SOMAIYA VIDYAVIHAR

K J Somaiya College of Science & Commerce

Autonomous (Affiliated to University of Mumbai)

Somaiya TRUST

# Learning Outcomes based Curriculum Framework

# (LOCF)

## For

## B.Sc. Physics

**Undergraduate Programme**

**from**

**Academic year**

**2021-22**

# Vision & Mission

## Mission:

- Equip the student with knowledge and skills of their chosen vocation.
- Inculcate values.
- Provide them opportunities for all, round growth and prepare them for life.

## Vision:

- To equip the Learners with advanced knowledge and skills in their chosen vocation.
- To provide value-based education and opportunities to Learners.
- To help them to face challenges in life.
- To nurture a scientific attitude, temperament and culture among the Learners.
- To continually review, develop and renew the approach to build India of the Founder's dream.

## Goals and Objectives:

- To build a strong Academia-Industry bridge.
- To provide flexibility in the courses offered and proactively adapt to the changing needs of Learners and the society.
- To establish a centre for multidisciplinary activities.
- To mould individuals who would nurture the cultural heritage of our country and contribute to the betterment of the society.

# Board of studies in Physics

## Undergraduate and Post graduate

| | Name | Designation | Institute/Industry |
|---|---|---|---|
| **Head of the Department** | | | |
| 1 | Dr Meena Sharma | Chairperson | K J Somaiya College of Science andCommerce |
| **Subject Expert nominated by Vice-Chancellor** | | | |
| 1 | Dr Shyamala Bodhane | Head, Department of Physics<br>Associate Professor | St. Xavier college |
| **Subject experts** | | | |
| 1 | Dr R R Deshmukh | Professor | ICT Mumbai |
| 2 | Dr Radha Srinivasan | Associate Professor | Mumbai University |
| 3 | Dr Paresh Joshi | Chairman, BASE | HBCSE |
| **Representative from Industry/corporate sector/allied area** | | | |
| 1 | Dr Anurag Gupta | Scientist | BARC, MUmbai |
| **Meritorious Alumnus** | | | |
| 1 | Ms Kanchan Thakur | Technical Assistant (Alumnus) | M G Solar Powertronics |
| 2 | Mr Devendra Shingare | Alumnus | |
| **Faculty of the specialisation** | | | |
| 1 | Dr Meena Sharma | Associate Professor | K J Somaiya College of Science and Commerce |
| 2 | Dr Deepak More | Associate Professor | K J Somaiya College of Science and Commerce |
| 3 | Dr Geeta Nair | Assistant Professor | K J Somaiya College of Science and Commerce |
| 4 | Mr A M Shaker | Assistant Professor | K J Somaiya College of Science and Commerce |
| 5 | Dr Jitendra Pendharkar | Assistant Professor | K J Somaiya College of Science and Commerce |
| 6 | Dr Smita Survase | Assistant Professor | K J Somaiya College of Science and Commerce |

| | | | |
|---|---|---|---|
| 7 | Mr Anshul Gupta | Assistant Professor | K J Somaiya College of Science and Commerce |
| 8 | Mr Deepak Jalla | Assistant Professor | K J Somaiya College of Science and Commerce |
| 9 | Mr Amit More | Assistant Professor | K J Somaiya College of Science and Commerce |
| 10 | Dr Pallavi Raote | Assistant Professor | K J Somaiya College of Science and Commerce |
| 11 | Mr Ketankumar Gayakwad | Assistant Professor | K J Somaiya College of Science and Commerce |
| 12 | Dr Rucha Naik | Assistant Professor | K J Somaiya College of Science and Commerce |
| 13 | Dr Shruti Barve | Assistant Professor | K J Somaiya College of Science and Commerce |
| 14 | Mr Ranjit Yadav | Assistant Professor | K J Somaiya College of Science and Commerce |

# Foreword

Autonomy reflects efforts for excellence in academic performances, capability of self-governance and enhancement in the quality of education. In the year 2012, the UGC and University of Mumbai conferred the Autonomous Status to K. J. Somaiya College of Science and Commerce. Post this recognition and having several accolades to our credit, we made significant changes to our existing syllabi to reflect the changing business, industrial and social needs. A holistic education that provides opportunities to gain and share knowledge, experiment and develop beyond curriculum, is offered at our College.

Autonomous college carries a prestigious image for the Learners and the teachers and we have made a collaborative attempt to maintain a high level of quality in the standard of education that we impart.

Structured feedback obtained from the Learners, alumni and the experts from the industry and the changes suggested by them were duly incorporated in the syllabi. The Board of Studies constituted for each department meets to carry out in depth discussions about different aspects of the curriculum taking into cognizance the recent trends in the discipline.

The IQAC team has facilitated the conduct of a number of workshops and seminars to equip the faculty with the necessary skill set to frame the syllabi and competencies to deliver the same. Training was also provided to employ innovative evaluation methods pertaining to higher cognitive levels of revised Bloom's taxonomy.

This ensured the attainment of the learning outcomes enlisted in the syllabus. Audits are conducted to critically review the practices undertaken in teaching, learning and evaluation. Innovative learning methodologies such as project-based learning, experiential learning and flip- class learning practiced by a committed fleet of faculty, supported by several hands have been our unique outstanding propositions. All efforts have been made to nurture the academic ambitions as well as the skills in co-curricular activities of the most important stakeholder i. e. student.

With sincere gratitude, I acknowledge the constant support and guidance extended by Shri Samir Somaiya, President- Somaiya Vidyavihar, and all the esteemed members of the Governing board and Academic council of the College. I also would like to acknowledge the Heads of the Departments and all the faculty members for their meticulous approach, commitment and significant contribution towards this endeavour for academic excellence.

**Dr Pradnya Prabhu**

**Principal**

# Acknowledgement

To begin with, I, on behalf of my department would like to place on record our indebtedness towards Principal Dr Pradnya Prabhu for her advice and encouragement during the entire process of curriculum restructuring. I am also grateful to all the esteemed members of the Board of Studies, for their valuable suggestions and inputs.

Above all, the young and dynamic colleagues in the Department of Physics need a special mention of appreciation for putting in the long hours of strenuous efforts during the compilation of the restructured syllabus.

**Dr Meena Sharma**

**Chairperson**

**Board of Studies in Physics**

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# Preamble

Physics is the most basic of all sciences. It seeks to understand natural phenomena in a quantitative manner, and to answer some of the oldest and deepest questions ever asked by human beings: What are things made of? Is there a limit to the smallest things that we can think of? Did the world have a beginning? Will it have an end? At the same time, it provides the base of much of the technology that we take for granted in the 21st century: computers, artificial satellites, mobile phones, TV, microwave ovens. Indeed, it will not be an exaggeration to say that modern human life is shaped by technologies that are largely based on a foundation of physics.

In the current fast paced world, simply cascading the knowledge in the classroom is not sufficient especially when the global requirements keep changing. Every learner should be encouraged to exchange ideas and thoughts in a collaborative approach. This leads to develop an environment which is cognitive in nature and not a one-way information flow. Keeping all this in mind, the curriculum under LOCF is designed.

This learning outcome-based curriculum framework (LOCF) supports the fundamental principle of providing quality education in India. Our focus is to involve young minds to participate, contribute and add value at each stage in the field of their study. The introduction of Choice Based Credit System (CBCS) has maximized the benefits of the newly designed curriculum in many folds.

The learning outcome-based curriculum framework will certainly help teachers to envisage the outcome expected from the learners at the end of the programme. For Learners, it will be a guide which shows how this curriculum will help them acquire all the skills and knowledge which are essential in their personal and academic growth. Higher education qualifications such as Bachelor's Degree Programme are awarded on the basis of demonstrated achievement of outcomes and academic standards; and this is the very essence of this curriculum

## 1. Introduction

Since the discipline of physics has existed for three hundred years, its "core" body of knowledge is larger than that of many other branches of learning. It was, therefore, difficult to fit this knowledge into limited number of courses. Naturally, we would aim to include as much of basic physics as possible, while introducing the student to the applied aspects of physics. We also need to keep in view the role of physics as a training ground for the mind. Not all Learners who complete B.Sc. in Physics will go on to become professional physicists; nevertheless, the study of physics is likely to make them good at logical thinking, quantitative argumentation, etc. Finally, we need to remember that this is an era of interdisciplinary studies. The physics student will benefit by the study of fields that overlap with other domains of knowledge. The syllabus presented here represents an attempt to balance all these requirements.

