# FATIMA COLLEGE (AUTONOMOUS)

**Re-Accredited with "A" Grade by NAAC (3rd Cycle)**
**74th Rank in India Ranking 2020 (NIRF) by MHRD**
**Maryland, Madurai- 625 018, Tamil Nadu, India**

**NAME OF THE DEPARTMENT : RESEARCH CENTRE OF PHYSICS**

**NAME OF THE PROGRAMME : M.SC**

**PROGRAMME CODE : PAPH**

**ACADEMIC YEAR : 2022-2023**

# Minutes of the Board of Studies Meeting

To be implemented from 2022-2023 onwards

Venue : A1

Convened on 23-03-2022 at 2pm

## Members Present :

1. Dr. A. Sheela Vimala Rani — Head of the Dept
2. Dr. Basherrudin Mahmud Ahmed — University Nominee
   Asst. Prof. School of Physics
   Madurai Kamaraj University
   Madurai
3. Dr. K. Marimuthu — Subject Expert
   Asst. Prof
   Department of Physics
   Gandhigram Rural Institute
   – Deemed University
   Gandhigram
4. Dr. M. Umadevi — Subject Expert
   ~~Associate~~ Professor & Head
   Department of Physics
   Mother Teresa Women's University
   Attuvampatti, Kodaikanal
   23/03/22

5. Mr. Ramprakash
Industrial Electronics
Corporation No. 1,
Industrial Estate
Madurai

Industrialist

V. Ramprakash

6. Dr. R. Vishnu Priya
Asst. Prof.
Dept. of Physics
The Madura College
Madurai

Alumnae

Vishnu Priya

7. Dr. Malathi
Asst. Prof.
Dept. of Zoology
Fatima College

Dean of Academic Affairs

Malathi
23/3/2022

8. Dr. L. Caroline Sugitham
Associate Prof.

L. Caroline Sugitham

9. Mrs. R. Alphonsa Fernando
Associate Professor

R. A. Fernando

10. Dr. M. V. Leena Chandra
Asst. Prof.

M. V. Leena Chandra

11. I Jeyashealan
Asst. Prof.

I. Jeyashealan

12. Dr. Ancemma Joseph
Asst. Prof.

Ancemma Joseph

13. Dr. M. Ragam
Asst. Prof.

14. Dr. G. Jenita Rani
Asst. Prof.

15. Dr. R. Jothimani
Asst. Prof.

16. Ms. I. Janet Sherly
Asst. Prof.

17. Ms. J. R. Sofia
Asst. Prof.

18 Dr. R. Niranjana Devi
Asst. Prof.

## AGENDA FOR BOARD OF STUDIES

1. Preparation of Action taken report
2. To carry out atleast 5-10% changes in a minimum - 20% or more in the courses offered (Approximately 8-10 courses minimum)
   (a) courses with revision less than 20% - same code
   (b) courses with revision more than 20% - New code - to be prefixed with 22...
3. New courses to be introduced
   • Course code to be prefixed with 22...

4. New Value-Added Courses can be introduced or the titles can be changed

5. Each department to offer atleast one Value-Added Courses per year

6. Frequency of the courses to be increased

7. Possibilities of the Credit transfer of SWAYAM MOOC Course to be explored

8. Both the Elective Courses have to be offered simultaneously.

MINUTES OF THE BOARD OF STUDIES

1. Presentation of Action taken report.

Action taken report for 2021-22
UG PHYSICS

| SNo. | SUGGESTIONS IN THE PREVIOUS BOARD | ACTION TAKEN IN THE ACADEMIC YEAR 2021-22 |
|---|---|---|
| 1. | Self learning papers for all UG students namely "Amazing Universe and Indian Space Missions" (21P2SL1) offered by Physics dept. | These papers were introduced with the suggested syllabus |

| S.No. | SUGGESTIONS IN THE PREVIOUS BOARD | ACTION TAKEN IN THE ACADEMIC YEAR 2021-22 |
|---|---|---|
| | Interdepartmental self learning papers "Microprocessor and Programming" (21P4SLB2) offered by Physics and Computer Science, "Space Science" (21P6SLM3) offered by Physics and Maths department were passed and syllabus were suggested | from the academic year 2021-22 onwards |
| 2. | Reference book for Self learning paper "Microprocessor and Programming" by Ramesh Gaonkar shall be appended | The suggested book is included |
| 3. | Board suggested to introduce "Physics for Competitive Exams" as Self Learning paper in the forth coming year | It will be introduced in the next year |
| 4 | Reference book by S.O. Pillai suggested for "Solid State Physics" paper | Reference book is included |

| S.No. | SUGGESTIONS IN THE PREVIOUS BOARD | ACTION TAKEN I THE ACADEMIC 2021-22 |
|---|---|---|
| 5 | Board suggested to introduce Skill embedded Certificate courses on "Non conventional energy sources" | A Skill based course "Solar cell and its applications" introduced |
| 6 | Syllabus for allied papers of BCA department on "Digital Principles and Computer Organization" (19P4AC14) and IT department on "Digital Principles and Computer Architecture" (19P3AC13) are passed | It was implemented |
| 7 | Reference book Malvino and Gates are recommended as reference book in Digital Electronics and Communication (19P5CC13) | The book is included |

PG PHYSICS

| S.No. | SUGGESTIONS IN THE PREVIOUS BOARD | ACTION TAKEN IN THE ACADEMIC YEAR 2021-22 |
|---|---|---|
| 1. | The title "Principles in advanced Mathematical Physics" can be changed to Advanced Mathematical Physics as the term "Principles" is a misnomer in Mathematical Physics | Title is changed |
| 2 | The following reference books were suggested for Quantum Mechanics and Advanced Quantum Mechanics<br>(i) Principles in Quantum Mechanics - A. Shankar<br>(ii) Introduction to Quantum Mechanics - Powell and Graftsman<br>(iii) Quantum Mechanics: Concepts and applications - Nouredine Zettili | The books are included |
| 3. | Industrialistic suggested to replace the currently existing self learning paper | |

| S.No. | SUGGESTIONS IN THE PREVIOUS BOARD | ACTION TAKEN IN THE ACADEMIC YEAR 2021-22 |
|---|---|---|
| | for advanced learners entitled on "Instrumentation and experimental methods" by paper entitled on "Digital Signal Processing" | This paper is to be passed in this board |

2. REVISION OF COURSES:

| S.No. | Course Code | Units revised | % of revision | Course Title |
|---|---|---|---|---|
| 1. | 19P1ACC1/ 19M3ACP1/ 19G3ACP1 | Unit II - Bernoulli's theorem, Unit III entropy, Unit IV ohms laws | 15%. | Allied Physics - I |
| 2. | 19P2ACC3/ 19M4ACP2/ 19G4ACP2 | Unit II - Frank-Hertz expt | 18%. | Allied Physics - II |
| 3 | 19P5CC14 | Unit II - Lasers removed Unit-V Spectroscopy included | 15%. | OPTICS |
| 4 | 19P6CC17 | Unit I - Work done included | 5%. | Thermodynamics & Statistical Mechanics Revised |
| 5 | 19P5CC16 | Non-electronics Practicals | 15%. | |

| S.No. | Course Code | Units revised | % revision | Course Title |
|---|---|---|---|---|
| 6 | 19PGME2 | Medical Physics - Unit V - Imaging Techniques | 10% | Medical Physics |
| 7 | [redacted] | [redacted] | [redacted] | [redacted] |
| 8 | [redacted] | [redacted] included | [redacted] | [redacted] |

3 NEW COURSES INTRODUCED:

| | PROGRAM | COURSE CODE | COURSE TITLE |
|---|---|---|---|
| 1. | B.Sc. | 22P4CC11 | Mathematical Methods |
| 2. | B.Sc. | 22P4SB2 | Solar Cell and its Applications |
| 3 | M.Sc. | 22PGSL2 | Batteries and its Applications |
| 4 | M.Sc. | 22PGSLP1 | Digital Signal Processing |

4. NEW VALUE ADDED COURSE:

| Course Code | Course Title |
|---|---|
| 22PGVAPC1 | PG Diploma in Instrumentation on Electrochemical Workstation |

5. Approval of Ph.D. Course Work Syllabus:

Course Work paper and Core paper for the Research Scholar are as follows:

| Ph.D. Scholar | Course work paper | Core paper |
|---|---|---|
| P. Mohanaa Muthuselvi | 22PHDCWP01 Solid State Ionics | 22PHDCPP02 Materials Science |

6. SUGGESTIONS GIVEN BY THE BOARD MEMBERS:

UG

* The new course Mathematical Methods can be offered as elective / skill based paper
* The nomenclature for the above paper can be changed into Numerical Methods
* A paper on Mathematical Physics can be included as core paper which will form a basis to studying papers like Mechanics, Quantum theory, Solid State Physics etc.
* "Interference" can be shifted from Allied Physics - II to Allied Physics - I to be on-par with the practicals

* The Board suggested to include "Principles of Electronics" by Mehta as one of the reference books.
* In the elective paper (19P6ME1), instead of Timer and Counter Assemblers and Compilers can be included.

