K.R. MANGALAM UNIVERSITY
THE COMPLETE WORLD OF EDUCATION

SCHOOL OF BASIC AND APPLIED SCIENCES

Bachelor of Science (Honours) Physics

B.Sc. (Hons.) Physics

Programme Code-09

2019-22

Approved in the 20th Meeting of Academic Council Held on 16 July 2019

Academic Council
Member Secretary
K.R. Mangalam University

Registrar
K.R. Mangalam University
Sohna Road, Gurugram, (Haryana)

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Content

1. Introduction

The K.R. Mangalam Group has made a name for itself in the field of education. Over a period of time, the various educational entities of the group have converged into a fully functional corporate academy. Resources at KRM have been continuously upgraded to optimize opportunities for the students. Our students are groomed in a truly inter-disciplinary environment wherein they develop integrative skills through interaction with students from engineering, management, journalism and media study streams.

The K.R. Mangalam story goes back to the chain of schools that offered an alternative option of world-class education, pitching itself against the established elite schools, which had enjoyed a position of monopoly till then. Having blazed a new trail in school education, the focus of the group was aimed at higher education. With the mushrooming of institutions of Higher Education in the National Capital Region, the university considered it very important that students take informed decisions and pursue career objectives in an institution, where the concept of education has evolved as a natural process.

K.R. Mangalam University was founded in the year 2013 by Mangalam Edu Gate, a company incorporated under Section 25 of the Companies Act, 1956.

K. R. Mangalam University is unique because of its

i. Enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.
ii. Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

Objectives

i. To impart undergraduate, post-graduate and Doctoral education in identified areas of higher education.
ii. To undertake research programmes with industrial interface.
iii. To integrate its growth with the global needs and expectations of the major stake holders through teaching, research, exchange & collaborative programmes with foreign, Indian Universities/Institutions and MNCs.
iv. To act as a nodal center for transfer of technology to the industry.
v. To provide job oriented professional education to the pecia student community with particular focus on Haryana.

2. About School

The school imparts out both teaching and research through its various science disciplines viz Mathematics, Chemistry and Physics.

School of Basic and Applied Sciences imparts students technical knowledge, enhances their skill and ability, motivating them to think creatively, helping them to act independently and take decisions accordingly in all their scientific pursuits and other endeavors. It strives to empower its students and faculty members to contribute to the development of society and Nation.

The faculty is in constant touch with various experts in the relevant field and is willing to experiment with latest ideas in teaching and research.

The school comprises of Discipline of Chemistry, Physics and Mathematics.

3. Programmes offered by the School

School offers undergraduate B.Sc. (Hons) Programmes and postgraduate M.Sc. Programmes. All these programmes are designed by choice-based credit system (CBCS) scheme to impart scientific knowledge to the students and will provide theoretical as well as practical training in their respective fields.

3.1 B.Sc. (Hons.) Physics

Physics, as a stream of study, helps in understanding fundamentals and develop curiosity in understanding various physical aspects of universe. This course aims to impart basic and applied knowledge in physics with a view to produce good academicians, researchers and professionals in varied fields.

Eligibility Criteria: - The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board in Science stream with an aggregate of 50% or more.

Course Outline: - Mathematical Physics / Mechanics / Electricity & Magnetism/Waves & Optics / Thermal Physics / Digital Systems & Applications/Elements of Modern Physics/Analog Systems & Applications/Quantum Mechanics & Applications / Electromagnetic Theory / Statistical Mechanics/ Solid State physics / Elementary Nuclear Physics/ Elementary Particle Physics/Applied Optics.

Career Options: - Opportunities exist in academics, research laboratories and administration besides all the opportunities applicable to any other graduate like UPSC examination's, defence services and other govt. jobs.

Programme scheme: - For Programme scheme see Annexure.

Objective and Expected Outcome:

The main objective of the course is to create consciousness among the students with the idea about healthy and safe environment. This course is aimed to explain students that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels. These changes need discussion, concern and recognition at national and international level with respect to formulate protection acts and sustainable developments policies. It can be possible only if every citizen of the nation is environmentally educated and gets involved into this matter at the grass root level to mitigate pollution.

After studying the course, the learners will be able to comprehend and become responsive regarding environmental issues. They will acquire the techniques to protect our mother earth, as without a clean, healthy, aesthetically beautiful, safe and secure environment no specie can survive and sustain. This is the only inheritance which every genera of specie passes to their future generation.

Programme scheme: - For Programme scheme see Annexure.

4. Programme Duration

The minimum period required for the B.Sc. (Hons.) Programme offered by the University shall extend over a period of three Academic Years.

