of any function using CMOS logic. COMBINATIONAL CIRCUITS USING TTL 74XX ICs: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Multiplexer (IC74151), Demultiplexer (IC 74154).

Sequential Circuits Using TTL 74xx ICs: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4- bit asynchronous binary counter (IC 7493).

(18 Hours)

BOOKS FOR STUDY

1.D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt.Ltd., New Delhi, India UNIT I,UNIT II,UNIT III,UNIT IV

2. S.Salivahanan,S.Arivazhagan ,(2019).Digital Circuits and Design,5 th edition,New delhi,Oxford university. UNIT V

BOOKS FOR REFERENCE

1.Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.

2.Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi.

3. Malvino and Leach (2005), Digital Principles and Applications 5th Edition, Tata McGraw Hill, New Delhi

4. Floyd, Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.

5. Millman & Halkias, (2000). Integrated Electronics, Tata McGraw Hill, New Delhi

WEB SOURCES

1.https://nptel.ac.in/course.html/digital circuits/

2.https://nptel.ac.in/course.html/electronics/operational amplifier/

3.https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effect-controlled-thyristors/

4.https://www.electrical4u.com/applications-of-op-amp/

5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

Course code 24PPHE12	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	3	1	3	1	1	1	-	3	-	1
CO2	3	2	2	1	1	1	1	3	-	1
CO3	3	2	2	2	1	1	1	3	-	
CO4	3	2	3	2	3	1	1	3	-	
CO5	3	2	3	1	3	-	-	3	-	

Strong (3) Medium (2) Low (1)

Mrs.P.Kanmani — **Head of the Department**

Mrs.P.S.Saritha — **Course Designer**

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VIRUDHUNAGAR
Quality Education with Wisdom and Values

M.Sc. Physics

(for those who join in 2024-2025)

Semester II	**STATISTICAL MECHANICS**	Hours/Week:6	
Core Course-4		Credits:5	
Course Code **24PPHC21**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: explain the basic laws, theorems and concepts and in classical and quantum statistics. [K2]

CO2: use statistical methods to find the parameters involved in physical systems. [K3]

CO3: use classical and quantum statistics to understand the properties of ideal and real gases. [K3]

CO4: analyze the behaviour of physical systems using statistical techniques. [K4]

CO5: examine the nature of ideal and real gases using statistical models. [K4]

UNIT I : Phase Transitions : Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics. Order parameters– Landau's theory of phase transition - Critical indices - Scale transformations and dimensional analysis. (18 hours)

UNIT II :Statistical Mechanics And Thermodynamics: Foundations of statistical mechanics Specification of states of a system - Micro canonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics – Entropy of an ideal gas using the micro canonical ensemble - Entropy of mixing and Gibb's paradox. (18 hours)

UNIT III :Canonical And Grand Canonical Ensembles : Trajectories and density of states - Liouville's theorem - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and density fluctuations. (18 hours)

UNIT IV :Classical And Quantum Statistics : Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermigas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einsteincondensation. (18 hours)

UNIT V :Real Gas, Ising Model And Fluctuations : Cluster expansion for a classical gas - Virial equation of state – Calculation of the first Virial coefficient in the cluster expansion - Ising model - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one dimension. Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin's theory - Fluctuation-dissipation theorem- The Fokker-Planck equation. (18 hours)

BOOKS FOR STUDY

1. Sinha.S. K,(1990).Statistical Mechanics, Tata McGraw Hill, New Delhi.
   UNIT I
2. Gupta Kumar, (2015). Statistical Mechanics, 28th Edition. Prakathi Prakashan Publishers.
   UNIT II,UNIT III,UNITIV
3. Agarwal.B.K. and Eisner.M.(1998), Statistical Mechanics, Second Edition New Age International, New Delhi. UNITV

BOOKS FOR REFERENCES

1. Pathria.R.K, (1996). *Statistical Mechanics,* 2nd edition, Butter WorthHeinemann, New Delhi.
2. Landau .L.D.and Lifshitz.E.M, (1969).*Statistical Physics,* Pergamon Press, Oxford.3.Huang.K, (2002). *Statistical Mechanics,* Taylor and Francis, London
3. Greiner.W, Neise.L and Stoecker.H, *Thermodynamics and Statistical Mechanics,* Springer Verlang, New York.
4. Gupta.A.B, Roy.H,(2002).*Thermal Physics,* Books and Allied, Kolkata.