This curriculum framework is developed on the principles of student centric learning pedagogy. The platform intends to empower graduates with the skills required for pursuing Physics-related careers, higher education in Physics and allied subjects. The programme also aims at equipping future teachers with a thorough grounding in the subject. Since physics is the base of much of modern technology, the programme also gives adequate hands-on experience to learners who may go on to work in applied fields. The syllabus is based on a basic and applied approach with vigour and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

Various graduate attributes are emphasised in this framework such as critical thinking, basic psychology, scientific reasoning, moral ethical reasoning etc. While designing these frameworks, an important aspect was taken into consideration that was the measurable teaching-learning outcomes to ensure employability of the graduates. Implementation of modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e-learning platforms are suggested through this framework. The framework also focuses on issues relevant to India and also of the rest of the world.

The systematic and planned curricula from first year to the third year shall motivate and encourage the Learners for pursuing higher studies in Physics and for becoming an entrepreneur. It covers the basic concepts of Physics to establish a strong foundation of

the subject and helps Learners to explore the subject more. Topics varying from Mechanics, Electricity and Magnetism, Electronics, Atomic and Nuclear Physics, Electrodynamics, Statistical Physics, Quantum Mechanics and Classical Mechanics, Optics, Material science, Solid State Physics etc are taught. Choice is offered in Module I in Course I in Semester III. Semester V and Semester VI while focusing on the depth and applications of the above topics, also includes topics on assembly language programming and C++ programming.

Much like other natural sciences, physics is based on rational discussions, experimental evidence and criticism. The essence of learning physics revolves around experimentation. With experimentation, Learners can enhance their learning of physics. Apart from that, practical physics goes a long way in developing learners planning, evaluation, observation and analysis skills. The practical curriculum is designed in such a way that it will help in connecting "Hands On" to "Brains On". As mentioned in the syllabus, practical form an integral part of B Sc Physics program.

## 2. Learning Outcome based Curriculum Framework

LOCF focuses on curriculum framework, curriculum aims, learning targets and objectives. The curriculum framework also provides examples of effective learning, teaching and assessment practices. As the curriculum development is a collaborative and an on-going enhancement process, the LOCF instructs periodic reviews and revisions of the curriculum in accordance with the ever changing needs of Learners, teachers and society.

The framework describes how Learners are given exposure towards core knowledge of the subject, specialisation, choice based learning and other skill enhancement courses ensuring development of an integrated personality and employability. The template defines expected outcomes for the programme like core competency, communication skills, critical thinking, affective skills, problem-solving, analytical, reasoning, research-skills, teamwork, digital literacy, moral and ethical awareness, and leadership readiness along with specific learning course outcomes at the starting of each course. The Learning Outcomes based Curriculum Framework (LOCF) for B.Sc. with Physics will certainly be a valuable document in the arena of outcome-based curriculum design.

## 2.1 Nature and extent of B Sc Physics

Physics is the branch of science which deals with matter and its relation to energy. It involves study of physical and natural phenomena around us. Various branches of physics help us to understand natural processes in details with proper analysis. Few branches of physics are classical physics, modern physics, astrophysics, electromagnetism, thermodynamics, atomic physics, nuclear physics and optics. The degree program in Physics is designed to include topics from the above-mentioned areas in a perfect balance.

The B.Sc. Physics programme is of three years duration. Each year is divided into two semesters, in all making it a six-semester programme. The teaching and learning in the B.Sc. physics programme will involve theory classes (lectures) and practical.

The curriculum will be taught through formal lectures with the aid of power-point presentations, audio and video tools and other teaching aids can be used as and when required. Wherever possible RBPT approach will be adopted to make the process of learning more learner-centric. ICT-based teaching-learning tools will be incorporated through which even the mundane aspects could be made more interesting and relevant. Use of simulations will also be made to make the process of learning joyful.

## 2.2 Aim of Bachelor degree Programme

The overall aims of bachelor's degree program in physics are to:

1. Critically evaluate scientific theories, analyze problems, discuss options for realistic demonstrations, explain and carry out work plans, organize data, and draw conclusions
2. Follow ethical workplace policies and view scientific evidence objectively and critically. Recognize environmental problems and look for long-term solutions.
3. As a lifelong learner, keep up with recent scientific advances in the discipline and adapt technical innovations for better applications
4. Apply scientific knowledge while being sensitive to the beliefs of various cultural groups. Effectively disseminate scientific information for the benefit of society.
5. Develop communication and collaborative skills.

## 3. Graduate Attributes

After the successful completion of modules in different courses of B.Sc. PHYSICS, the learner will be able to:

**GA 1:** apply concepts of Physics and acquired skill sets to novel and unknown problems in order to establish an effective approach or strategy for dealing with them.

**GA 2:** explore and derive quantitative data in the realms of physics.

**GA 3:** collect, analyze, and interpret scientific data in the realms of physics using modern experimental apparatus and research methods.

**GA 4:** develop Psychomotor, analytical, observation skills through lab work

**GA 5:** approach any real life problem with proper assumption, logic and constraints.

**GA 6:** prepare for jobs, career development, and lifelong learning in Physics, by using acquired ICT skills, physics practical skills, and mathematical skills.

## 4. Qualification descriptors

Upon successful completion of the programme, Learners receive B.Sc. degree in Physics. Graduates of Physics are expected to demonstrate the extensive knowledge of various concepts of physics and its application and thereby contribute in research, teaching, government and public sectors. This programme will establish a foundation for student to further pursue higher studies in physics.

The learners who complete three years of full-time study of an undergraduate programme of study will be awarded a Bachelor's degree in physics.

**The list below provides a synoptic overview of possible career paths provided by an undergraduate training in physics:**

1. Academics
2. Research
3. Defence
4. Information technology Industry
5. Space research centres
6. Health Physics

7. Forensic science department
8. Oil and gas sectors
9. Packaging Industry
10. Geophysics and meteorology
11. Energy sector
12. Telecommunication
13. Sound Engineering

**Job Roles for B.Sc. Physics graduate:**

After graduation one can seek a professional career as:

1. Research scientist
2. Teacher
3. Radiologist
4. Laboratory Technician
5. System Analyst
6. Data Analyst
7. Accelerator operator
8. Laser Engineer
9. Web developer
10. Astronomer
11. Meteorologist
12. Aerospace systems engineer

**Higher Education options for B Sc Physics graduate:**

1. M Sc
2. Integrated M Sc –Ph D
3. PG Diploma:
    i. PG Diploma in Data Science
    ii. PG Diploma in Astronomy
    iii. PG Diploma in Nanotechnology
    iv. Diploma in Medical Lab Technology
    v. PG Diploma in Community Health Nursing

vi. Certificate in Lab Assistant/Technician

vii. Diploma in Operation Theatre Technology (OTT)

viii. PG Diploma in Machine Learning/Artificial Intelligence

4. MBA
5. B Ed
6. Entrance Exams after BSc Physics
   i. IIT JAM
   ii. TIFR GS
   iii. JEST

## 5. Programme Learning outcomes

After the successful completion of modules in different courses of B.Sc. physics the learner will be able to:

**PLO I:** apply principles of physics on various physical phenomenon.

**PLO II:** calculate physical parameters from the available data.

**PLO III:** analyse and interpret the data in various (numerical/graphical) forms **PLO IV:** development of Psychomotor, analytical, observation skills through Laboratory work.

**PLO V:** approach any real life problem with proper assumption, logic and constraints.

**PLO VI:** compete and succeed in various qualifying examinations in various related fields. (Higher education/software/industry)

## 5.1 Course Mapping

| Semester | PLO / Course | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|---|
| I | CC I | √ | √ | √ | | | |
| | CC II | √ | | √ | √ | | |
| | AECC -CE* | | | | | | |
| | AECC FC* | | | | | | |
| | SEC Sports | | | | | | |
| II | CC I | √ | √ | √ | √ | | |
| | CC II | √ | √ | √ | √ | √ | |
| | AECC VE*** | | | | | | |
| | AECC FC | | | | | | |
| | SEC Sports | | | | | | |
| III | CC I | √ | √ | √ | √ | | |
| | CC II | √ | √ | √ | | √ | √ |
| | CC III | √ | √ | √ | √ | √ | √ |
| | AECC -CE* | | | | | | |
| | AECC FC* | | | | | | |
| | SEC Sports | | | | | | |
| IV | CC I | √ | √ | √ | √ | √ | √ |
| | CC II | | √ | | √ | √ | √ |
| | CC III | √ | √ | √ | √ | √ | √ |
| | SEC VE*** | | | | | | |
| | AECC FC | | | | | | |
| | SEC Sports | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| V | CC I | √ | √ | √ | √ | √ | √ |
| | CC II | | √ | √ | | | |
| | CC III | √ | √ | √ | √ | √ | |
| | CC IV | √ | | √ | √ | √ | √ |
| | DSE I | √ | √ | | | | √ |
| | DSE II | √ | √ | √ | | √ | √ |
| | DSE V | √ | √ | √ | | √ | √ |
| | DSE VI | √ | √ | √ | | √ | √ |
| | AECC | | | | | | |
| | SEC | √ | √ | √ | | | √ |
| VI | CC I | √ | √ | √ | √ | √ | √ |
| | CC II | | √ | √ | √ | | |
| | CC III | √ | √ | √ | √ | √ | √ |
| | CC IV | √ | | √ | √ | √ | √ |
| | DSE III | √ | √ | | | √ | √ |
| | DSE IV | √ | √ | | √ | √ | √ |
| | DSE VII | √ | √ | | √ | √ | √ |
| | DSE VIII | √ | √ | | √ | √ | √ |
| | AECC | | | | | | |
| | SEC | √ | | √ | | √ | |