The maximum period for the completion of the B.Sc. (Hons) Programme offered by the University shall be five years.

5. Class Timings

The classes will held from Monday to Friday from 09:10 am to 04:10 pm.

6. Syllabi

The syllabi of all courses for B.Sc. (H) Physics programme offered by SBAS are given in the following pages. These are arranged as: (a) common courses (b) degree specific courses, in numeric order of the last three digits of the course code.

For each course, the first line contains; Course Code and Credits (C) of the course. This is followed by the course objectives, syllabus (Unit I to IV), Text book and reference books.

6.1 Syllabi of Common Courses in all B.Sc. (Hons.) Programme

BSCH125A ENVIRONMENTAL STUDIES (Credits 3)

Overview:

Everything that surrounds and affects living organisms is the environment. The environment includes all those things on which we are directly or indirectly dependent for our survival, whether it is living or biotic components like animals, plants or non-living or abiotic components like soil, air and water etc. It belongs to all, influences all and is important to all.

Environmental Protection Act (1986) defined "Environment as the sum total of water, air and land, their interrelationship among themselves and with the human beings, other living organisms and materials." Environmental studies are important since it deals with the most mundane problems of life like hygienic living conditions, safe and clean drinking water, fresh air, healthy food and sustainable development.

The syllabus for Environmental Studies includes conventional classroom teaching as well as field work. In this course the teacher simply acts as a catalyst to infer what the student observes or discovers in his/her own environment. Involvement of students in project work is one of the most effective learning tools for environmental issues. This syllabus is beyond the scope of textbook teaching and also the realm of real learning by observing the surroundings. The content of this course provides an overview of introduction to environment, concept of an ecosystem, various renewable and non-renewable resources, how are various biodiversity occur and different means to conserve these. This course also includes various types of pollution and environmental policies & practices related with environs. Finally, it also highlights the relationship of human population with the environment.

The course further integrates to project work such as visit to an area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds, and study of simple ecosystems. These studies are as imperative as it forms a unique synergistic tool for comprehensive learning process. This will help students to recognize and appreciate how technological advancement at global level, exponential growth of human population and their unlimited demands has put the environment at stake and has contaminated the environment worldwide.

Objective and expected Outcome:

The main objective of the course is to create consciousness among the students with the idea about a healthy and safe environment. This course is aimed to explain students that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels. These changes need discussion, concern and recognition at national and international level with respect to formulate protection acts and sustainable developments policies. It can be possible only if every citizen of the nation is environmentally educated and gets involved in this matter at the grass root level to mitigate pollution.

After studying the course, the learners will be able to comprehend and become responsive regarding environmental issues. They will acquire the techniques to protect our mother earth, as without a clean, healthy, aesthetically beautiful, safe and secure environment no species can survive and sustain. This is the only inheritance which every genera of species passes to their future generation.

BSCS102A INFORMATION TECHNOLOGY FUNDAMENTALS (Credits 4)

Overview:

Computing and programming is essential to leverage the technical skills of a student. These techniques equip the students with know-how of the latest technologies and reduce considerable time spent in solving problems. Success in college and beyond requires computer and information literacy's that are flexible enough to change with a changing IT environment and adaptable to new problems and tasks. The purpose of the information technology requirement is to ensure that students achieve an essential understanding of information technology infrastructure encompassing systems and devices; and become more sophisticated technology users and consumers.

Objectives and Expected Outcome:

The main objective is to introduce IT in a simple language to all undergraduate students, regardless of their specialization. It will help them to pursue specialized programs leading to technical and professional careers and certifications in the IT industry. The focus of the subject is on introducing skills relating to IT basics, computer applications, programming, interactive media, Internet basics, etc.The aims is to: 1. Understand basic functions of computer software components including operating system functions; 2. Develop a critical attitude to gathering, processing and evaluating information; 3. Develop a broad understanding of hardware, software, networks, databases and information systems and their uses; 4. Sensitise students to the use of Information Technology in conducting and living their daily lives; 5. Develop an awareness of the power and pitfalls of Information Technology.

OPEN ELECTIVE COURSE I:

IIIT101A HARNESSING THE POWER OF THE WEB AS A KNOWLEDGE DEVICE

(Credits 4)

Overview:

This course will give the learner an understanding of internet as a medium of learning. The "Internet" is a gigantic library where information about almost any subject is available in depth and up to date. Through this program the student learns to appreciate the richness of the Web and the Internet and gets an understanding to make clear what is reality and what is false propaganda and uses his/her own intelligence or mind to investigate further.