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PG

* The nomenclature for the New Value added course was discussed in detail.
* The above course can be offered as "certificate course".
* So the title of the New Value added course is

Certificate Course on Instrumentation on Electrochemical techniques.

* In the Nuclear and Particle Physics course, the Board

suggested to include "Nuclear Physics - Theory and Experiments" by Roy and Nigam as reference book.

* In the Applied Electronics paper, the Industrialist suggested that Pulse width Modulation and Switching regulators can be introduced instead of registers and counters.

* Mr. Ramprakash also recommended to include Assemblers and Simulators in the course "Instrumentation and Microcontroller" 21PG2P10 and to reduce the content of programming in 8051.

* The subject experts strongly recommended to specify the details of sections in the books for study in all the units of the syllabus for both UG and PG programs.

The specifications of the sections would enable the students to learn more precisely. The detailed sections in all units would feciliate the examiner also.

* CREDIT TRANSFER OF SWAYAM MOOC COURSE:

The board members suggested the credit transfer of Swayam-MOOC course is possible:

1) Both the syllabus should be same

2) Number of hours should mat

1) Dr. A. Sheela Vimala Rani

2) Dr. Basheeruddin Mahmud Ahmed

3) Dr. K. Marimuthu

4) Dr. M. Umadevi 23/03/22

5) Mr. Ramprakash

6) Dr. R. Vishnu Priya 23/03/22

7) Dr. Malathy 23/3/22

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18) Dr. R. Niranjana Devi R. N

23/3/22

## VISION OF THE DEPARTMENT

Educating and Empowering the youth and make them excel in all fields of Physics.

## MISSION OF THE DEPARTMENT

- To ignite the young minds and impart quality education in basic Physics
- To promote enthusiasm in the study of physics through innovative and dedicated teaching methodologies
- To discover the budding talents in theoretical and experimental physics and ensure their global competency
- To provide a stimulating environment and strengthen basic and application oriented research aptitude among the students.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

A graduate of M.Sc. Physics programme after two years will be

| | |
|---|---|
| **PEO 1** | Our graduates will be academic, digital and information literates, creative, inquisitive, innovative and committed researchers who would be desirous for the "more" in all aspects |
| **PEO 2** | They will be efficient individual and team performers who would deliver excellent professional service exhibiting progress, flexibility, transparency, accountability and in taking up initiatives in their professional work |
| **PEO 3** | The graduates will be effective managers of all sorts of real life and professional circumstances, making ethical decisions, pursuing excellence within the time framework and demonstrating apt leadership skills |
| **PEO 4** | They will engage locally and globally evincing social and environmental stewardship demonstrating civic responsibilities and employing right skills at the right moment. |

## GRADUATE ATTRIBUTES (GA)

Fatima College empowers her women graduates holistically. A Fatimite achieves all-round empowerment by acquiring Social, Professional and Ethical competencies. A graduate would sustain and nurture the following attributes:

| I. SOCIAL COMPETENCE | |
|---|---|
| **GA 1** | Deep disciplinary expertise with a wide range of academic and digital literacy |
| **GA 2** | Hone creativity, passion for innovation and aspire excellence |
| **GA 3** | Enthusiasm towards emancipation and empowerment of humanity |
| **GA 4** | Potentials of being independent |
| **GA 5** | Intellectual competence and inquisitiveness with problem solving abilities befitting the field of research |
| **GA 6** | Effectiveness in different forms of communications to be employed in personal and professional environments through varied platforms |
| **GA 7** | Communicative competence with civic, professional and cyber dignity and decorum |
| **GA 8** | Integrity respecting the diversity and pluralism in societies, cultures and religions |
| **GA 9** | All inclusive skill sets to interpret, analyse and solve social and environmental issues in diverse environments |
| **GA 10** | Self awareness that would enable them to recognise their uniqueness through continuous self-assessment in order to face and make changes building on their strengths and improving their weaknesses |

| | |
|---|---|
| **GA 11** | Finesse to co-operate exhibiting team-spirit while working in groups to achieve goals |
| **GA 12** | Dexterity in self-management to control their selves in attaining the kind of life that they dream for |
| **GA 13** | Resilience to rise up instantly from their intimidating setbacks |
| **GA 14** | Virtuosity to use their personal and intellectual autonomy in being life-long learners |
| **GA 15** | Digital learning and research attributes |
| **GA 16** | Cyber security competence reflecting compassion, care and concern towards the marginalised |
| **GA 17** | Rectitude to use digital technology reflecting civic and social responsibilities in local, national and global scenario |
| **II. PROFESSIONAL COMPETENCE** | |
| **GA 18** | Optimism, flexibility and diligence that would make them professionally competent |
| **GA 19** | Prowess to be successful entrepreuners and become employees of trans-national societies |
| **GA 20** | Excellence in Local and Global Job Markets |
| **GA 21** | Effectiveness in Time Management |
| **GA 22** | Efficiency in taking up Initiatives |
| **GA 23** | Eagerness to deliver excellent service |
| **GA 24** | Managerial Skills to Identify, Commend and tap Potentials |

| III. ETHICAL COMPETENCE | |
|---|---|
| **GA 25** | Integrity and be disciplined in bringing stability leading a systematic life promoting good human behaviour to build better society |
| **GA 26** | Honesty in words and deeds |
| **GA 27** | Transparency revealing one's own character as well as self-esteem to lead a genuine and authentic life |
| **GA 28** | Social and Environmental Stewardship |
| **GA 29** | Readiness to make ethical decisions consistently from the galore of conflicting choices paying heed to their conscience |
| **GA 30** | Right life skills at the right moment |

## PROGRAMME OUTCOMES (PO)

The learners will be able to

| | |
|---|---|
| **PO 1** | Apply acquired scientific knowledge to solve major and complex issues in the society/industry. |
| **PO 2** | Attain research skills to solve complex cultural, societal and environmental issues. |
| **PO 3** | Employ latest and updated tools and technologies to solve complex issues. |
| **PO 4** | Demonstrate Professional Ethics that foster Community, Nation and Environment Building Initiatives. |

## PROGRAMME SPECIFIC OUTCOMES (PSO)

On completion of **M.Sc. Physics** programme, the graduates would be able to

| | |
|---|---|
| **PSO 1** | Acquire thorough knowledge of the basic concepts of the frontier areas of Physics comprising Mathematical Physics, Electromagnetic theory, Classical Mechanics, Quantum Mechanics, Condensed Matter Physics, Nuclear Physics, Numerical Methods, Communication systems, Molecular Spectroscopy, Material Science and Advanced Quantum Mechanics. |
| **PSO 2** | Understand and solve the physics problems in everyday life using the acquired basic knowledge. |
| **PSO 3** | Develop skills to perform experiments based on the theoretical understanding |
| **PSO 4** | Apply the knowledge acquired to analyse and design models in the versatile realm of physics. |
| **PSO 5** | Equip with the essential foundations for higher education and research in physics. |

**FATIMA COLLEGE (AUTONOMOUS), MADURAI-18**

**DEPARTMENT OF PHYSICS**

***For those who joined in June 2019 onwards***

**MAJOR CORE 70 CREDITS**

**PROGRAMME CODE: PAPH**

| COURSE CODE | COURSE TITLE | HRS / WK | CREDIT | CIA Mks | ESE Mks | TOT. MKs |
|---|---|---|---|---|---|---|
| **SEMESTER – I** | | | | | | |
| 19PG1P1 | Introduction to Mathematical Physics | 5 | 3 | 40 | 60 | 100 |
| 19PG1P2 | Applied Electronics | 5 | 3 | 40 | 60 | 100 |
| 19PG1P3 | Classical Mechanics | 5 | 3 | 40 | 60 | 100 |
| 21PG1P4 | Applied Optics | 4 | 3 | 40 | 60 | 100 |
| 19PG1P5 | Practicals-I Non Electronics | 4 | 2 | 40 | 60 | 100 |
| 19PG1P6 | Practicals-II Electronics | 4 | 2 | 40 | 60 | 100 |
| **Total** | | **27** | **16** | | | |
| **SEMESTER – II** | | | | | | |
| 19PG2P7 | Advanced Mathematical Physics | 5 | 3 | 40 | 60 | 100 |
| 19PG2P8 | Quantum Mechanics | 5 | 3 | 40 | 60 | 100 |
| 19PG2P9 | Electromagnetic Theory | 5 | 3 | 40 | 60 | 100 |
| 21PG2P10 | Instrumentation and Microcontroller | 4 | 3 | 40 | 60 | 100 |
| 19PG2P11 | Practicals-III Non Electronics | 4 | 2 | 40 | 60 | 100 |