**** CE= Basic communication in English**
***FC= Foundation Course**
****VE= Value Education**

## 6. Structure of B.Sc. Physics programme

The curriculum frame work is designed around the choice-based credit system (CBCS). The programme consists of three years and six semesters (two semesters per year). To acquire a degree in B.Sc. physics a learner must study

1. **Core Courses (CC):**

a) A course that is required to be opted by a candidate as a core course.

b) There are eighteen Core courses (CC), two each, in semesters I and II; three each in semesters III and IV and four each in semesters V and VI.

c) Each Core Course is compulsory.

d) Each CC is comprised of 2 credits for theory ie. 30 hour; 3 lectures of each 50 min per week and 1 credit for practical of two hour per week in every semester.

e) The purpose of fixing core papers is to ensure that the institution follows a minimum common curriculum so as to adhere to common minimum standard with other universities/institutions.

f) The course designed under this category aims to cover the basics that a student is expected to imbibe in that particular discipline.

**2. Ability Enhancement Compulsory Courses (AECC)**

a) There are seven AECC courses. Student must take two Ability Enhancement Compulsory Courses (AECC) in semester I and one AECC each in semesters II-VI.

b) The AECC courses offered are: AECC 1- Foundation Course (2 credits) (Semester 1-IV), AECC 2- Basic communication in English (1 credit) (Semester I) AECC 3- Environmental Science (2 credits) (Semester V and VI).

**3. Discipline Specific Elective Courses (DSE):**

a) Elective courses offered under the main discipline subject of study.

b) There are four discipline specific elective courses (DSE), two each in semesters V and VI out of any eight (four offered in semester V and VI each).

c) Each DSE theory course is of 2 credits i.e. 30 hour; 3 lectures of each 50 min per week and 1 credit for practical of two hour per week in every semester. B

**4. Skill Enhancement Course (SEC):**

a) They are designed to provide skill-based knowledge and contain both lab/hands on training/field work.

b) The main purpose of these courses is to provide life skills in hands on mode to increase employability.

c) There are four skill enhancement courses (Sports/Value Education) one in each Semester I to IV of 1 credit.

d) There are two discipline centred skill enhancement courses (SEC) one in each semester V and semester VI of each 2 credit.

5. **Generic Elective Course (GE)**

a) Learners can opt for one interdisciplinary Generic Elective Course (GE) in each of the semester V and VI.

b) Generic elective courses are offered in cognitive disciplines by different departments in the college.

c) Credits for these courses are granted as additional credits.

## 6.1 Content

| Sr.No | Semester | Course number | Course Code | Course title |
|---|---|---|---|---|
| Core Course (CC) | | | | |
| 1 | I | CC I | 21US1PHCC1MEC1 | Mechanics I |
| 2 | | CC II | 21US1PHCC2EAE | Electricity and Electronics |
| 3 | | CCP | 21US1PHCCP | Based on CC I and CC II |
| 4 | II | CC I | 21US2PHCC1MNP | Modern Physics and Nuclear Physics |
| 5 | | CC II | 21US2PHCC2APP | Applied Physics |
| 6 | | CCP | 21US2PHCCP | Based on CC I and CC II |
| 7 | III | CC I | 22US3PHCC1MEC2 | Mechanics II |
| 8 | | CC II | 22US3PHCC2ELE1 | Electronics I |
| 9 | | CC III | 22US3PHCC3THD | Thermodynamics |
| 10 | | CCP | 22US3PHCCP | Based on CC I ,CC II and CC III |
| 11 | IV | CC I | 22US4PHCC1OPT | Optics |
| 12 | | CC II | 22US4PHCC2EAM | Electricity and Magnetism |
| 13 | | CC III | 22US4PHCC3QME | Quantum Mechanics |
| 14 | | CCP | 22US4PHCCP | Based on CC I ,CC II and CC III |
| 15 | V | CC I | 23US5PHCC1STP | Statistical Physics |
| 16 | | CC II | 23US5PHCC2SSP | Solid State Physics |
| 17 | | CCP I | 23US5PHCCP1 | Based on CC I and CC II |

| | | | | |
|---|---|---|---|---|
| 18 | | CC III | 23USPHCC3ATP | Atomic Physics |
| 19 | | CC IV | 23USPHCC4ELD | Electrodynamics |
| 20 | | CCP II | 23US5PHCCP2 | Based on CC III and CC IV |
| 21 | VI | CC I | 23US6PHCC1CLM | Classical Mechanics |
| 22 | | CC II | 23US6PHCC2ELE2 | Electronics II |
| 23 | | CCP I | 23US6PHCCP1 | Based on CC I and CC II |
| 24 | | CC III | 23US6PHCC3NPH | Nuclear Physics |
| 25 | | CC IV | 23US6PHCC4STR | Special Theory of Relativity |
| 26 | | CCP II | 23US6PHCCP2 | Based on CC III and CC IV |
| | **Discipline Specific Electives (DSE)** | | | |
| 1 | V | DSE I | 23US5PHDS1AEL | Analog Electronics |
| 2 | | DSE II | 23US5PHDS2DEI | Digital Electronics and instrumentation |
| 3 | | DSE III | 23US5PHDS3ELC | Electronics Communication |
| 4 | | DSE IV | 23US5PHDS4MME | Mathematical Methods |
| 5 | | DSEP | 23US5PHDSP | Practical Based on DSE Courses |
| 6 | VI | DSE I | 23US6PHDS1MUP | 8085 microprocessor architecture, programming and applications |
| 7 | | DSE II | 23US6PHDS2CPG | C++ Programming |
| 8 | | DSE III | 23US6PHDSAOP | Applied Optics |
| 9 | | DSE IV | 23US6PHDSSCI | Introduction to scilab |
| 10 | | DSEP | 23US6PHDSP | Practical Based on DSE Courses |
| **Skill Enhancement Course (SEC)** | | | | |
| 1 | I | SEC I | 21US1SE1STP1 | Sports Training Program Level I |
| 2 | II | SEC I | 21US2SE1STP2 | Sports Training Program Level 2 |
| 3 | | SEC II | 21US2SE2ICH1 | Indian cultural Heritage Level I (value education) |
| 4 | III | SEC I | 22US3SE1STP3 | Sports Training Program Level II |
| 5 | | SEC II | 22US3SE2ICH2 | Indian cultural Heritage Level II (value education) |

| | | | | |
|---|---|---|---|---|
| 8 | V | SEC I | 23US5PHSEIREH | Renewable Energy Harvesting |
| 9 | | | 23US5PHSEIIFP | Introduction to Forensic Physics |
| 10 | VI | SEC II | 23US6PHSE2ECN | Electrical circuits and Network skills |
| 11 | | | 23US6PHSE2CPJ | Computational Physics using Julia language |
| | Ability Enhancement Compulsory Course (AECC) | | | |
| 1 | I | AECCI | 21US1AE1FOC | Foundation Course |
| 2 | | AECC II | 21US1AE2BCE | Basic Communication in English |
| 3 | II | AECC I | 21US2AE1FOC | Foundation Course |
| 4 | III | AECC I | 22US3AE1FOC | Foundation Course |
| 5 | IV | AECC I | 22US4AE1FOC | Foundation Course |
| 6 | V | AECC I | 23US5AE1EVS | Environmental Science |
| 7 | VI | AECC I | 23US6AE1EVS | Environmental Science |
| 6 | IV | SEC I | 22US4SE1STP4 | Sports Training Program Level IV |
| 7 | | SEC II | 22US4SE2ICH3 | Indian cultural Heritage Level III (value education) |