Web Sources:

1. https://byjus.com/chemistry/third-law-of-thermodynamics/
2. https://web.stanford.edu/~peastman/statmech/thermodynamics.html
3. https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics
4. https://en.wikipedia.org/wiki/Grand_canonical_ensemble
5. https://en.wikipedia.org/wiki/Ising_model

Course code 24PPHC21	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	3	1	3	2	1	2	1	1	-	-
CO2	3	1	3	2	1	2	1	1	-	-
CO3	3	1	3	3	3	3	1	2	-	-
CO4	3	1	1	3	3	3	1	3	-	-
CO5	3	1	1	3	3	3	1	3	-	-

Strong (3) Medium (2) Low (1)

Mrs.P.Kanmani
Head of the Department

Dr.M.Reka devi
Course Designer

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VIRUDHUNAGAR
Quality Education with Wisdom and Values

M.Sc. Physics

(for those who join in 2024-2025)

Semester II	**Quantum Mechanics-I**	Hours/Week: 6	
Core Course 5		Credits: 5	
Course Code **24PPHC22**		Internal 25	External 75

COURSE OUTCOMES

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

CO1 : understand basic principles, theorems & postulates, wave function, Schrodinger waveequation, different types of operators, potential well and representations in quantum mechanics. [K2]

CO2 : apply basic principles and laws, Schrodinger wave equation to solve quantum mechanicalproblems. [K3]

CO3 : use WKB approximation & variation methods, various representations to solve quantummechanical problems. [K3]

CO4 : analyze non-degeneracy, the occurrence of degeneracy & its removal, approximation methods, and angular momenta [K4]

CO5 : evaluate energy states of atoms, eigen functions & values, and wave function of particle indifferent potentials. [K4]

UNIT I

Basic Formalism: Interpretation of the wave function – Time dependent Schrodinger equation –Time independent Schrodinger equation – Stationary states – Ehrenfest's theorem – Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation. (18 Hours)

UNIT II

One Dimensional And Three-Dimensional Energy Eigen Value Problems: Square – well potential with rigid walls – Square well potential with finite walls – Square potential

barrier – Alpha emission – Bloch waves in a periodic potential – Kronig-penny square – well periodic potential – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles – Hydrogen atom – Rigid rotator. (18 Hours)

UNIT III

General Formalism: Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation – Coordinate representation – Momentum representation – Symmetries and conservation laws – Unitary transformation – Parity and time reversal. (18 Hours)

UNIT IV

Approximation Methods: Time independent perturbation theory for non-degenerate energy levels – Degenerate energy levels – Stark effect in Hydrogen atom – Ground and excited state – Variation method – Helium atom – WKB approximation – Connection formulae (no derivation) – WKB quantization – Application to simple harmonic oscillator. (18 Hours)

UNIT V

Angular Momentum: Eigenvalue spectrum of general angular momentum – Ladder operators and their algebra – Matrix representation – Spin angular momentum – Addition of angular momenta – CG Coefficients – Symmetry and anti – symmetry of wave functions – Construction of wave-functions and Pauli's exclusion principle. (18 Hours)

BOOKS FOR STUDY

1. P. M. Mathews and K. Venkatesan, (2010). A Text book of Quantum Mechanics, 2nd edition (37th Reprint), Tata McGraw-Hill, New Delhi.
2. L.I.Schiff, (1968),Quantum mechanics,3rd edition, Tata McGraw-Hill, New Delhi.

BOOKS FOR REFERENCE

1. E. Merzbacher, (1970). Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York,.
2. V. K. Thankappan, (1985). Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi.
3. V. Devanathan, (2011). Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford.
4. G. Aruldhas, ,(2009). Quantum Mechanics, 2nd edition, Prentice Hall of India, NewDelhi.