| COURSE CODE | COURSE TITLE | HRS / WK | CREDIT | CIA Mks | ESE Mks | TOT. MKs |
|---|---|---|---|---|---|---|
| 19PG2P12 | Practicals-IV Electronics | 4 | 2 | 40 | 60 | 100 |
| **Total** | | **27** | **16** | | | |
| **SEMESTER _ III** | | | | | | |
| 19PG3P11 | Condensed Matter Physics | 6 | 5 | 40 | 50 | 100 |
| 19PG3P12 | Statistical Mechanics | 6 | 5 | 40 | 60 | 100 |
| 19PG3P13 | Nuclear and Particle Physics | 6 | 5 | 40 | 60 | 100 |
| 19PG3P14 | Practicals _ V Advanced Non Electronics | 4 | 2 | 40 | 60 | 100 |
| 19PG4P15 | Practicals _ V1 Computational Programming | 4 | 2 | 40 | 60 | 100 |
| **Total** | | **26** | **19** | | | |
| **SEMESTER _ IV** | | | | | | |
| 19PG4P16 | Advanced Condensed Matter Physics | 6 | 5 | 40 | 60 | 100 |
| 19PG4P17 | Molecular Spectroscopy | 6 | 5 | 40 | 60 | 100 |
| 19PG4P18 | Advanced Quantum Mechanics | 6 | 5 | 40 | 60 | 100 |
| 19PG4P19 | Practicals VII Advanced Electronics | 4 | 2 | 40 | 60 | 100 |
| 19PG4P20 | Practicals VIII PROGRAMMING IN C++ | 4 | 2 | 40 | 60 | 100 |
| **Total** | | **26** | **19** | | | |
| | **Total** | **106** | **70** | | | |

## MAJOR ELECTIVE / EXTRA DEPARTMENTAL COURSE / INTERNSHIP/ PROJECT -20 CREDITS

| S. No | SEM. | COURSE CODE | COURSE TITLE | HRS | CREDITS | CIA Mks | ESE Mks | TOT. Mks |
|---|---|---|---|---|---|---|---|---|
| 1. | I | 19P1EDC | Modern Photography | 3 | 3 | 40 | 60 | 100 |
| 2. | II | 19P2EDC | Modern Photography | 3 | 3 | 40 | 60 | 100 |
| 3. | III | 19PG3PE1A/ 19PG3PE1B | Communication system/ Numerical methods and Programming in C++ | 4 | 4 | 40 | 60 | 100 |
| 4. | | 19PG3PSI | Summer Internship | - | 3 | 40 | 60 | 100 |
| 5. | IV | 19PG4PE2A/ 19PG4PE2B | Material Science / Astro Physics | 4 | 4 | 40 | 60 | 100 |
| 6. | | 19PG4PPR | Project | | 3 | 40 | 60 | 100 |
| | | | TOTAL | 14 | 20 | | | |

## OFF-CLASS PROGRAMME

### ADD-ON COURSES

| Course Code | Courses | Hrs. | Credits | Semester in which the course is offered | CIA Mks | ESE Mks | Total Marks |
|---|---|---|---|---|---|---|---|
| 19PAD2SS | SOFT SKILLS | 40 | 4 | I | 40 | 60 | 100 |
| 19PAD2CA | COMPUTER APPLICATIONS<br>LATEX<br>(Dept. Specific Course) | 40 | 4 | II | 40 | 60 | 100 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **MOOC COURSES** (Department Specific Courses) * Students can opt other than the listed course from UGC-SWAYAM /UGC /CEC | - | Minimum2 Credits | - | - | - | |
| **19PAD 4CV** | **COMPREHENSIVE VIVA** (Question bank to be prepared for all the papers by the respective course teachers) | - | 2 | IV | - | - | 100 |
| **19PAD 4RC** | **READING CULTURE** | 15/ Semester | 1 | I-IV | - | - | - |
| | **TOTAL** | | 13 + | | | | |

**EXTRA CREDIT COURSE**

| Course Code | Courses | Hrs. | Credits | Semester in which the course is offered | CIA Mks | ESE Mks | Total Marks |
|---|---|---|---|---|---|---|---|
| 19PGSLP1 | **SELF LEARNING COURSE for ADVANCE LEARNERS (Offered for II PG)** | - | 3 | III & IV | 40 | 60 | 100 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Instrumentation& Experimental Methods | | | | | | |
| **21PG2PSL1** | **NANOTECHNOLOGY FOR ALL** | - | 3 | II | 40 | 60 | 100 |
| **22PGSLP1** | **Digital Signal Processing** | | | | | | |
| **22PGSL2** | **Batteries and its applications** | | | | | | |

- **Lab Courses:**
  - A range of 10-15 experiments per semester

- **Summer Internship:**
  - Duration-1 month (2nd Week of May to 2nd week of June-before college reopens)

- **Project:**
  - Off class
  - Evaluation components-Report writing + Viva Voce (Internal marks-50) + External marks 50

- **EDC:**

  Syllabus should be offered for two different batches of students from other than the parent department in Sem-I & Sem-II

# I M.Sc., PHYSICS

## SEMESTER –I

**(*For those who joined in 2019 onwards*)**

| PROGRAMME CODE | COURSE CODE | COURSE TITLE | CATEGORY | HRS/WEEK | CREDITS |
|---|---|---|---|---|---|
| PAPH | 19PG1P2 | Applied Electronics | PG Core | 6 Hrs. | 4 |

**COURSE DESCRIPTION**

This course aims to introduce applied electronics to students, encompassing the concepts of semiconductor diode characteristics, Op-Amp characteristics, registers , counters, and analog to digital conversion techniques.

**COURSE OBJECTIVES**

The course curriculum is devised in a way to cover the theory giving a broader explanation on characteristics of Field Effect Transistors. It further includes basic circuitry involved for the linear and nonlinear analog systems comprising operational amplifier and its various applications. It also imparts knowledge on working principles of counters, registers and A/D conversion techniques.

**UNITS**

**UNIT I: FIELD EFFECT TRANSISTORS [18HRS]**

The junction field effect transistor- the Pinch off voltage (Vp)-the JFET volt-ampere characteristics-the FET small signal model-the Metal-oxide semiconductor FET(MOSFET) Biasing the FET- the FET as a Voltage-Variable Resistor-the Common source Amplifier at High frequencies-Common Drain amplifier at High frequencies.

**UNIT II: LINEAR ANALOG SYSTEMS [18 HRS]**

The Basic operational amplifier- The differential amplifier- The Emitter Coupled Differential amplifier-Offset Error Voltages and Currents-

Measurement of Operational amplifier Parameters. Basic Operational Amplifier applications-Differential DC amplifier-Stable AC-Coupled Amplifier-Analog Integration and Differentiation- Electronic Analog Computation .

**UNIT III: NON LINEAR ANALOG SYSTEMS [18 HRS]**

Comparators-Sample-and-hold Circuits- Logarithmic amplifiers-Anti log amplifier-Logarithmic Multiplier-Square wave generator-Pulse generator-Triangle wave generator- Saw tooth generator-Regenerative Comparator (Schmitt Trigger)- Square wave generator &Pulse generator using 555 Timer.

**UNIT IV :REGISTERS AND COUNTERS [18 HRS]**

The Shift Register- Clocking- Serial- Parallel data transfer- End around carry- Shift- Right-Shift- Left Register- Ripple counter-Methods to improve Counter Speed- Non binary counters- Mod-3 counters-Mod 5 counters-lockout- The up-down ripple counter- the up-down synchronous counter-ring counters- sequence generator.

**UNIT V :ANALOG TO DIGITAL CONVERSIONS [18 HRS]**

Sampling theorem- time-division- multiplexing- quantization - the weighted resistor D/A converter- The R-2R ladder D/A converter – Inverted ladder D/A converter- A/D converters- A parallel- comparator type- successive Approximation converters

**UNIT –VI DYNAMISM (Evaluation Pattern-CIA only)**

**TEXT BOOK:**

**Jacob Millman, Cristos C. Halkias and Chetan D Parikh, ( Second edition**.
**Seventh Reprint 2012** ) ***Milman's Integrated Electronics: Analog and Digital Circuits and systems***- **New Delhi: Tata McGraw Hill Publishing company Ltd**.