**F.Y Credit distribution for B.Sc. Physics**

| Semester | Course number | Course title | Credits | | |
|---|---|---|---|---|---|
| | | | Theory | Practical | Total |
| I | CC I | Mechanics I | 2 | 1 | 3 |
| | CC II | Electricity and Electronics | 2 | 1 | 3 |
| | AECCI | Foundation Course | 2 | | 2 |
| | AECCII | Basic Communication in English | 1 | | 1 |
| | SECI | Sports Training Program Level I | 1 | | 1 |
| II | CC I | Modern Physics and Nuclear Physics | 2 | 1 | 3 |
| | CC II | Applied Physics | 2 | 1 | 3 |
| | AECCI | Foundation Course | 2 | | 2 |
| | SECI | Sports Training Program Level 2 | 1 | | 1 |

| | | | | | |
|---|---|---|---|---|---|
| | SECII | Indian cultural Heritage Level I (value education) | 1 | | 1 |
| III | CC I | Mechanics II | 2 | 1 | 3 |
| | CC II | Electronics | 2 | 1 | 3 |
| | CC III | Thermodynamics | 2 | 1 | 3 |
| | AECCI | Foundation Course | 2 | | 2 |
| | SECI | Sports Training Program Level 3 | 1 | | 1 |
| | SECII | Indian cultural Heritage Level 2 (value education) | 1 | | 1 |
| IV | CC I | Optics | 2 | 1 | 3 |
| | CC II | Electricity and Magnetism | 2 | 1 | 3 |
| | CC III | Quantum Mechanics | 2 | 1 | 3 |
| | AECCI | Foundation Course | 2 | | 2 |
| | SECI | Sports Training Program Level 4 | 1 | | 1 |
| | SECII | Indian cultural Heritage Level 3 (value education) | 1 | | 1 |
| V | CC I | Statistical Physics | 2 | 1 | 3 |
| | CC II | Solid State Physics | 2 | 1 | 3 |
| | CC III | Atomic Physics | 2 | 1 | 3 |
| | CC IV | Electrodynamics | 2 | 1 | 3 |
| | DSE I | Analog Electronics | 2 | 1 | 3 |
| | DSE II | Digital Electronics and instrumentation | 2 | 1 | 3 |
| | DSE III | Electronics Communication | 2 | 1 | 3 |
| | DSE IV | Mathematical Methods | 2 | 1 | 3 |
| | SEC I | Renewable Energy Harvesting | 2 | | 2 |
| VI | CC I | Classical Mechanics | 2 | 1 | 3 |
| | CC II | Electronics | 2 | 1 | 3 |
| | CC III | Nuclear Physics | 2 | 1 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| | CC IV | Special Theory of Relativity | 2 | 1 | 3 |
| | DSE I | 8085 microprocessor architecture, programming and applications | 2 | 1 | 3 |
| | DSE II | C++ Programming | 2 | 1 | 3 |
| | DSE III | Applied Optics | 2 | 1 | 3 |
| | DSE IV | Introduction to Scilab | 2 | 1 | 3 |
| | SEC II | Electrical circuits and Network skills | 2 | | 2 |

## F.Y Semester Schedule

| Sem | Core Course number | Core Course (CC) title | Discipline Specific Electives (DSE) | Generic Elective Course (GE) | Skill Enhancement Course (SEC) | Ability Enhancement Compulsory Course (AECC) |
|---|---|---|---|---|---|---|
| I | CC I | MechanicsI | | | Sports Training Program Level I | 1] Foundation Course<br>2] Basic Communication in English |
| | CC II | Electricity and Electronics | | | | |
| II | CC I | Modern Physics and Nuclear Physics | | | 1] Sports Training Program Level II<br><br>2] Indian cultural Heritage Level I (Value Education) | Foundation Course |
| | CC II | Applied Physics | | | | |
| III | CC I | MechanicsI I | | | 1] Sports Training Program Level III<br><br>2] Indian cultural Heritage Level II (Value | Foundation Course |
| | CC II | Electronics | | | | |
| | CC III | Thermodynamics | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | Education) | |
| IV | CC I | Optics | | | 1] Sports Training Program Level IV 2] Indian cultural Heritage Level III (Value Education) | Foundation Course |
| | CC II | Electricity and Magnetism | | | | |
| | CC III | Quantum Mechanics | | | | |
| V | CC I | Statistical Physics | Any two DSE | GE | SEC I | Environmental Science |
| | CC II | Solid State Physics | | | | |
| | CC III | Atomic Physics | | | | |
| | CC IV | Electrodynamics | | | | |
| VI | CC I | Classical Mechanics | Any two DSE | GE | SEC II | Environmental Science |
| | CC II | Electronics | | | | |
| | CC III | Nuclear Physics | | | | |
| | CC IV | Special Theory of Relativity | | | | |

## 6.4 Course Learning Objective

The three-year undergraduate Physics programme is designed to familiarize learners with significant developments in Physics. The objective of structured syllabus in Physics is to make the concepts and basics of Physics clear and interesting to learners and also to ensure the development of vertical growth in the subject. The idea behind this is to enable learners to develop analytical skills and critical thinking.

It is our attempt that learners achieve this objective through systematic reading and class lectures and through feedback on their written work-assignments, project/research papers, presentations, discussions, debates, etc. Our intention is to enable learners to formulate cogent arguments, presenting the necessary evidence to establish these, based on a training in Physics.

# 7. Detailed B.Sc. Physics Syllabus

**F. Y. B.Sc. Syllabus with effect from the Academic year 2021–2022**

## Syllabus – F. Y. B.Sc. Physics

| Course No. | Course Title | Course Code | Credits | Hour | Periods (50 min) | Module | Lectures per module (50 minutes) | Examination | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Internal Marks | External Marks | Total Marks |
| **SEMESTER I** | | | | | | | | | | |
| **Core courses THEORY** | | | | | | | | | | |
| I | Mechanics I | 21US1PHCC1 MECI | 2 | 30 | 36 | 3 | 12 | 40 | 60 | 100 |
| II | Electricity and Electronics | 21US1PHCC2 EAE | 2 | 30 | 36 | 3 | 12 | 40 | 60 | 100 |
| **Core courses PRACTICAL** | | | | | | | | | | |
| I &II | | 21US1PHCCP | 2 | 75 | 90 | | | 40 | 60 | 100 |
| **SEMESTER II** | | | | | | | | | | |
| **Core courses THEORY** | | | | | | | | | | |
| I | Modern Physics and Nuclear Physics | 21US2PHCC1 MNP | 2 | 30 | 36 | 3 | 12 | 40 | 60 | 100 |
| II | Applied Physics | 21US2PHCC2 APP | 2 | 30 | 36 | 3 | 12 | 40 | 60 | 100 |
| **Core courses PRACTICAL** | | | | | | | | | | |
| I &II | | 21US2PHP | 2 | 75 | 90 | | | 40 | 60 | 100 |

**F.Y. B. Sc. (Physics) SEMESTER I**

**Core Course- I**

**COURSE TITLE: Mechanics 1**

**COURSE CODE: 21US1PHCC1MEC1 [CREDITS – 02]**

| Course Learning Outcome |
|---|
| After the successful completion of the Course, the learner will be able to:<br>1. Understand the basic ideas of elasticity.<br>2. Derive the equations related to fluid mechanics.<br>3. Apply the concept of partial derivatives in the context of Physics and Mathematics<br>4. Apply the principle of superposition to two perpendicular SHMs<br>5. Understand the mechanics of a system of particles<br>6. Derive the expression for velocity of transverse waves on a string and longitudinal waves on a rod.<br>7. Explain the production and application of ultrasonic waves.<br>8. Acquire the ability to examine the basic information about acoustics in building design.<br>9. Explain the physical aspects of transmission of sound in the ear. |

| Module 1 | Mathematical methods,Elasticity and Fluid dynamics | [12L] |
|---|---|---|

**Learning Objectives:**

The module is intended to

1. Differentiate between streamline and turbulent flows.
2. Understand the concept of lines of flow in an air foil.
3. Demonstrate competence with the basic ideas of elasticity and fluid mechanics
4. Develop a quantitative and conceptual understanding of mechanics and mathematical physics.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to:

1. Identify the different forces associated with different moduli of elasticity.
2. Describe the continuity equation in the context of conservation of mass.
3. Discuss the significance of Bernoulli's equation in the context of motion of aircraft.