WEB SOURCES

1. http://research.chem.psu.edu/lxjgroup/download_files/chem565-c7.pdf
2. http://www.feynmanlectures.caltech.edu/III_20.html

   http://web.mit.edu/8.05/handouts/jaffe1.pdf
3. https://theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf

Course code 24PPHC22	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	3	1	3	2	1	-	1	3	1	1
CO2	3	1	3	2	1	-	1	3	1	1
CO3	3	1	3	3	2	L	2	3	1	-
CO4	3	1	3	3	2	L	2	3	1	-
CO5	3	1	3	3	3	L	2	3	1	-

Strong (3) Medium (2) Low (1)

Mrs.P.Kanmani
Head of the Department

Mrs.P.Kanmani
Course Designer

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M.Sc. Physics

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Semester II	**PRACTICAL II**	Hours/Week: 6	
Core Course-6 Practical -2		Credits: 4	
Course Code **24PPHC21P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: understand the basic law/principle behind the experiment. [K2]

CO2: explain the basic laws/principle to correlate the physical parameters involved in the experiment. [K2]

CO3: apply the learned concepts to execute the experiment scientifically and systematically. [K3]

CO4: use the relevant theories to calculate the required Physical parameters. [K3]

CO5: analyze the results obtained and interpret the results. [K4]

List of Experiments (Any Twelve)

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Measurement of Susceptibility of liquid - Quincke's method
3. Determination of Thickness of thin film. - Michelson Interferometer
4. Determination of Refractive index of liquids using diode Laser/ He – Ne Laser
5. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source.
6. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility
7. Determination of I-V Characteristics and efficiency of solar cell.
8. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
9. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.

10. Construction of square wave generator using IC 555 – Study of VCO
11. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474
    Study of Modulus Counter
12. Determination of e/m - Millikan's method
13. Miscibility measurements using ultrasonic diffraction method
14. IC 7490 as scalar and seven segment display using IC7447
15. Solving simultaneous equations – IC 741 / IC LM324

BOOKS FOR STUDY

1. S.L. Gupta, V.K. Kumar, (2018). Practical Physics, Pragati Prakasan.
2. K A. Navas, (2015). Electronic lab manual Volume I, PHI Learning Pvt. Ltd.
3. K A. Navas, (2018). Electronic lab manual Volume II, PHI Learning Pvt. Ltd.

BOOKS FOR REFERENCE

1. S.P Singh, (2015). Advanced Practical Physics, Pragati Prakasan.
2. Ramakanth A Gaykwad, (2000). Op-Amps and Linear Integrated Circuit, Pearson Education, New Delhi.

Course code 24PPHC21P	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	3	3	2	1	1	1	1	2	1	1
CO2	3	3	2	2	2	1	1	2	1	1
CO3	2	3	2	2	2	1	1	2	2	2
CO4	2	3	2	3	3	1	2	3	2	2
CO5	2	3	2	3	3	2	2	3	2	2

Strong (3) Medium (2) Low (1)

Mrs.P.Kanmani
Head of the Department

Mrs.P.Kanmani
Course Designer

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VIRUDHUNAGAR
Quality Education with Wisdom and Values

M. Sc. Physics

(for those who join in 2024-2025)

Semester II	**SOLAR ENERGY UTILIZATION**	Hours/Week:4	
Elective Course -3 (DSEC)		Credits:3	
Course Code **24PPHE21**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: explain the fundamental aspects of solar and renewable energy utilization. [K2]

CO2: apply Physics principles for energy conversion in solar thermal & electrical systems and fuel cells. [K3]

CO3: apply the learned concepts to calculate the efficiency of solar thermal & electrical systems. [K3]

CO4: analyze the performance of solar thermal & electrical systems and fuel cells. [K4]

CO5: analyze the parameters involved in efficiency of solar thermal & electrical systems [K4]

UNIT I

Heat Transfer & Radiation Analysis: Conduction, Convection and Radiation – Solar Radiationat the earth's surface - Determination of solar time – Solar energy measuring instruments.