**Unit I** Chapter: 10.1-10.5,10.8-10.11.

**Unit II** Chapters: 15.1-15.3,15.6,15.8,16.1- 16.5.

**Unit III** Chapter: 16.12-16.13,16.15-16.17,16.20

**Herbert Taub & Donald Schilling**, ***Digital integrated electronics*** ,**McGraw Hill Book Company.**

**Unit IV** Chapters: 10.1-10.7, 10.8-10.11, 10.14-10.17

**Unit V** Chapters: 14.1-14.6, 14.9, 14.12-14.13

**BOOKS FOR REFERENCE**

**1.Thomas L.Floyd-PEARSON, *Electronic devices***

**2.Albert Paul Malvino ,*Digital Principles and Applications* ,Tata Mc Graw Hill**

**3.Garud, *Electronic devices and Linear circuits* –Tata McGraw Hill**

**4.Boylestad, *Electronic devices and circuit theory* New Delhi Prentice Hall of India**

**5.Jain Digital electronics and Microprocessors – Problems and Solutions Tata Mc Graw Hill**

## COURSE CONTENTS & LECTURE SCHEDULE:

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| **UNIT -1** | **FIELD EFFECT TRANSISTORS** | | | |
| 1.1 | The junction field effect transistor- the Pinch off voltage (Vp) | 3 | Chalk & Talk | Black Board |
| 1.2 | JFET volt-ampere characteristics-the FET small signal model | 2 | Chalk & Talk | Black Board |
| 1.3 | Metal-oxide semiconductor FET(MOSFET) | 3 | Chalk & Talk | Black Board |
| 1.4 | Biasing the FET | 4 | Chalk & Talk | Black Board |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| 1.5 | FET as a Voltage- Variable Resistor | 1 | Lecture | LCD |
| 1.6 | Common source Amplifier at High frequencies | 3 | Chalk & Talk | Black Board |
| 1.7 | Common Drain Amplifier at High frequencies | 2 | Lecture | Black Board |
| **UNIT -2 LINEAR ANALOG SYSTEMS** | | | | |
| 2.1 | The Basic operational amplifier-The differential amplifier | 2 | Chalk & Talk | Black Board |
| 2.2 | The Emitter Coupled Differential amplifier | 3 | Chalk & Talk | Black Board |
| 2.3 | -Offset Error Voltages and Currents-Measurement of Operational amplifier Parameters | 2 | Chalk & Talk | Black Board |
| 2.4 | . Basic Operational Amplifier applications | 3 | Chalk & Talk | Black Board |
| 2.5 | Analog Integration and Differentiation | 2 | Lecture | LCD |
| 2.6 | Differential DC amplifier-Stable AC-Coupled Amplifier | 3 | Chalk & Talk | Black Board |
| 2.7 | Electronic Analog Computation | 3 | Lecture | Black Board |
| **UNIT -3 NON LINEAR ANALOG SYSTEMS** | | | | |
| 3.1 | Comparators-Sample-and-hold Circuits | 3 | Chalk & Talk | Black Board |
| 3.2 | Logarithmic amplifiers-Anti log amplifier-Logarithmic Multiplier | 3 | Chalk & Talk | Black Board |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| 3.3 | -Square wave generator-Pulse generator | 3 | Chalk & Talk | Black Board |
| 3.4 | Triangle wave generator | 3 | Chalk & Talk | Black Board |
| 3.5 | Saw tooth generator-Regenerative Comparator (Schmitt Trigger) | 3 | Chalk & Talk | Black Board |
| 3.6 | Square wave generator &Pulse generator using 555 Timer. | 3 | Chalk & Talk | Black Board |
| **UNIT -4 REGISTERS AND COUNTERS** | | | | |
| 4.1 | The Shift Register- Clocking- Serial- Parallel data transfer- End around carry | 2 | Lecture | Black Board |
| 4.2 | Shift- right-shift- left register | 2 | Lecture | LCD |
| 4.3 | Ripple counter-Methods to improve Counter Speed | 3 | Chalk & Talk | Black Board |
| 4.4 | Non binary counters- Mod-3 counters-Mod 5 counters | 3 | Lecture | LCD |
| 4.5 | Lockout | 2 | Chalk & Talk | Black Board |
| 4.6 | The up-down ripple counter- the up-down synchronous counter | 2 | Lecture | LCD |
| 4.7 | Ring counters | 2 | Chalk & Talk | Black Board |
| 4.8 | Sequence Generator | 2 | Chalk & Talk | Black Board |
| **UNIT -5 ANALOG TO DIGITAL CONVERSIONS** | | | | |
| 5.1 | Sampling theorem- time-division- multiplexing- quantization | 4 | Chalk & Talk | Black Board |
| 5.2 | the weighted resistor D/A | 3 | Lecture | LCD |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| | converter | | | |
| 5.3 | - The R-2R ladder D/A converter | 3 | Chalk & Talk | Black Board |
| 5.4 | – Inverted ladder D/A converter- A/D converters | 4 | Chalk & Talk | Black Board |
| 5.5 | A parallel- comparator type- successive Approximation converters | 4 | Chalk & Talk | Black Board |

| Levels | C1 | C2 | C3 | C4 | Total Scholastic Marks | Non Scholastic Marks C5 | CIA Total | % of Assessment |
|---|---|---|---|---|---|---|---|---|
| | Session -wise Average 5 Mks. | Better of W1, W2 5+5=10 Mks. | M1+M2 15 Mks | MID-SEM TEST 5 Mks | 35 Mks. | 5 Mks. | 40Mks. | |
| K1 | 5 | - | - | 2 ½ | - | | - | - |
| K2 | - | 5 | 4 | 2 ½ | 5 | | 5 | 12.5 % |
| K3 | - | - | 3 | 5 | 12 | | 12 | 30 % |
| K4 | - | - | 3 | 5 | 9 | | 9 | 22.5% |
| Non Scholastic | - | - | - | - | 9 | | 9 | 22.5 % |
| Total | 5 | 5 | 10 | 15 | 35 | 5 | 40 | 100 % |

| CIA | |
|---|---|
| Scholastic | 35 |

| | |
|---|---|
| **Non Scholastic** | **5** |
| | **40** |

- ✓ **All the course outcomes are to be assessed in the various CIA components.**
- ✓ **The levels of CIA Assessment based on Revised Bloom's Taxonomy for I PG are :**

  **K1-** Remember, **K2-**Understand, **K3-**Apply, **K4-**Analyse
- ✓ **The I PG course teachers are requested to start conducting S1, W1, M1,**

## EVALUATION PATTERN

| SCHOLASTIC | | | | NON - SCHOLASTIC | MARKS | | |
|---|---|---|---|---|---|---|---|
| C1 | C2 | C3 | C4 | C5 | CIA | ESE | Total |
| 5 | 10 | 15 | 5 | 5 | 40 | 60 | 100 |

**C1** – Average of Two Session Wise Tests

**C2** – Average of Two Monthly Tests

**C3** - Mid Sem Test

**C4** – Best of Two Weekly Tests

**C5** – Non - Scholastic

## COURSE OUTCOMES

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

| NO. | COURSE OUTCOMES | KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY) | PSOs ADDRESSED |
|---|---|---|---|

| NO. | COURSE OUTCOMES | KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY) | PSOs ADDRESSED |
|---|---|---|---|
| **CO 1** | Distinguish between BJT and FET | K1,K2 | PSO1& PSO2 |
| **CO 2** | Explain the fundamental concepts of diode, BJT and transistor biasing to understand the small signal behaviour of FET for amplification applications | K2 | PSO3 |
| **CO 3** | Outline the basics of linear and nonlinear analog systems | K1 , K2 | PSO5 |
| **CO 4** | Describe the design concepts of counters and shift registers | K2, K3 | PSO2,PSO3 |
| **CO 5** | Apply the theory of OPAMP to design the linear and nonlinear applications of it. | K2 , K3 | PSO4,PSO5 |
| **CO6** | Describe the design concepts of counters and shift registers. Demonstrate the various techniques to develop A/D and D/A converters | K2,K3 | PSO4,PSO5 |

## COURSE DESIGNER

**R.ALPHONSA FERNANDO**

**Forwarded By**

**Dr. A. Sheela Vimala Rani**

**HoD'S Signature & Name**

EMPLOYABILITY: 100%

# I M.Sc. PHYSICS

## SEMESTER –I

***(For those who joined in 2019 onwards)***

| PROGRAMME CODE | COURSE CODE | COURSE TITLE | CATEGORY | HRS/WEEK | CREDITS |
|---|---|---|---|---|---|
| PAPH | 19PG1P2 | Applied Electronics | Theory | 5 | 3 |

**COURSE DESCRIPTION**

This course aims to introduce applied electronics to students, encompassing the concepts of semiconductor diode characteristics, Op-Amp characteristics, registers, counters, and analog to digital conversion techniques.

**COURSE OBJECTIVES**

The course curriculum is devised in a way to cover the theory giving a broader explanation on characteristics of Field Effect Transistors. It further includes basic circuitry involved for the linear and nonlinear analog systems comprising operational amplifier and its various applications. It also imparts knowledge on working principles of counters, registers and A/D conversion techniques.

**UNIT I: FIELD EFFECT TRANSISTORS (15 HRS)**

The junction field effect transistor- the Pinch off voltage (Vp)-the JFET volt-ampere characteristics-the FET small signal model-the Metal-oxide semiconductor FET (MOSFET) Biasing the FET- the FET as a Voltage-Variable Resistor-the Common source Amplifier at High frequencies- Common Drain amplifier at High frequencies.