4. Explain how Poisson's ratio can be used to categorize the behaviour of materials in real world situations.
5. Apply the concept of partial derivatives in the context of Physics and Mathematics
6. Use the concepts of elasticity to understand material properties

| | | |
|---|---|---|
| 1.1 | Mathematical Methods: Partial Differentiation, variable treated as constants, Total Derivative, Partial Differentiation of Composite Functions: change of variables.<br>Ref: BVR: 3.2, 3.3, 3.4, 3.13.5 | [4L] |
| 1.2 | Elasticity:(Elastic constants Y, K, η, σ: review) Equivalence of shear strain to compression and extension strains. Relation between elastic constants,<br>Ref: HP: 15.2. A to 15.5.A and 15.7. A Add Ref.: DSM | [4L] |
| 1.3 | Fluid Dynamics: Equation of continuity, Bernoulli's equation, streamline and turbulent flow, lines of flow in air foil, Poiseuille's equation.<br>Ref: HP 15.2B to 15.6B Add. Ref.: HCV, DSM | [4L] |
| **Module 2** | **SHM, System of particles and Wave motion** | **[12L]** |

**Learning Objectives:**

This module is intended to:

1. Use the principle of superposition to illustrate graphically the result of combining two waves.
2. Develop the fundamental dynamics equations and principles for a system of particles.
3. Write a mathematical expression for the speed of a wave on a string and generalize these concepts for other media.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to:

1. Apply the principle of superposition to two SHMs having their periods in different ratios.
2. Analyze the motion of a system of particles using the conservation principles.
3. Differentiate between longitudinal and transverse waves.
4. Apply wave equation to transverse waves on a string and longitudinal waves on a rod.

| | | |
|---|---|---|
| 2.1 | Composition of two SHM: (Definition of SHM and composition of two parallel SHM's of same period: review) Composition of two perpendicular S H M's having the same period and period in the ratio 1:2, Lissajous figures. | [4L] |

| | | |
|---|---|---|
| | Ref: SPP 2.4.1, 2.4.3, 2.4.4 | |
| 2.2 | Mechanics of a system of particles: Centre of mass of a system of particles, Linear momentum of a system of particles and its conservation. Angular momentum of a system of particles and its conservation (only statement). Rocket motion (neglecting gravity)<br>Ref: TM: 9.2, 9.3, 9.4, 9.11 | [4L] |
| 2.3 | Wave motion in one dimension: General solution of wave equation, Classification of waves, Examples of one dimensional waves, Transverse wave on string, Longitudinal Waves<br>Ref: SPP: 6.1, 6.2, 6.5, 6.5.1, 6.5.2, 6.5.3. | [4L] |
| **Module 3** | **Ultrasonics and Acoustics** | **[12L]** |

**Learning Objectives:**

The module is intended to

1. List the properties and applications of ultrasonic waves.
2. Discuss the piezoelectric effect.
3. Explain the production of ultrasonic waves.
4. State the acoustic requirements of a good auditorium.
5. State the factors affecting reverberation time for a hall
6. Determine the absorption coefficient of material by Sabine formula
7. Discuss the function of the ear as a hearing organ and also physical aspects of transmission of sound in the ear.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to:

1. Explain the production of ultrasonic sound by piezoelectric crystal.
2. Use the properties and application of ultrasonic waves.
3. Derive the frequency generated by the crystal from its dimension.
4. Explain the methods of detection of ultrasonic waves.
5. Apply Sabine's formula for determining the absorption coefficient or reverberation time.
6. List the factors affecting the acoustics of buildings.
7. List the requisites of a good auditorium.
8. Explain the function of the ear as a hearing organ.

| | | |
|---|---|---|
| 9. Determine the intensity in decibel.<br>10. Explain the physical aspects of transmission of sound in the ear. | | |
| 3.1 | Ultrasonic: Piezoelectric effect, Production of Ultrasonic waves: Magnetostriction method and Piezoelectric Crystal Method, Detection, Properties and applications of Ultrasonic Waves<br>Ref: MS: 5.1 to 5.6, | [4L] |
| 3.2 | Acoustics of Buildings: Reverberation, Sabine's formula with derivation, Determination of Absorption coefficient, Acoustics of Buildings, factors affecting Acoustics of Buildings, Sound distribution in an auditorium.<br>Ref: MS: 5.8, 5.9, 5.10, 5.12, 5.13, 5.14, 5.15 | [4L] |
| 3.3 | Bio- Acoustics: Sound and its characteristics, Functions of Ear as a hearing, Physical basis of hearing, Module of intensity of sound, Physical aspects of Transmission or conduction of sound in Ear.<br>Ref: P N Roy: Chapter 20: 20.1, 20.2, 20.3, 20.4, 20.6. | [4L] |

**References:**


- BVR: Higher Engineering Mathematics- B V Ramana Tata McGraw Hill.
- TM: Classical Dynamics – Thornton and Marion (5th Ed.) Thomson Books.
- HP: Mechanics – Hans and Puri, 2nd Ed. Tata McGraw Hill.
- SPP: Fundamentals of vibration and waves – S P Puri (Tata McGraw Hill)
- MS: Properties of matter and Acoustics – R Murugeshan and K. Shivaprasath, S Chand & Co. Ltd. (2005-Ed)
- P.N. Roy: A text book Bio Physics- R N Roy (New Central Book Agency ltd) (Revised Edition)

## Question Paper Template

## F.Y. B. Sc. (Physics) SEMESTER I

## Core Course- I

## COURSE TITLE: Mechanics I

## COURSE CODE: 21US1PHCC1MEC1 [CREDITS - 02]

| Module | Remembering/ Knowledge | Understanding | Applying | ANALYSING /EVALUATING /CREATING | Total marks |
|---|---|---|---|---|---|
| I | 05 | 10 | 10 | 05 | 30 |
| II | 04 | 18 | 04 | 04 | 30 |
| III | 12 | 04 | 04 | 10 | 30 |
| Total marks per objective | 21 | 32 | 18 | 19 | 90 |
| % Weightage | 23.3 | 35.5 | 20 | 21.2 | 100 |

**F.Y. B. Sc. (Physics) SEMESTER I**

**Core Course- II**

**COURSE TITLE: Electricity and Electronics**

**COURSE CODE: 21US1PHCC2EAE [CREDITS - 02]**

| Course Learning Outcomes |
|---|
| After the successful completion of the Course, the learner will be able to:<br>1. Simplify complex dc networks to equivalent circuits.<br>2. Understand the problems related to transient response and ways to minimise them in future.<br>3. Compare phase variations in LR and CR circuits in comparison with pure R circuits, they will also be able to calculate quantities like, impedance, reactance, admittance, Resonance conditions for various circuits.<br>4. Choose type of transformer as per requirement of circuits<br>5. Understand the oscillator circuits and use them to find unknown values of various components or determine unknown frequencies of signal.<br>6. Use Filter circuits to minimize ac components in the output of a full wave bridge rectifier.<br>7. Develop number systems namely Binary and Hexadecimal. Solve Boolean expressions. Perform the addition and subtraction of Binary numbers using 2's complement method. |

| Module 1 | Circuit Theorem and Transient Response | [12L] |
|---|---|---|

**Learning Objectives:**

The module is intended to

1. Analyse different types of dc electrical networks.
2. Understand the physical significance of transient response.
3. Grasp the phasor concept to understand passive circuits.
4. Develop skill for simplifying dc electrical networks.

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to:

1. Simplify complex dc networks to equivalent circuits.
2. Design dc electrical networks for maximum efficiency.
3. Develop passive circuits for optimising power output.
4. Identify the problems related to transient response and minimise them in future.