(12 hours)

UNIT II

Solar Collectors: Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss. (12 hours)

UNIT III

Solar Heaters: Types of solar water heater - Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling system (12 hours)

UNIT IV

Solar Energy Conversion: Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo - electric conversion - process flow of silicon solar cells- different approaches on the process- texturization, diffusion, Antireflective coatings, metallization. (12 hours)

UNIT V

Nanomaterials in Fuel Cell Applications: Use of nanostructures and nanomaterials in fuel cell technology - high and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts. Use of Nano technology in hydrogen production and storage. (12 hours)

BOOKS FOR STUDY

1. Rai G. D., (1987). *Solar energy utilization* New Delhi: Khanna publishers.
2. Sukhatme S.P., (1997*). Solar Energy*, New Delhi: Tata McGraw Hill Publishing Company Ltd.

BOOKS FOR REFERENCE

1. Romer R. H., Freeman W.H., (1976). *Energy – An Introduction to Physics.*

2. John Drife A. and William, (1974). *Solar energy thermal processes.*

3. John Twidell W. & Anthony Weir D., (2005). *Renewable Energy Resources*.

WEB SOURCES

1. https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4fb
2. https://books.google.vg/books?id=l-HcwZo9XwC&sitesec=buy&source=gbs_vpt_read
3. www.nptel.ac.in/courses/112105051
4. www.freevideolectures.com
5. http://www.e-booksdirectory.com

Course code 24PPHE21	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	3	1	3	1	1	2	2	3	-	-
CO2	3	1	3	1	2	2	2	3	-	-
CO3	3	2	3	2	3	3	3	3	-	-
CO4	3	2	3	2	3	3	3	3	2	2
CO5	3	2	3	2	3	3	3	3	2	2

Strong (3) Medium (2) Low (1)

Mrs. P.Kanmani — **Head of the Department**

Mrs.T.S. Lalitha — **Course Designer**

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VIRUDHUNAGAR - 626 001

M.Sc. Physics

(for those who join in 2024-2025)

Semester I	**PHYSICS OF NANO SCIENCE AND TECHNOLOGY**	Hours/Week: 4	
Elective Course – 4 (Generic)		Credits: 3	
Course Code **24PPHE22**		Internal 25	External 75

COURSE OUTCOMES

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

CO1 :explain geometry, basic properties, and fabrication of nanomaterials. [K2]

CO2 :understand the principles of characterization techniques and applications of nanomaterials. [K2]

CO3 :apply the theories of Physics to synthesis, characterize and interpret/calculate the properties/parameters of nano materials. [K3]

CO4 :use the nano materials for various commercial and domestic applications. [K3]

CO5 :examine the properties of characterized nano materials and identify their applications. [K4]

UNIT I

Fundamentals of Nano science and technology: Fundamentals of Nano – Historical Perspective on Nanomaterial and Nanotechnology – Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterial (12 Hours)

UNIT II

Properties of Nanomaterials: Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior: Elastic properties – strength - ductility - superplastic behavior - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS) (12 Hours)

UNIT III

Synthesis and Fabrication :Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography – Nanomanipulator. (12 Hours)

UNIT IV

Characterization of Nano materials : Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer (12 Hours)

UNIT V

Applications of Nano materials: Sensors: Nanos sensors based on optical and physical properties - Electrochemical sensors – Nano-biosensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Carbon Nanotube Emitters – Photocatalytic application: Air purification, water purification -Medicine: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells - rechargeable batteries - supercapacitors - photovoltaics. (12 Hours)

BOOKS FOR STUDY

1. M.A.Shah, T.Ahmad (2015), Principles of Nano Science and Technology, Narosa Publishing House, New Delhi UNIT I, UNIT II, UNIT III, UNIT IV
2. T.Pradeep, (2008), A Textbook of Nano Science and Technolgy Tata McGraw-Hill Publishing Co. UNIT V

BOOKS FOR REFERENCE

1. Richard Booker and Earl Boysen, (2005), Nanotechnology, Wiley Publishing Inc. USA
2. J. H. Fendler (2007), Nano particles and Nano structured films; Preparation, Characterization, John Wiley and Sons.
3. B. S. Murty, et al (2012). Textbook of Nano science and Nanotechnology Universities Press.