**UNIT II: LINEAR ANALOG SYSTEMS (15 HRS)**

The Basic operational amplifier- The differential amplifier- The Emitter Coupled Differential amplifier - Offset Error Voltages and Currents-

Amplifier applications-Differential DC amplifier-Stable AC-Coupled Amplifier-Analog Integration and Differentiation- Electronic Analog Computation .

**UNIT III: NON LINEAR ANALOG SYSTEMS [18 HRS]**

Comparators-Sample-and-hold Circuits- Logarithmic amplifiers-Anti log amplifier-Logarithmic Multiplier-Square wave generator-Pulse generator-Triangle wave generator- Saw tooth generator-Regenerative Comparator (Schmitt Trigger)- Square wave generator &Pulse generator using 555 Timer.

**UNIT IV :REGISTERS AND COUNTERS [18 HRS]**

The Shift Register- Clocking- Serial- Parallel data transfer- End around carry- Shift- Right-Shift- Left Register- Ripple counter-Methods to improve Counter Speed- Non binary counters- Mod-3 counters-Mod 5 counters-lockout- The up-down ripple counter- the up-down synchronous counter-ring counters- sequence generator.

**Change -10%**

**UNIT V :ANALOG TO DIGITAL CONVERSIONS [18 HRS]**

Sampling theorem- time-division- multiplexing- quantization - the weighted resistor D/A converter- The R-2R ladder D/A converter – Inverted ladder D/A converter- A/D converters- A parallel- comparator type- successive Approximation converters-Memory Devices: ROM, implementation of ROM, PROM, EPROM-Application of ROMs and RAMs.

**UNIT –VI DYNAMISM (Evaluation Pattern-CIA only)**

**Total Change -10%**

**TEXT BOOK:**

**Jacob Millman, Cristos C. Halkias and Chetan D Parikh, ( Second edition.**
**Seventh Reprint 2012 ) *Milman's Integrated Electronics: Analog and Digital Circuits and systems*- New Delhi: Tata McGraw Hill Publishing company Ltd.**

**Unit I** Chapter: 10.1-10.5,10.8-10.11.

**Unit II** Chapters: 15.1-15.3,15.6,15.8,16.1- 16.5.

**Unit III** Chapter: 16.12-16.13,16.15-16.17,16.20

**Herbert Taub & Donald Schilling**, ***Digital integrated electronics,*** **McGraw Hill Book Company.**

**Unit IV** Chapters: 10.1-10.7, 10.8-10.11, 10.14-10.17

**Unit V** Chapters: 14.1-14.6, 14.9, 14.12-14.13

**BOOKS FOR REFERENCE**

**1.Thomas L.Floyd- PEARSON, *Electronic devices***

**2.Albert Paul Malvino, *Digital Principles and Applications,* Tata Mc Graw Hill**

**3.Garud, *Electronic devices and Linear circuits* –Tata McGraw Hill**

**4.Boylestad, *Electronic devices and circuit theory* New Delhi Prentice Hall of India**

**5.Jain Digital electronics and Microprocessors – Problems and Solutions Tata Mc Graw Hill**

## COURSE CONTENTS & LECTURE SCHEDULE:

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| **UNIT -1 FIELD EFFECT TRANSISTORS** | | | | |
| 1.1 | The junction field effect transistor- the Pinch off voltage (Vp) | 3 | Chalk & Talk | Black Board |
| 1.2 | JFET volt-ampere characteristics-the FET small signal model | 2 | Chalk & Talk | Black Board |
| 1.3 | Metal-oxide semiconductor FET(MOSFET) | 3 | Chalk & Talk | Black Board |
| 1.4 | Biasing the FET | 4 | Chalk & Talk | Black Board |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| 1.5 | FET as a Voltage- Variable Resistor | 1 | Lecture | LCD |
| 1.6 | Common source Amplifier at High frequencies | 1 | Chalk & Talk | Black Board |
| 1.7 | Common Drain Amplifier at High frequencies | 1 | Lecture | Black Board |
| **UNIT -2 LINEAR ANALOG SYSTEMS** | | | | |
| 2.1 | The Basic operational amplifier- The differential amplifier | 2 | Chalk & Talk | Black Board |
| 2.2 | The Emitter Coupled Differential amplifier | 3 | Chalk & Talk | Black Board |
| 2.3 | -Offset Error Voltages and Currents-Measurement of Operational amplifier Parameters | 2 | Chalk & Talk | Black Board |
| 2.4 | . Basic Operational Amplifier applications | 2 | Chalk & Talk | Black Board |
| 2.5 | Analog Integration and Differentiation | 2 | Lecture | LCD |
| 2.6 | Differential DC amplifier- Stable AC-Coupled Amplifier | 2 | Chalk & Talk | Black Board |
| 2.7 | Electronic Analog Computation | 2 | Lecture | Black Board |
| **UNIT - 3 NON - LINEAR ANALOG SYSTEMS** | | | | |
| 3.1 | Comparators-Sample-and-hold Circuits | 3 | Chalk & Talk | Black Board |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| 3.2 | Logarithmic amplifiers-Anti log amplifier-Logarithmic Multiplier | 3 | Chalk & Talk | Black Board |
| 3.3 | Square wave generator-Pulse generator | 3 | Chalk & Talk | Black Board |
| 3.4 | Triangle wave generator | 2 | Chalk & Talk | Black Board |
| 3.5 | Saw tooth generator-Regenerative Comparator (Schmitt Trigger) | 2 | Chalk & Talk | Black Board |
| 3.6 | Square wave generator &Pulse generator using 555 Timer. | 2 | Chalk & Talk | Black Board |
| **UNIT - 4 REGISTERS AND COUNTERS** | | | | |
| 4.1 | The Shift Register- Clocking-Serial- Parallel data transfer-End around carry | 2 | Lecture | Black Board |
| 4.2 | Shift- right-shift- left register | 2 | Lecture | LCD |
| 4.3 | Ripple counter-Methods to improve Counter Speed | 3 | Chalk & Talk | Black Board |
| 4.4 | Non binary counters- Mod-3 counters-Mod 5 counters | 2 | Lecture | LCD |
| 4.5 | Lockout | 1 | Chalk & Talk | Black Board |
| 4.6 | The up-down ripple counter-the up-down synchronous counter | 2 | Lecture | LCD |
| 4.7 | Ring counters | 1 | Chalk & Talk | Black Board |
| 4.8 | Sequence Generator | 2 | Chalk & Talk | Black Board |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| **UNIT - 5 ANALOG TO DIGITAL CONVERSIONS** | | | | |
| 5.1 | Sampling theorem- time-division- multiplexing- quantization | 3 | Chalk & Talk | Black Board |
| 5.2 | The weighted resistor D/A converter | 3 | Lecture | LCD |
| 5.3 | The R-2R ladder D/A converter | 3 | Chalk & Talk | Black Board |
| 5.4 | Inverted ladder D/A converter- A/D converters | 3 | Chalk & Talk | Black Board |
| 5.5 | A parallel- comparator type- successive Approximation converters | 2 | Chalk & Talk | Black Board |

| Levels | C1 | C2 | C3 | C4 | C5 | Total Scholastic Marks | Non Scholastic Marks C6 | CIA Total | % of Assessment |
|---|---|---|---|---|---|---|---|---|---|
| | T1 | T2 | Seminar | Assignment | OBT/ PPT | | | | |
| | 10 Mks. | 10 Mks. | 5 Mks. | 5 Mks | 5 Mks | 35 Mks. | 5 Mks. | 40Mks. | |
| **K2** | **4** | **4** | **-** | **-** | **-** | **8** | - | **8** | 20 % |
| **K3** | **2** | **2** | **-** | **5** | **-** | **9** | - | **9** | 22.5 % |
| **K4** | **2** | **2** | **-** | **-** | **5** | **9** | - | **9** | 22.5 % |
| **K5** | **2** | **2** | **5** | **-** | **-** | **9** | - | **9** | 22.5 % |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Non Scholastic** | - | - | - | - | - | | **5** | **5** | 12.5 % |
| **Total** | **10** | **10** | **5** | **5** | **5** | **35** | **5** | **40** | **100 %** |

**CIA**

| | |
|---|---|
| **Scholastic** | **35** |
| **Non Scholastic** | **5** |
| | **40** |

## EVALUATION PATTERN

| SCHOLASTIC | | | | | NON - SCHOLASTIC | MARKS | | |
|---|---|---|---|---|---|---|---|---|
| **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **CIA** | **ESE** | **Total** |
| **10** | **10** | **5** | **5** | **5** | **5** | **40** | **60** | **100** |

- **PG CIA Components**

| | | | **Nos** | | |
|---|---|---|---|---|---|
| **C1** | - | Test (CIA 1) | 1 | - | 10 Mks |
| **C2** | - | Test (CIA 2) | 1 | - | 10 Mks |
| **C3** | - | Assignment | 2 * | - | 5 Mks |
| **C4** | - | Open Book Test/PPT | 2 * | - | 5 Mks |
| **C5** | - | Seminar | 1 | - | 5 Mks |
| **C6** | - | Attendance | | - | 5 Mks |