| | | |
|---|---|---|
| 1.1 | Circuit theorems:<br>Thevenin's theorem, Norton theorem, Reciprocity theorem, Maximum power transfer theorem.<br>Ref: CR: 7.7, 7.8, 7.9, 7.10, 7.11 (more problems oriented) | [6L] |
| 1.2 | Transient response of circuits:<br>Series LR, CR and LCR circuit. Growth and decay of current<br>Ref: CR: 14.1 to 14.3 | [6L] |

| Module 2 | Alternating Current Theory | [12L] |
|---|---|---|
| **Learning Objectives:**<br>This module is intended to:<br>1. Understand the basic mathematical concepts and physical description of ac signals.<br>2. Understand the phase variation in inductor, capacitor, and Resistance circuits when sinusoidal signal is applied.<br>3. Understand the working principle of transformer.<br>4. Apply this knowledge to construct various bridge circuits and learn their applications<br>5. Demonstrate quantitative problems solving skills in all the topics covered | | |
| **Learning Outcomes:**<br>After the successful completion of the module, the learner will be able to:<br>1. Analyse signals and identify features such as wavelength, frequency, period, phase and amplitude, will also be able to compute average, root mean square value of signals.<br>2. Compare phase variations in LR and CR circuits in comparison with pure R circuits, they will also be able to calculate quantities like, impedance, reactance, admittance, Resonance conditions for various circuits.<br>3. Choose type of transformer as per requirement of circuits<br>4. Evaluate unknown values of various components or determine unknown frequencies of signal of oscillator circuits. | | |
| 2.1 | Alternating current theory: (Concept of L, R and C: Review)<br>AC circuit containing pure R, Pure L and pure C, Series L-R, C-R and LCR circuits. Resonance in LCR circuit (both series and parallel), Power in AC circuit, Q factor. Transformer | [6L] |
| | Ref: CR: Art 5.12 Omit phasor diagram & Auto transformer) Using Complex numbers only, 15.2, 15.5 to 15.12 | |
| 2.2 | A C bridges: | [6L] |

| | | |
|---|---|---|
| | General AC Bridge, Maxwell's Bridge, De-Sauty's Bridge, Wien's, Schering's Bridge.<br>Ref: CR: 15.14 (more problems oriented) | |
| | | |

| | | |
|---|---|---|
| 3.1 | Rectifier Circuit: (Half wave and Full wave rectifier: Review) Bridge rectifier: Efficiency and Ripple factor of Full wave Rectifier, Filter circuits: types of filter circuits – capacitor filter, choke input filter, | [4L] |

| **Module 3** | **Rectifiers and Digital Electronics** | **[12L]** |
|---|---|---|

**Learning Objectives:**

The module is intended to be familiar with

1. Operation of full wave bridge rectifier and operational parameters.
2. Filter circuits namely capacitor filter and choke input filter.
3. Number Systems namely decimal, binary and hexadecimal and their inter conversions.
4. Addition and subtraction of Binary Numbers using 2's complement method.
5. Arithmetic of Boolean algebra using gates.
6. Basic and universal gates

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to:

1. Design and construct a simple dc power supply.
2. Use Filter circuits to minimize ac components in the output of a full wave bridge rectifier.
3. Develop number systems namely Binary and Hexadecimal.
4. Perform the addition and subtraction of Binary numbers using 2's complement method.
5. Solve Boolean expressions.
6. Design and implement sequential and combinational circuits using gates.

| | | |
|---|---|---|
| | Ref: VKM: 9.10 to 9.20, 9.22, 9.23 | |
| 3.2 | Digital electronics: (Logic Gates: Review) (i) De-Morgan's Theorems, NAND & NOR as Universal Building blocks. (ii) EX-OR gate: Logic expression, logic symbol, truth table, Implementation using basic gates (iii) Number System: Decimal, Binary and Hexadecimal (their conversion)<br>(iv) Addition and Subtraction of Binary numbers using 2's compliments, implementation of Boolean expressions using gates<br>VKM: 28.8 to 28.14, 28.19<br>ML: Relevant topics | [8L] |
| | **References:**<br>• CR: D. Chattopadhyay, P C Rakshit , Electricity and Magnetism 7th Ed. New Central Book agency.<br>• VKM: V K Mehta and R Mehta Electronics Principals, Multi coloured Revised 11th Ed. reprint in 2012, S Chand.<br>• M L:A P Malvino, Digital Principles and Applications: Tata McGraw Hill Tokhiem, Digital electronics, 4th ed, McGraw Hill International Edition | |
| | **Additional References:**<br>• BN: Boylestad and Nashelsky, Electronic devices and Circuit Theory: 7th edition, Prentice Hall of India. | |

## Question Paper Template

## F.Y. B. Sc. (Physics) SEMESTER I

## Core Course- II

## COURSE TITLE: Electricity and Electronics

## COURSE CODE: 21US1PHCC2EAE [CREDITS - 02]

| Module | Remembering/ Knowledge | Understanding | Applying | ANALYSING /EVALUATING /CREATING | Total marks |
|---|---|---|---|---|---|
| I | 10 | 14 | 04 | 02 | 30 |
| II | 11 | 12 | 03 | 04 | 30 |
| III | 08 | 09 | 05 | 08 | 30 |
| Total marks per objective | 29 | 35 | 12 | 14 | 90 |
| % Weightage | 32.2 | 38.8 | 13.4 | 15.5 | 100 |

**F.Y. B. Sc. (Physics)**

**SEMESTER I - Practical**

**COURSE CODE:** 21US1PHCCP **Credit- 02**

**Learning Objectives:**

Learners are expected to:

1. Handle measuring instruments.
2. Identify various electronic components and to connect them
3. Use graphical representation to determine physical quantities.
4. Verify the truth table of ICs and laws.

**Learning Outcomes:**

After the successful completion of the practical, the learner will be able to:

1. Demonstrate their practical skills.
2. Use apparatus with ease
3. Correlate their physics theory concepts through practical.
4. Estimate errors in the measurements.

**Core Course I**

1. Flywheel
2. Torsional oscillations
3. Bifilar Pendulum
4. Helmholtz Resonator
5. Y by Vibration
6. η By Poiseuille's Method
7. Spectrometer (A)

| Core Course II |
|---|
| 1. Bridge rectifier (to study load regulation)<br>2. LR Circuit<br>3. C R Circuit<br>4. De-Morgan's Theorems<br>5. NAND and NOR as Universal Building Blocks.<br>6. Thevenin's Theorem<br>7. Determination of Unknown Capacitance by De-Sauty's Method |
| Skill Experiments |
| 1. Use of Vernier Callipers, Micrometre Screw Gauge and Travelling Microscope<br>2. Graph plotting (Exponential, Straight line with intercept, Resonance curve etc.)<br>3. Spectrometer: Schuster's Method<br>4. Use of DMM. |
| Minimum of 8 experiments from both the Courses should be completed in first semester. All the skill experiments are to be reported in journal. Certified journal is must to be eligible to appear for the semester end practical examination. |

**F.Y. B. Sc. (Physics) SEMESTER II**

**Core Course- I**

**COURSE TITLE: Modern Physics and Nuclear Physics**

**COURSE CODE: 21US2PHCC1MNP [CREDITS - 02]**

| Course Learning Outcomes |
|---|
| After the successful completion of the Course, the learner will be able to:<br>1. Apply classical physics laws and quantum physics laws to explain observed discrete nature of energy spectra.<br>2. Relate quantum physics with classical physics through correspondence principle.<br>3. Describe the continuous and characteristic X-rays.<br>4. Apply Bragg's law to obtain inter-planar spacing of crystals<br>5. Understand the various properties of nucleus and relation between binding energy and nuclear stability.<br>6. Explain radioactivity, half-life and the method of carbon dating to determine the age of fossils.<br>7. Understand the concept of successive disintegration and radioactive equilibrium<br>8. Develop an understanding of wave particle duality and the experimental techniques used for the same<br>9. Discuss pair production, pair annihilation and gravitational red shift. |

| Module 1 | Atomic Physics and X-rays | [12L] |
|---|---|---|

**Learning Objectives:**

The module is intended to know:

1. The chronological discovery of atomic structures.
2. The quantization of energy of atomic states.
3. The correspondence principle.
4. The origin of Atomic Spectra.
5. The effect of nuclear motion on Atomic Spectra.
6. The production of X-rays.
7. The continuous and characteristic X-rays.