The Internet has been incredibly useful as a learning medium as it facilitates both information and communication. The Internet has increased the accessibility of education at all levels and has turned out to be a giant repository of knowledge as it is not only a great place to gather and store information but also allows its easy retrieval whenever desired. In fact, it has turned out to be better than libraries when it comes to gathering information and doing research work.

The Internet expeditiously entered the life of humankind in the 20th century. Less than a decade back we did not know much about the modern Internet and imagined its facilities and our life with it. In a few years now it has become not only the hugest information resource in the world. The Internet provides unique learning opportunities as the very idea behind the invention of internet was education.

Today we live in an information society where knowledge has great value and knowledge can be manifested through qualification. All the countries are using high-end technology which needs highly qualified specialists. The Web can be very effective in promoting this process.

The most important thing is the ability to work with information because it demands a student's ability to use different kinds of intellectual skills. It means that a student should be able to analyze the information he deals with, to select the facts and data adequate to the problem he investigates.

The information the student comes across on the Internet is not always helpful. The Internet is a very democratic environment where every user can locate his/her information. A lot of educational materials do not undergo any examination. Besides, we should keep in mind that reading electronic texts on the net is not like reading printed texts.

For effective education mere access to Internet information resources is not enough. It is necessary to prepare the students beforehand to work with information. The goal of this program is to develop critical thinking of student so that he or she can use internet for effective learning.

Objective and Expected Outcome:

The usage of the information resources located in the Internet is not such a simple affair. It requires not only the ability to search for it in the huge ocean of the Internet, but to process it, to use it effectively for the cognitive goals. Through this course the student will develop skills to use search engines effectively for learning and research.

The growth of the Internet has provided many opportunities people in different ways. Students consider the use of the Internet is mainly for information, social and entertainment purposes but the Internet provides huge academic and scientific information as well which makes it as a tool to learn. It provides asynchronous education to student, as they are passionate internet lovers and prefer to use web for information.

The course equips the student to find information on web and use critically and creatively, to become collaborative and cooperative workers and to solve problems

BSEL101A COMMUNICATION SKILLS (Credits 5)

Overview:

The world is shrinking into a global village and therefore, communication skills in English have emerged as a major means of empowerment and human resource development. Many professionals fail to make an impact on the global market as they lack the required communicative competence. The course with its practice-based learning tasks will facilitate the learners to enhance their communication skills in a modern and globalized context. It will enhance the linguistic and communicative competence of the learners and hone their interpersonal skills. This course will augment comprehension skills, enhance vocabulary, acquire impressive writing skills, correspond with others effectively, understand the non-verbal cues and enhance skills in spoken English through a variety of teaching techniques. The course will be instrumental in acquiring proficiency both in spoken and oral language.

Objective and Expected Outcome:

The course will help the learners to focus on communication activities in functional and situational contexts as well as enhance the four language skills of reading, writing, listening and speaking through real-life and professional situations. It will build confidence among the students and encourage them to speak fluently. Through practical learning and delivery, the learners will be able to identify their areas of strengths and weaknesses and improvise their personality and soft skills. The learners will be able to strengthen and broaden their communication skills through various insightful ways.

OPEN ELECTIVE COURSE II:

IIIT104A UNDERSTANDING THE POWER OF DATA (Credits-4)

Overview:

This course is designed to provide students with hands-on experience for gaining an understanding of numbers and data for building models.

Why data is so important in our life? Many of us are knowingly or unknowingly using it but are unknown about the fact. Such as “I sleep for about 8 hours a day.”, “I usually drive at 50 km/hr.”, “If I start early then the chances that I will pass in the exam are higher.” or “Which political party will win next assembly elections?” These are nothing but statistical in nature. We are constantly gathering, organizing and analyzing information, and using it to make judgments and decisions that affect our actions.

This course aims to enable students to figure out and solve problems on their own and use technology efficiently. The activities are designed to encourage students to take accountability for their own learning. The skills the students acquire during the course are necessary for the needs and challenges of the country.

Objective and Expected Outcome:

This course encourages students to blend theoretical and practical knowledge, and transfer it into practice. The themes on which the course is based are –

- Interesting properties of prime numbers without proofs
- Analysis of data for simple quantitative inference
- Correlate real-world observations with theoretical knowledge
- Compute and validate probabilities
- Use of spreadsheets and R for practical work
- Statistical analysis of the stock market, weather, and daily life data.

Data can be used to describe situations or events. For instance, a manufacturer might want to know something about the consumers who will be purchasing his product so he can plan an effective marketing strategy. In another situation, a buyer might survey before purchasing a product. For example, when we purchase a cell phone we look at various features and specifications provided by different companies. Further, trends in the market can be analyzed, enabling prospective buyers to make more intelligent decisions. These examples illustrate a few situations where collecting and analyzing data will help students make better decisions.