## COURSE OUTCOMES

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

| NO. | COURSE OUTCOMES | KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY) | PSOs ADDRESSED |
|---|---|---|---|
| **CO 1** | Distinguish between BJT and FET | K1, K2 | PSO1 & PSO2 |
| **CO 2** | Explain the fundamental concepts of diode, BJT and transistor biasing to understand the small signal behaviour of FET for amplification applications | K2 | PSO3 |
| **CO 3** | Outline the basics of linear and nonlinear analog systems | K1, K2 | PSO5 |
| **CO 4** | Describe the design concepts of counters and shift registers | K2, K3 | PSO2, PSO3 |
| **CO 5** | Apply the theory of OPAMP to design the linear and nonlinear applications of it. | K2, K3 | PSO4, PSO5 |
| **CO6** | Describe the design concepts of counters and shift registers. Demonstrate the various techniques to develop A/D and D/A converters | K2, K3 | PSO4, PSO5 |

## Mapping of COs with PSOs

| CO/ PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 |
| CO2 | 2 | 2 | 3 | 1 | 1 |
| CO3 | 2 | 2 | 1 | 2 | 3 |
| CO4 | 2 | 3 | 3 | 1 | 2 |
| CO5 | 1 | 2 | 2 | 3 | 3 |
| CO6 | 2 | 1 | 2 | 3 | 3 |

## Mapping of COs with POs

| CO/ PSO | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 2 |
| CO2 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 2 |
| CO5 | 2 | 3 | 3 | 2 |

**Note**: ♦ Strongly Correlated – **3** ♦ Moderately Correlated – **2**

♦ Weakly Correlated -**1**

**COURSE DESIGNER**

**R. ALPHONSA FERNANDO**

**Forwarded By**

**Dr. A. Sheela Vimala Rani**

**HoD's Signature & Name**

**II M.Sc.,**

**SEMESTER –III**

***For those who joined in 2019 onwards***

| PROGRAMME CODE | COURSE CODE | COURSE TITLE | CATEGORY | HRS/WEEK | CREDITS |
|---|---|---|---|---|---|
| PAPH | 19PG3P13 | NUCLEAR AND PARTICLE PHYSICS | PG Core | 6 | 5 |

**COURSE DESCRIPTION**

The aim of this course is to provide an overview of the fields of nuclear and particle physics.

**COURSE OBJECTIVES**

This course provides the knowledge about alpha and beta particles in nuclear physics. And it explains about nuclear fission and fusion reactions and its application in nuclear reactor. Expels knowledge in nuclear force and elementary particles.

**UNITS- 6**

**UNIT –I ALPHA PARTICLES ( 18HRS.)**

Introduction- range of alpha particles-range-velocity-energy-life relations-alpha energy- -mass number- alpha particle spectra- Gamow's Theory of alpha decay, (decay probability, hindrance factors, spontaneous nuclear disintegration).

**BETA-DECAY:** Introduction- Beta-Spectroscopy. The neutrino hypothesis-energy- half life relationships-Fermi theory of Beta Decay, (Kurie plots, Mass of neutrino, Life time of beta decay, selection rules for allowed and forbidden transitions)-Parity violation- Helicity.

**UNIT –II NUCLEAR FISSION ( 18 HRS.)**

The discovery of nuclear fission- fission cross sections and thresholds- the fission products-the mass and energy distributions of the fission products- Neutron emission in fission-the energy distribution of the neutrons emitted in fission-the energy release in fission- the theory of the fission process.

**NUCLEAR ENERGY SOURCES: Nuclear fission as a source of energy- the chain-reacting system of nuclear reactor- Thermal nuclear reactors- The neutron cycle- the calculation of the multiplication factor for a homogeneous thermal reactor- the heterogeneous thermal reactor- power and breeding- energy production in stars- thermonuclear reactions-controlled thermo nuclear reactions.(self study)**

**UNIT –III NUCLEAR FORCE & MODELS ( 18 HRS.)**

**NUCLEAR FORCES:** The Deuteron- Ground State of the Deuteron- Triplet and Singlet states- Meson theory of Nuclear forces.

**NUCLEAR MODELS:** Introduction- Degenerate Fermi gas model- The Semi-empirical mass formula- the liquid drop model- the shell model- the collective model.

**UNIT –IV NUCLEAR REACTIONS ( 18 HRS.)**

Types of nuclear reactions, conservation laws, Nuclear Reaction Kinematics- Solution to Q-equation; Nuclear cross- section, Partial wave analysis of Reaction cross-section, Requirements for a reaction- Reaction mechanism.

**UNIT –V ELEMENTARY PARTICLES ( 18 HRS.)**

Introduction- Classification of Elementary particles- Particle Interactions (Gravitational, Electromagnetic, Strong, Weak) Conservation laws- Invariance under charge, parity ,C.P ,time reversal and C.P.T- Electrons and positrons- **protons and antiprotons- neutrons and antineutrons- neutrinos and Antineutrinos – Photons,** Mesons -Hyperons- Elementary particle symmetries, Quark theory.

**UNIT –VI DYNAMISM (Evaluation Pattern-CIA only) ( 3 HRS.)**

Application of nuclear fission and nuclear fusion. Application of nuclear energy in constructive purposes.

**REFERENCES**


1. D.C. TAYAL " Nuclear Physics" Umesh Prakashan- Khurja
2. Irving Kaplan, Nuclear Physics, Addison-Wesley Publishing Company.
3. Arthur Beiser, Perspectives of Modern Physics, Mcgraw Hill Book company
4. SATHYA PRAKASH, Nuclear Physics and Particle Physics, Sultan Chand
5. Devanathan.V, Nuclear physics, Narosa publishers.
6. Harald Enge Addison, Introduction to Nuclear Physics, Wesley
    a. Publishing Company.