| | | |
|---|---|---|
| 8. The X-ray diffraction and its application for determination of lattice constants of crystals. | | |
| **Learning Outcomes:**<br>After the successful completion of the module, the learner will be able to:<br>1. Explain the historical development in atomic structures.<br>2. Apply classical physics laws and quantum physics laws to explain observed discrete nature of energy spectra.<br>3. Relate quantum physics with classical physics through correspondence principle.<br>4. Derive generalized formula for wave numbers of observed spectral series of H-atom.<br>5. Explain discovery of deuteron nucleus.<br>6. Explain X-rays production.<br>7. Elaborate the continuous and characteristic X-rays.<br>8. Apply Bragg's law to obtain inter planar spacing of crystals. | | |
| 1.1 | Atomic Physics:(Review of Bohr's Postulates) Nuclear atom, Electron orbits, atomic spectra, Bohr atom, energy levels and spectra, correspondence principle, nuclear motion, atomic excitation.<br>Ref: AB: 4.1 to 4.8, | [7L] |
| 1.2 | X-Rays: X-Rays production (Review), continuous and characteristic X ray spectra, X-Ray Diffraction, Bragg's Law, Diffractometer<br>Ref: AB: 2.4, 2.5, 2.6 | [5L] |
| **Module 2** | **Nuclear Physics** | **[12L]** |
| **Learning Objectives:**<br>This module is intended to:<br>1. Develop an understanding of nuclear properties and nuclear behavior.<br>2. Explain the binding energy curve and draw inference from the same. | | |

| | | |
|---|---|---|
| 3. Apply the concepts to solve problems based on radioactive decay and carbon dating. | | |
| **Learning Outcomes:**<br>After the successful completion of the module, the learner will be able to:<br>1. Define radioactivity, half-life and state various types of radioactivity.<br>2. Explain the method of carbon dating to determine the age of fossils.<br>3. Discuss the various properties of nucleus and relation between binding energy and nuclear stability.<br>4. Solve the problems based on radioactive decay. | | |
| 2.1 | Nuclear Physics: Nuclear composition, nuclear properties, Stable nuclei, Binding energy, Meson theory of nuclear forces. Ref: AB: 11.1 to 11.4, 11.7, | [6L] |
| 2.2 | Radioactivity: Radioactive decay: Five kinds, Radioactivity and the Earth, Radiation Hazards, Half-Life, Radiometric Dating, Successive Disintegration A B =>C (stable), Radioactive Series and Radioactive Equilibrium.<br>Ref: AB: 12.1 to 12.3. | [6L] |
| **Module 3** | **Quantum Mechanics** | **[12L]** |
| **Learning Objectives:**<br>The module is intended to<br>1. To have an appreciation for the subject of quantum Mechanics.<br>2. To have an understanding of why quantum Mechanics occupies an important place in understanding various aspects of modern research. | | |
| **Learning Outcome:**<br>After the successful completion of the module, the learner will be able to:<br>1. General experience with non-relativistic quantum mechanics that is useful for further studies in theoretical physics, as well as nanotechnology<br>2. Knowledge about fundamental quantum mechanical processes in nature | | |

| | | |
|---|---|---|
| 3. Identify and understand the kinds of experimental results which are incompatible with classical physics and which required the development of a quantum theory of matter and light understand the role of uncertainty in quantum physics<br>4. Describe pair production and pair annihilation<br>5. Calculate gravitational red shift. | | |
| 3.1 | Introduction to Quantum Mechanics I: De Broglie Waves, Wave function, Particle Diffraction, Davisson Germer Experiment, Heisenberg's Uncertainty Principle.<br>Ref: AB: 2.7, 2.8, 2.9, | [6L] |
| 3.2 | Introduction to Quantum Mechanics II: Compton Effect, Pair production, Photons and Gravity, gravitational red shift<br><br>Ref: AB: 3.1, 3.2, 3.5, 3.7, 3.8, 3.9 | [6L] |

**References:**


- AB: Concepts of Modern Physics – A. Beiser (6th Ed), Tata McGraw Hill.
- K: Kaplan: Nuclear Physics, Irving Kaplan, 2nd Ed. Narosa Publishing House
- SBP: Dr. S. B. Patel, Nuclear Physics Reprint 2009, New Age International
- BSS: N Subrahmanyam, Brijlal and Seshan, Atomic and Nuclear Physics Revised Ed. Reprint 2012, S. Chand


**Additional References:**


- Kenneth Krane, Introduction to Nuclear Physics, Wiley India Pvt. Ltd.
- Robert Eisberg and Robert Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles Wiley (2006)
- David Griffith, Introduction to Elementary Particles John Wiley and sons.
- http://dae.nic.in or http://www.npcil.nic.in for 3 stage- Nuclear programme of India.
- http://www.aerb.gov.in/ for Regulatory framework and nuclear safety in India.

## Question Paper Template

## F.Y. B. Sc. (Physics) SEMESTER II

## Core Course- I

## COURSE TITLE: Modern Physics and Nuclear Physics

## COURSE CODE: 21US2PHCC1MNP [CREDITS - 02]

| Module | Remembering/ Knowledge | Understanding | Applying | ANALYSING /EVALUATING /CREATING | Total marks |
|---|---|---|---|---|---|
| I | 12 | 12 | 04 | 02 | 30 |
| II | 10 | 12 | 04 | 04 | 30 |
| III | 07 | 10 | 08 | 05 | 30 |
| Total marks per objective | 29 | 34 | 16 | 11 | 90 |
| % Weightage | 32.2 | 37.8 | 17.8 | 12.2 | 100 |

**F.Y. B. Sc. (Physics) SEMESTER II**

**Core Course- II**

**COURSE TITLE: Applied Physics**

**COURSE CODE: 21US2PHCC2APP [CREDITS - 02]**

| Course Learning Outcomes |
|---|
| After the successful completion of the Course, the learner will be able to:<br>1. Classify and categorize materials including metals<br>2. State the concept of nanotechnology and synthesis mechanisms<br>3. Identify the 14 types of lattices, find atomic packing fraction and derive the Miller Indices for different planes find spacing between lattice planes.<br>4. Distinguish between the various types of Lasers by mode of operation and gain media<br>5. Describe total internal reflection and propagation of light through optical fibre.<br>6. Apply principles of thermodynamics for living organisms. Compare living and non-living organisms with reference to thermodynamics.<br>7. Explain and determine the physicochemical properties of liquids<br>8. Discuss the use of astronomical units in context of gigantic masses and distances of stellar bodies.<br>9. Apply Physics concepts and techniques like photoelectric effect, Doppler effect and spectroscopy to the study of the Universe. |

| Module 1 | Material Science | [12L] |
|---|---|---|

**Learning Objectives:**

The module is intended to

1. Understand the classification and selection of material
2. Distinguish among materials based on different properties
3. Understand the application-based requirements and understand the concept of importance at nanoscale level.
4. Understand crystal structure in detail.

| | | |
|---|---|---|
| 5. Calculate Miller indices and spacing between lattice planes. | | |
| **Learning Outcomes:**<br>After the successful completion of the module, the learner will be able to:<br>1. Classify and categorize materials.<br>2. Describe the properties and applications of organic and semiconducting materials.<br>3. State the concept of nanotechnology and synthesis mechanisms.<br>4. Identify the 14 types of lattice and find atomic packing fraction<br>5. Obtain Miller Indices for different planes and find spacing between lattice planes | | |
| 1.1 | Material Science: Classification and selection of materials: Classification of materials, organic, semiconductor materials, current trends and advances in materials, Material structure and examination, Selection of materials. Ref: KK: Chapter 1(3 TO 9) Chapter 3 (1 to 18, 33) | [4L] |
| 1.2 | Nano- Materials**:**<br>Definitions of nano materials, size dependent properties of nano materials, alternate approaches of preparations of nano materials, synthetic strategies<br>Ref: BV: Chapter 1 (1.1 to 1.4). | [4L] |
| 1.3 | Crystal geometry and structure:<br>Crystals, single crystal, lattice point and space lattice. Unit cell, primitive cell, Atomic radius, Density of crystal, Direction lattice planes, Miller indices, Inter-planer spacing.<br>Ref: S: 12.1, 12.1.1, 12.1.2,1 2.4.1, 12.4.2, 12.4.3 | [4L] |

| Module 2 | **Lasers and Fiber Optics** | **[12L]** |
|---|---|---|
| **Learning Objectives:**<br>This module is intended to: | | |

1. Understand the concepts of LASERs
2. Describe the process of stimulated emission
3. Differentiate between stimulated and spontaneous emission
4. Understand the basic concepts of fiber optics
5. Understand the concepts of numerical aperture and acceptance angle

**Learning Outcomes:**

After the successful completion of the module, the learner will be able to:

1. Distinguish between the various types of Lasers by mode of operation and gain media
2. Identify the various applications of Lasers
3. Describe how total internal reflection helps in propagation of light through a fibre optics cable.
4. List the various types of fibre optics cables.
5. Calculate the numerical aperture and acceptance angle for various fibre optic cables.

| | | |
|---|---|---|
| 2.1 | Laser:<br>Introduction, transition between atomic energy states (without derivation), Principle of Laser, Properties of Laser, Types of Lasers, Helium–Neon Laser, Application of Laser to Holography and other applications.<br>Ref: S P: 9.1, to 9.6, 9.10, 9.11. | [6L] |
| 2.2 | Fibre Optics:<br>Light propagation through Fibres, Fibre Geometry, Internal reflection, Numerical Aperture, Step-Index and Graded-Index Fibres, Applications of Fibres<br>Ref: S P: – 13.3, 13.5, 13.9. | [6L] |

| Module 3 | Bio-Physics and Astro-Physics | [12L] |
|---|---|---|

**Learning Objectives:**

The module is intended to

1. Apply principles of thermodynamics for living organisms.
2. Compare living and non-living organisms with reference to thermodynamics.
3. Understand the characteristics of living organisms.
4. Understand the physicochemical properties of liquids.
5. Develop a basic understanding of the Universe around us.
6. Grasp the vastness and complexity of stellar structures in terms of their distances and masses.
7. Correlate different concepts in physics and spectroscopy with the stellar spectra.