WEB SOURCES

1. https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=2411&printable=1
2. https://www.nationalgeographic.org/encyclopedia/tidal-energy/
3. https://www.ge.com/renewableenergy/wind-energy/what-is-wind-energy
4. https://www.reenergyholdings.com/renewable-energy/what-is-biomass/
5. https://www.acciona.com/renewable-energy/solar-energy/

Course code 24PPHE22	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	3	2	3	2	1	2	1	1	1	-
CO2	3	2	3	2	1	2	1	1	1	-
CO3	3	2	3	2	1	3	2	2	2	-
CO4	3	2	3	2	1	3	2	2	2	2
CO5	3	2	3	3	2	3	3	3	2	2

Strong (3) Medium (2) Low (1)

Mrs.P.Kanmani
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M. Sc. Physics

(for those who join in 2024-2025)

Semester II	**SOLID WASTE MANAGEMENT**	Hours/Week:4	
Elective Course -5 (Non Major Elective)		Credits:2	
Course Code **24PPHN21**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: explain the SWM for economic development and environmental protection and tools and equipment [K1]

CO2: explain the types of solid wastes.[K2]

CO3: describe Municipal Solid waste and non-municipal solid waste. [K2]

CO4: apply physics concepts for effective solid waste management in view of environmental protection. [K3]

CO5: analyze the status of solid waste management in the nearby areas. [K4]

UNIT I

SOLID WASTE MANAGEMENT: Introduction - Definition of solid waste - Types – Hazardous Waste: Resource conservation and Renewal act – Hazardous Waste: Municipal Solid waste and non-municipal solid waste. (12 hours)

UNIT II

SOLID WASTE CHARACTERISTICS: Solid Waste Characteristics: Physical and chemical characteristics - SWM hierarchy - factors affecting SW generation (12 hours)

UNIT III

TOOLS AND EQUIPMENT: Tools and equipment - Transportation - Disposal techniques - Composting and land filling technique (12 hours)

UNIT IV

HAZARDOUS SOLID WASTE – Types of hazardous solid waste, their characteristics & their harmful effects on community- Safe methods of disposal of hazardous waste & their management principles - Sources, generation, and storage of Bio-medical waste -Transportation and disposal of Bio- medical waste with necessary precautions.

UNIT V

ECONOMIC DEVELOPMENT: SWM for economic development and environmental protection Linking SWM and climate change and marine litter. (12 hours)

BOOKS FOR STUDY:

1. George Tchobanoglous, (2002). Handbook of Solid Waste Management, Second Edition, Tata McGraw Hill

BOOKS FOR REFERENCE :

1. Christian Ludwig, Samuel Stucki, Stefanie Hellweg, (2012). Municipal Solid Waste Management, Springer Berlin Heisenberg
2. A.Bhide (1983), Solid Waste Management, Indian National Scientific Documentation Centre, New Delhi Edition ASIN: B0018MZ0C2
3. George Techobanoglous, Kreith, Frank (2002). Solid Waste, McGraw Hill Publication, New Delhi 9780071356237
4. D. L. Manjunath, (2006). Environmental Studies, Pearson Education Publication, New Delhi, 20061SBN-I3: 978-8131709122
5. K.Sasikumar, (2009). Solid Waste Management, PHI learning, New Delhi, ISBN 8120338693.

WEB SOURCES

1. https://www.meripustak.com/Integrated-Solid-Waste-Management-Engineering-Principles-And-Management-Issues-125648
2. https://testbook.com/learn/environmental-engineering-solid-waste-management/
3. https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsA-gM0iVpismAJN93CHA1sX6NuNeOKLXfQJ_jxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB
4. :\Users\ADMIN\Downloads\https://images.app.goo.gl/tYiW2gUPfS2cxdD28
5. https://amzn.eu/d/5VUSTDI

Course code 24PPHN21	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	PSO8
CO1	3	1	2	1	1	3	-	3	-	1
CO2	3	1	2	2	1	3	-	3	-	1
CO3	3	1	2	2	1	3	-	3	-	-
CO4	2	1	1	2	3	3	-	3	1	-
CO5	2	1	2	2	3	3	-	2	1	-

Strong (3) Medium (2) Low (1)

Mrs P.Kanmani
Head of the Department

Mrs.P.S.Saritha
Course Designer