## COURSE CONTENTS & LECTURE SCHEDULE:

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| **UNIT -1 ALPHA PARTICLES** | | | | |
| 1.1 | Introduction | 1 | Chalk & Talk | Black Board |
| 1.2 | Range of alpha particles, Range,Velocity and energy | 2 | Chalk & Talk | LCD |
| 1.3 | mass number | 2 | Lecture | PPT & White board |
| 1.4 | alpha particle spectra | 2 | Lecture | Smart Board |
| 1.5 | Gamow's Theory of alpha decay, (decay probability, hindrance factors, spontaneous nuclear disintegration) | 2 | Lecture | Black Board |
| 1.6 | Introduction to beta decay. | 2 | Discussion | Google classroom |
| 1.7 | Beta-Spectroscopy | 2 | Specimen | Microscope |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| 1.8 | The neutrino hypothesis, energy, half life relationships | 2 | Discussion | Black Board |
| 1.9 | Fermi theory of Beta Decay, Kurie plots, Mass of neutrino, Life time of beta decay, | 1 | Chalk & Talk | Black Board |
| | selection rules for allowed and forbidden transitions)- | 1 | Chalk & Talk | Black Board |
| 1.10 | Parity violation & Helicity | 1 | Discussion | Google class room |
| **UNIT -2 NUCLEAR FISSION** | | | | |
| 2.1 | The discovery of nuclear fission | 1 | Lecture | PPT |
| 2.2 | Fission cross sections and thresholds | 1 | Chalk & Talk | Green Board |
| 2.3 | The fission products-the mass | 1 | Chalk & Talk | Black Board |
| 2.4 | Energy distributions of the and fission products | 1 | Chalk & Talk | Black Board |
| 2.5 | Neutron emission in fission | 1 | Chalk & Talk | Black Board |
| 2.6 | Energy distribution of the neutrons emitted in fission | 2 | Chalk & Talk | Black Board |
| 2.7 | Energy release in fission | 1 | Chalk & Talk | Black Board |
| 2.8 | The theory of the fission process. | 1 | Chalk & Talk | Black Board |
| 2.9 | Nuclear fission as a source of energy and chain-reacting system of nuclear reactor. | 2 | Discussion | Google class room |
| 2.10 | Thermal nuclear reactors | 1 | Chalk & Talk | Black Board |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| 2.11 | The neutron cycle, the calculation of the multiplication factor for a homogeneous thermal reactor | 1 | Chalk & Talk | Black Board |
| 2.12 | The heterogeneous thermal reactor & power and breeding | 1 | Chalk & Talk | Black Board |
| 2.13 | Energy production in stars | 2 | Chalk & Talk | Black Board |
| 2.14 | Thermonuclear reactions& controlled thermo nuclear reactions. | 2 | Chalk & Talk | Black Board |
| **UNIT -3 NUCLEAR FORCES** | | | | |
| 3.1 | The Deuteron | 1 | Chalk & Talk | Black Board |
| 3.2 | Ground State of the Deuteron- | 3 | Chalk & Talk | Black Board |
| 3.3 | Triplet and Singlet states- | 1 | Chalk & Talk | Black Board |
| 3.4 | Meson theory of Nuclear forces. | 1 | Discussion | Google class room |
| 3.5 | Introduction to nuclear models | 1 | Discussion | Google class room |
| 3.6 | Degenerate Fermi gas model | 3 | Chalk & Talk | Black Board |
| 3.7 | The Semi- empirical mass formula | 2 | Chalk & Talk | Black Board |
| 3.8 | liquid drop model | 1 | Discussion | Google class room |
| 3.9 | Collective model. | 3 | Discussion | Google class room |
| 3.10 | The shell model | 2 | Chalk & Talk | Black Board |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| **UNIT - 4 NUCLEAR REACTIONS** | | | | |
| 4.1 | Types of nuclear reactions | 3 | Chalk & Talk | Black Board |
| 4.2 | Conservation laws | 2 | Discussion | Google class room |
| 4.3 | Nuclear Reaction Kinematics | 2 | Chalk & Talk | Black Board |
| 4.4 | Solution to Q-equation | 2 | Chalk & Talk | Black Board |
| 4.5 | Nuclear cross- section, | 3 | Chalk & Talk | Black Board |
| 4.6 | Partial wave analysis of Reaction cross-section | 3 | Chalk & Talk | Black Board |
| 4.7 | Requirements for a reaction& Reaction mechanism. | 3 | Chalk & Talk | Black Board |
| **UNIT -5 ELEMENTARY PARTICLES** | | | | |
| 5.1 | Introduction | 1 | Chalk & Talk | Black Board |
| 5.2 | Classification of Elementary particles | 2 | Chalk & Talk | Black Board |
| 5.3 | Particle Interactions (Gravitational, Electromagnetic, Strong, Weak) | 2 | Discussion | Google class room |
| 5.4 | Conservation laws- | 2 | Chalk & Talk | Black Board |
| 5.5 | Invariance under charge, parity time reversal and C.P.T | 2 | Chalk & Talk | Black Board |
| 5.6 | Electrons and positrons<br>protons and antiprotons | 2 | Chalk & Talk | Black Board |
| 5.7 | neutrons ,antineutrons,neutrino | 2 | Discussio | Google |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| | s and Antineutrinos | | n | class room |
| 5.8 | Photons, Mesons & Hyperons | 2 | Discussion | Google class room |
| 5.9 | Elementary particle symmetries | 2 | Discussion | Google class room |
| 5.10 | Quark theory | 2 | Discussion | Google class room |
| **UNIT -6 DYNAMISM** | | | | |
| 6.1 | Nuclear fission and fusion | | Discussion | Google class room |
| 6.2 | Thermal nuclear reactors | | Discussion | Google class room |
| 6.3 | Applications of nuclear energy for constructive purposes. | | Discussion | Google class room |

| Levels | C1 | C2 | C3 | C4 | Total Scholastic Marks | Non Scholastic Marks C5 | CIA Total | % of Assessment |
|---|---|---|---|---|---|---|---|---|
| | Session - wise Average | Better of W1, W2 | M1+M2 | MID-SEM TEST | | | | |
| | 5 Mks. | 5+5=10 Mks. | 15 Mks | 5 Mks | 35 Mks. | 5 Mks. | 40Mks. | |
| K1 | 5 | - | - | 2 ½ | - | | - | - |
| K2 | - | 5 | 4 | 2 ½ | 5 | | 5 | 12.5 % |
| K3 | - | - | 3 | 5 | 12 | | 12 | 30 % |
| K4 | - | - | 3 | 5 | 9 | | 9 | 22.5% |
| Non | - | - | - | - | 9 | | 9 | 22.5 % |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Scholastic | | | | | | | | |
| Total | 5 | 5 | 10 | 15 | 35 | 5 | 40 | 100 % |

**CIA**

| | |
|---|---|
| **Scholastic** | **35** |
| **Non Scholastic** | **5** |
| | **40** |

- ✓ **All the course outcomes are to be assessed in the various CIA components.**
- ✓ **The levels of CIA Assessment based on Revised Bloom's Taxonomy for I PG are :**

**K1-** Remember, **K2-**Understand, **K3-**Apply, **K4-**Analyse

- ✓ **The I PG course teachers are requested to start conducting S1, W1, M1,**

## EVALUATION PATTERN

| SCHOLASTIC | | | | NON - SCHOLASTIC | MARKS | | |
|---|---|---|---|---|---|---|---|
| C1 | C2 | C3 | C4 | C5 | CIA | ESE | Total |
| 5 | 10 | 15 | 5 | 5 | 40 | 60 | 100 |

**C1** – Average of Two Session Wise Tests

**C2** – Average of Two Monthly Tests

**C3** - Mid Sem Test

**C4** – Best of Two Weekly Tests

**C5** – Non - Scholastic

## COURSE OUTCOMES

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

| NO. | COURSE OUTCOMES | KNOWLEDGE LEVEL (ACCORDING TO REVISED BLOOM'S TAXONOMY) | PSOs ADDRESSED |
|---|---|---|---|
| **CO 1** | Define nuclear fission and fusion process and beta decay | K1 | PSO1& PSO2 |
| **CO 2** | Describe nuclear energy sources | K1, K2, | PSO3 |
| **CO 3** | Explain various nuclear models | K1 & K3 | PSO5 |
| **CO 4** | Describe nuclear reactions and solve some problems related to cross section | K1, K2, K3 & | PSO1, PSO2& PSO3 |
| **CO 5** | Classify the elementary particles and explain their various properties | K2 & K4 | PSO3& PSO4 |

**COURSE DESIGNER:**

1. **Dr.A.Sheela Vimala Rani**

**Forwarded By**

**Dr. A. Sheela Vimala Rani**

**HoD'S Signature & Name**

**II M.Sc.,**

**SEMESTER –III**

***For those who joined in 2019 onwards***

| PROGRAMME CODE | COURSE CODE | COURSE TITLE | CATEGORY | HRS/WEEK | CREDITS |
|---|---|---|---|---|---|
| PAPH | 19PG3P13 | NUCLEAR AND PARTICLE PHYSICS | PG Core | 6 | 5 |

**COURSE DESCRIPTION**

The aim of this course is to provide an overview of the fields of nuclear and particle physics.

**COURSE OBJECTIVES**

This course provides the knowledge about alpha and beta particles in nuclear physics. And it explains about nuclear fission and fusion reactions and its application in nuclear reactor. Expels knowledge in nuclear force and elementary particles.

**UNITS- 6**

**UNIT –I ALPHA PARTICLES ( 18HRS.)**

Introduction- range of alpha particles-range-velocity-energy-life relations-alpha energy- -mass number- alpha particle spectra- Gamow's Theory of alpha decay, (decay probability, hindrance factors, spontaneous nuclear disintegration).

**BETA-DECAY:** Introduction- Beta-Spectroscopy. The neutrino hypothesis-energy- half life relationships-Fermi theory of Beta Decay, (Kurie plots, Mass of neutrino, Life time of beta decay, selection rules for allowed and forbidden transitions)-Parity violation- Helicity.

**UNIT –II NUCLEAR FISSION ( 18 HRS.)**

The discovery of nuclear fission- fission cross sections and thresholds- the fission products-the mass and energy distributions of the fission products- Neutron emission in fission-the energy distribution of the neutrons emitted in fission-the energy release in fission- the theory of the fission process.

**NUCLEAR ENERGY SOURCES: Nuclear fission as a source of energy- the chain-reacting system of nuclear reactor- Thermal nuclear reactors- The neutron cycle- the calculation of the multiplication factor for a homogeneous thermal reactor- the heterogeneous thermal reactor- power and breeding- energy production in stars- thermonuclear reactions-controlled thermo nuclear reactions.(self study)**

**UNIT –III NUCLEAR FORCE & MODELS ( 18 HRS.)**

**NUCLEAR FORCES:** The Deuteron- Ground State of the Deuteron- Triplet and Singlet states- Meson theory of Nuclear forces.

**NUCLEAR MODELS:** Introduction- Degenerate Fermi gas model- The Semi-empirical mass formula- the liquid drop model- the shell model- the collective model.

**UNIT –IV NUCLEAR REACTIONS ( 18 HRS.)**

Types of nuclear reactions, conservation laws, Nuclear Reaction Kinematics- Solution to Q-equation; Nuclear cross- section, Partial wave analysis of Reaction cross-section, Requirements for a reaction- Reaction mechanism.