1. Discuss the use of astronomical units in context of gigantic masses and distances of stellar bodies
2. Differentiate between different types of spectra and their origins
3. Apply physics concepts like photoelectric effect, Doppler Effect to the study of the Universe.
4. Explain the cyclicity of nature in the form of the life-cycle of Stars

| | | |
|---|---|---|
| 3.1 | Bio Physics:<br>Introduction, definition, history & scope of biophysics, biological fluids, Physico-chemical properties, viscosity, surface tension, pH, osmosis, osmotic pressure, diffusion,<br>Thermodynamics approach to Bio-Physics, Laws of thermodynamics and living organisms, First and Second law of thermodynamics, comparison of living and non-living systems as a thermodynamics system.<br>Ref: R N Roy Chapter1, Chapter 3: 3.1.3.3, 3.4.1, 3.4.2, 3.6.1, 3.6.2, 3.14 | [6L] |
| 3.2 | Astro -Physics: | [6L] |

| | | |
|---|---|---|
| | Basic Astro-Physics: Planck's Theory of Radiation, Photoelectric effect, Pressure of Radiation, Type of Spectrum, Doppler Effect<br>Ref: BB: 2.1, 2.2, 2.3, 2.4, 2.5<br>Large Scale Structure of the Universe: Introduction, Structural Hierarchy, Hubble's law, Radiation Background, Life cycle of star<br>Ref: JN: 1.1, 1.2, 1.3, 1.4, 1.5 | |

**References:**


- KK : Material Science – S. K. Kakani and Amit Kakani, New Age International (P) Ltd. – Reprint 2004.
- BV: B. Viswanathan, Nano materials, Narosa Publication House, Fourth Reprint-2013.
- SP: Modern Physics Concept and Applications – Sanjeev Puri, Narosa Publication
- Roy: A textbook Bio Physics- R N Roy (New Central Book Agency ltd) (Revised Edition)
- BB: Baidyanath Basu, Introduction to Astro-Physics, PHI learning Pvt Ltd, 2010

JN: Jayant Narlikar, Elements of Cosmology, University Press (India) Ltd 1996

## Question Paper Template
## F.Y. B. Sc. (Physics) SEMESTER II
## Core Course- II
## COURSE TITLE: Applied Physics
## COURSE CODE: 21US2PHCC2APP [CREDITS - 02]

| Module | Remembering/ Knowledge | Understanding | Applying | ANALYSING /EVALUATING /CREATING | Total marks |
|---|---|---|---|---|---|
| I | 10 | 14 | 04 | 02 | 30 |
| II | 12 | 05 | 09 | 04 | 30 |
| III | 10 | 10 | 07 | 03 | 30 |
| Total marks per objective | 32 | 29 | 20 | 09 | 90 |
| % Weightage | 35.5 | 32.2 | 22.3 | 10.0 | 100 |

**F. Y. B. Sc. (Physics)**

**SEMESTER II - Practical**

**COURSE CODE: 21US2PHCCP Credit- 02**

**Learning Objectives:**

Learners are expected to:

1. Operate various mechanical instruments.
2. Handle various optical instruments
3. Use graphical representation to determine physical quantities.
4. Design combinational circuits using Boolean Algebra.

**Learning Outcomes:**

After the successful completion of the practical, the learner will be able to:

1. Develop the practical skills in physics.
2. Use various apparatus effectively
3. Correlate physics theory concepts through practical.
4. Apply the concept of errors.

**Core Course I**

1. Laser Divergence
2. LDR characteristics
3. Spectrometer (determination of refractive index μ of material of prism)
4. Combination of lenses
5. Surface Tension of Biological Fluid
6. Viscosity by Stoke's Method
7. Frequency of AC mains

| Core Course II |
| --- |
| 1. Use of CRO<br>2. I-V Characteristics of LED<br>3. Norton's Theorem<br>4. LCR Series Resonance<br>5. EX OR gate – half adder<br>6. Implementation of Boolean expression<br>7. Photo Electric Effect |
| Minimum of 8 experiments from both the Courses should be completed in first semester. Minimum four demonstration experiments are to be reported in journal. Certified journal is must to be eligible to appear for the semester end practical examination. |

## 8. Teaching learning process

The pedagogic methods adopted involve direct lectures, tutorial discussions, as well as technology- supported presentations. We believe that education is interactive and all sessions between Learners and teachers are based upon reciprocity and respect.

1) The lectures (of fifty minutes duration) delivered to one whole class at a time systematically deal with the themes of the syllabus. This constitutes the core of the teaching - learning process. The learners are provided with bibliographic references and encouraged to go through at least some readings so that they could be more interactive and ask more relevant questions in the class. This also helps obtain knowledge beyond the boundaries of the syllabi.

2) Wherever needed, teachers use audio-video based technology devices (e.g. power point, YouTube videos, simulators) to make their presentations more effective. Some courses require that Learners see a documentary or feature film and course themes are structured so that discussions of these will further nuance the critical engagement of learners with ideas introduced in their textual materials.

3) Remedial coaching, bridge courses are adopted to enhance the scope of learning for the learners. Remedial sessions are conducted to offer assistance on certain advanced topics. Bridge courses facilitate to develop a concrete basis for the topics to be learnt in the coming academic year.

## 9. Assessment Methods

### Evaluation Pattern: Theory

- Assessments are divided into two parts: Continuous Internal Assessment (CIA) and Semester End Examination.
- The Semester End Examination shall be conducted by the College at the end of each semester.
- Semester End Examination (external) (60 M)- Duration:2 hours Paper Pattern.

| Question No | Module | Marks with Option | Marks without Option |
|---|---|---|---|
| 1 | I | A) 7 M x 3 Q = 21 M<br>B) 3 M x 3 Q = 09 M | A) 7 M x 2 Q = 14 M<br>B) 3 M x 2 Q = 06 M |
| 2 | II | A) 7 M x 3 Q = 21 M<br>B) 3 M x 3 Q = 09 M | A) 7 M x 2 Q = 14 M<br>B) 3 M x 2 Q = 06 M |
| 3 | III | A) 7 M x 3 Q = 21 M<br>B) 3 M x 3 Q = 09 M | A) 7 M x 2 Q = 14 M<br>B) 3 M x 2 Q = 06 M |

- For Internal Evaluation (40 M)

i. Continuous evaluation 25 M

ii. Workshop/Project/Industrial Visit/ Excursion/ Seminar/ Assignment/ Research paper review 15 M

Or

i. Project (40 M)

**Evaluation pattern: Practical**

- Semester-end evaluation: 30 Marks practical examination for each Course at the end of semester.
- Continuous internal evaluation 20 marks as per the following rubrics

| Journal | Quiz | Total |
|---|---|---|
| 10 M | 10 M | 20 M |

## 10. Program and Course Code Format

The course is coded according to following criteria:

1. First two numbers in each course code indicates year of implementation of syllabus (21- year of implementation is 2021-22)
2. Third letter 'U' designates undergraduate
3. Fourth letter 'S' designate Science discipline and the digit followed is for semester number (S1 – 1st Semester)
4. Letter 'PH' is for Physics discipline (PH - Physics)
   This forms the programme code 21USPH.
5. To designate the semester, add the digit (1-6) after S in the programme code. (Eg: 21US1PH- for semester I)
6. To represent core courses (CC) followed by course number digit (1/2/3/4) and three lettered code representing the title of the course.
7. Ability enhancement course code, (AE) alphabets followed by a digit (1/2) followed by 'FOC'- Foundation course, 'BCE'-Basic communication in English, 'EVS'-Environmental science are used
8. For Skill enhancement courses code (SE) followed by digits (1/2/3) followed by letters 'STP'-Sports training program, 'ICH'-Indian cultural heritage, followed by digits (1/2/3) representing the levels are used. In case of subject related SEC, (SE) followed by digits (1/2/3) followed by a three lettered code representing the title of the course are used.

9. For Discipline specific elective course (DS) of Semester V and VI, (DS) followed by digits (1/2/3/4) followed by a three lettered code representing the title of the course are used.
10. 'P' followed by digit indicates practical course number. (Practical course number will be added for semesters only where there is more than one course.