**UNIT –V ELEMENTARY PARTICLES** **Change -10%** **18 HRS.)**

Introduction- Classification of Elementary particles- Particle Interactions (Gravitational, Electromagnetic, Strong, Weak) Conservation laws- Invariance under charge, parity ,C.P ,time reversal and C.P.T- Electrons and positrons- **protons and antiprotons- neutrons and antineutrons- neutrinos and Antineutrinos – Photons,** Mesons -Hyperons- Elementary particle symmetries, Quark theory- SU3 symmetry-Quark masses-Quantum numbers

**UNIT –VI DYNAMISM (Evaluation Pattern-CIA only) ( 3 HRS.)**

Application of nuclear fission and nuclear fusion. Application of nuclear energy in constructive purposes.

**Total Change -10%**

**REFERENCES**


1. D.C. TAYAL " Nuclear Physics" Umesh Prakashan- Khurja
2. Irving Kaplan, Nuclear Physics, Addison-Wesley Publishing Company.
3. Arthur Beiser, Perspectives of Modern Physics, Mcgraw Hill Book company
4. SATHYA PRAKASH, Nuclear Physics and Particle Physics, Sultan Chand
5. Devanathan.V, Nuclear physics, Narosa publishers.
6. Harald Enge Addison, Introduction to Nuclear Physics, Wesley
   a. Publishing Company.


## COURSE CONTENTS & LECTURE SCHEDULE:

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| **UNIT -1 ALPHA PARTICLES** | | | | |
| 1.1 | Introduction | 1 | Chalk & Talk | Black Board |
| 1.2 | Range of alpha particles, Range,Velocity and energy | 2 | Chalk & Talk | LCD |
| 1.3 | mass number | 2 | Lecture | PPT & White board |
| 1.4 | alpha particle spectra | 2 | Lecture | Smart Board |
| 1.5 | Gamow's Theory of alpha decay, (decay probability, hindrance factors, spontaneous nuclear disintegration) | 2 | Lecture | Black Board |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| 1.6 | Introduction to beta decay. | 2 | Discussion | Google classroom |
| 1.7 | Beta-Spectroscopy | 2 | Specimen | Microscope |
| 1.8 | The neutrino hypothesis, energy, half life relationships | 2 | Discussion | Black Board |
| 1.9 | Fermi theory of Beta Decay, Kurie plots, Mass of neutrino, Life time of beta decay, | 1 | Chalk & Talk | Black Board |
| | selection rules for allowed and forbidden transitions)- | 1 | Chalk & Talk | Black Board |
| 1.10 | Parity violation & Helicity | 1 | Discussion | Google class room |
| **UNIT -2 NUCLEAR FISSION** | | | | |
| 2.1 | The discovery of nuclear fission | 1 | Lecture | PPT |
| 2.2 | Fission cross sections and thresholds | 1 | Chalk & Talk | Green Board |
| 2.3 | The fission products-the mass | 1 | Chalk & Talk | Black Board |
| 2.4 | Energy distributions of the and fission products | 1 | Chalk & Talk | Black Board |
| 2.5 | Neutron emission in fission | 1 | Chalk & Talk | Black Board |
| 2.6 | Energy distribution of the neutrons emitted in fission | 2 | Chalk & Talk | Black Board |
| 2.7 | Energy release in fission | 1 | Chalk & Talk | Black Board |
| 2.8 | The theory of the fission process. | 1 | Chalk & Talk | Black Board |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| 2.9 | Nuclear fission as a source of energy and chain-reacting system of nuclear reactor. | 2 | Discussion | Google class room |
| 2.10 | Thermal nuclear reactors | 1 | Chalk & Talk | Black Board |
| 2.11 | The neutron cycle, the calculation of the multiplication factor for a homogeneous thermal reactor | 1 | Chalk & Talk | Black Board |
| 2.12 | The heterogeneous thermal reactor & power and breeding | 1 | Chalk & Talk | Black Board |
| 2.13 | Energy production in stars | 2 | Chalk & Talk | Black Board |
| 2.14 | Thermonuclear reactions& controlled thermo nuclear reactions. | 2 | Chalk & Talk | Black Board |
| **UNIT -3 NUCLEAR FORCES** | | | | |
| 3.1 | The Deuteron | 1 | Chalk & Talk | Black Board |
| 3.2 | Ground State of the Deuteron- | 3 | Chalk & Talk | Black Board |
| 3.3 | Triplet and Singlet states- | 1 | Chalk & Talk | Black Board |
| 3.4 | Meson theory of Nuclear forces. | 1 | Discussion | Google class room |
| 3.5 | Introduction to nuclear models | 1 | Discussion | Google class room |
| 3.6 | Degenerate Fermi gas model | 3 | Chalk & Talk | Black Board |
| 3.7 | The Semi- empirical mass formula | 2 | Chalk & Talk | Black Board |
| 3.8 | liquid drop model | 1 | Discussion | Google class room |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| 3.9 | Collective model. | 3 | Discussion | Google class room |
| 3.10 | The shell model | 2 | Chalk & Talk | Black Board |
| **UNIT - 4 NUCLEAR REACTIONS** | | | | |
| 4.1 | Types of nuclear reactions | 3 | Chalk & Talk | Black Board |
| 4.2 | Conservation laws | 2 | Discussion | Google class room |
| 4.3 | Nuclear Reaction Kinematics | 2 | Chalk & Talk | Black Board |
| 4.4 | Solution to Q-equation | 2 | Chalk & Talk | Black Board |
| 4.5 | Nuclear cross- section, | 3 | Chalk & Talk | Black Board |
| 4.6 | Partial wave analysis of Reaction cross-section | 3 | Chalk & Talk | Black Board |
| 4.7 | Requirements for a reaction& Reaction mechanism. | 3 | Chalk & Talk | Black Board |
| **UNIT -5 ELEMENTARY PARTICLES** | | | | |
| 5.1 | Introduction | 1 | Chalk & Talk | Black Board |
| 5.2 | Classification of Elementary particles | 2 | Chalk & Talk | Black Board |
| 5.3 | Particle Interactions (Gravitational, Electromagnetic, Strong, Weak) | 2 | Discussion | Google class room |
| 5.4 | Conservation laws- | 2 | Chalk & Talk | Black Board |
| 5.5 | Invariance under charge, parity | 2 | Chalk & | Black |

| Module No. | Topic | No. of Lectures | Teaching Pedagogy | Teaching Aids |
|---|---|---|---|---|
| | time reversal and C.P.T | | Talk | Board |
| 5.6 | Electrons and positrons<br>protons and antiprotons | 2 | Chalk & Talk | Black Board |
| 5.7 | neutrons ,antineutrons,neutrinos and Antineutrinos | 2 | Discussion | Google class room |
| 5.8 | Photons, Mesons & Hyperons | 2 | Discussion | Google class room |
| 5.9 | Elementary particle symmetries | 2 | Discussion | Google class room |
| 5.10 | Quark theory | 2 | Discussion | Google class room |
| **UNIT -6 DYNAMISM** | | | | |
| 6.1 | Nuclear fission and fusion | | Discussion | Google class room |
| 6.2 | Thermal nuclear reactors | | Discussion | Google class room |
| 6.3 | Applications of nuclear energy for constructive purposes. | | Discussion | Google class room |

| Levels | C1 | C2 | C3 | C4 | Total Scholastic Marks | Non Scholastic Marks C5 | CIA Total | % of Assessment |
|---|---|---|---|---|---|---|---|---|
| | Session - wise Average<br>5 Mks. | Better of W1, W2<br>5+5=10 Mks. | M1+M2<br>15 Mks | MID-SEM TEST<br>5 Mks | 35 Mks. | 5 Mks. | 40Mks. | |
| K1 | 5 | - | - | 2 ½ | - | | - | - |
| K2 | - | 5 | 4 | 2 ½ | 5 | | 5 | 12.5 % |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| K3 | - | - | 3 | 5 | 12 | | 12 | 30 % |
| K4 | - | - | 3 | 5 | 9 | | 9 | 22.5% |
| Non Scholastic | - | - | - | - | 9 | | 9 | 22.5 % |
| Total | 5 | 5 | 10 | 15 | 35 | 5 | 40 | 100 % |

**CIA**

| | |
|---|---|
| **Scholastic** | **35** |
| **Non Scholastic** | **5** |
| | **40** |

- ✓ **All the course outcomes are to be assessed in the various CIA components.**
- ✓ **The levels of CIA Assessment based on Revised Bloom's Taxonomy for I PG are :**

**K1**- Remember, **K2**-Understand, **K3**-Apply, **K4**-Analyse

- ✓ **The I PG course teachers are requested to start conducting S1, W1, M1,**

## EVALUATION PATTERN

| SCHOLASTIC | | | | NON - SCHOLASTIC | MARKS | | |
|---|---|---|---|---|---|---|---|
| C1 | C2 | C3 | C4 | C5 | CIA | ESE | Total |
| 5 | 10 | 15 | 5 | 5 | 40 | 60 | 100 |

**C1** – Average of Two Session Wise Tests

**C2** – Average of Two Monthly Tests

**C3** - Mid Sem Test

**C4** – Best of Two Weekly Tests

**C5** – Non - Scholastic

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