The course is about exercising the brain and learning new ideas, not to just mimic steps, procedures, and formulas. The students are expected to acquire the ability to overcome obstacles and keep trying until they reach a goal.

6.2 Syllabi of Common Courses in B.Sc. (Hons.) Physics and Mathematics OPEN ELECTIVE COURSE I:

BSCH110A FUNDAMENTALS OF CHEMISTRY & WATER PROCESSES (Credits 4)

Overview:

This course inculcates the thought process of basic understanding of chemistry for the students of Mathematics and Physics background. It is a mandatory requirement to include chemistry in their course curriculum, which would helpful in their future education. All the higher education and professional context depends on basic sciences, which can relate the theories or concepts based on chemistry. Our daily life processes have an intense relation with chemistry. So, there is a need of an hour to provide exposure of basic chemistry to the students.

Objective and Expected Outcome:

This course will enable the students to appreciate the developments in the field of chemical bonding with respect to Valence Bond theory and Molecular orbital theory. Students can relate these theories with structure and shapes of various homonuclear and heteronuclear molecules. This syllabus is mixture of all types of chemistry. In this course the students can understand basic concepts involved in organic reactions and appreciate the concept of geometric and optical isomerism. Water technology is a part of this course, which provides the complete processes of water quality analysis, hardness determination, softening and disinfection of water.

The outcome of this course enables the students for the analysis of the structure, composition of organic compounds, their orientation and optical activity of compounds. After studying this course students are also capable to determine water quality.

6.3 Syllabi of Courses specific to B.Sc. (Hons.) Physics

BSPH131A MATHEMATICAL PHYSICS-I (Credits 6)

Overview:

Differential equations are an important mathematical tool which can be used to describe many applications to everyday life and technology. Differential equations can be used to model various problems from population dynamics to quantum mechanics. Knowledge of Vectors and Orthogonal Curvilinear coordinates systems is also very important for solving many problems in Physics. Uncertainty and randomness occur in many aspects of our daily life and having a good knowledge of probability helps us make sense of these uncertainties. This course aims to develop the basics of modeling of real life problems using these mathematical tools.This course covers basics of vectors, vector differentiation and integration, orthogonal curvilinear coordinate systems, differential equations and probability theory.

Objective and Expected Outcome:

Students will be able to identify the difference between order/degree, linear/non linear, ordinary/ partial, homogeneous/non homogeneous nature of differential equations. They will learn various methods and techniques for solving differential equations such as separation of variable, Integrating factor method, Variation of parameters and D operator method etc. Apart from this, they will be able to apply differential equations to model various problems in Physics for example electrical circuits, radioactive decay, simple harmonic motion, bending of beams, wave propagation etc. Students will also get acquainted with Vector Calculus (Dot product, cross product, vector differentiation, Integration, Stoke's theorem and Gauss Divergence theorem), Orthogonal Curvilinear coordinates system and probability theory.

BSPH132A ELECTRICITY AND MAGNETISM (Credits 6)

Overview:

The course gives an overview and understanding of basic physics, with moderate use of mathematical formalism. Topics include concepts in electricity and magnetism together with their relationship to practical applications.

The major concepts covered are: - The abstraction from forces to fields using the examples of the electric and magnetic fields, with some applications vis-a-vis the connection between conservative forces and potential energy, how charges move through electric circuits, the close connection between electricity and magnetism, leading to the discovery of electromagnetic waves. - the integral form of Maxwell's Equations etc.

Objective and Expected Outcome:

The objective of the course is to develop a basic understanding of electric and magnetic fields in free space: definitions, units, laws and rules as well as interesting things connected with discoveries and discoverers of crucial phenomena.

After completion of this course, students will:

- Apply knowledge of electricity and magnetism to explain natural physical processes and

  related technological advances.
- Use an understanding of calculus along with physical principles to effectively solve problems encountered in everyday life, further study in science, and in the professional world.
- The student can solve problems with moderate mathematical complexity related to electric and magnetic force and field, electric charge, electric potential, current, voltage and resistance, capacitors, electromagnetic waves, reflection, refraction, interference and diffraction.
- Design experiments and acquire data in order to explore physical principles, effectively communicate results, and critically evaluate related scientific studies.
- Assess the contributions of physics to our evolving understanding of global change and sustainability while placing the development of physics in its historical and cultural context.

BSPH134A WAVES AND OPTICS (Credits 6)

Overview:

The physics and mathematics of wave motion underlies many important phenomena. The water wave on the sea, the vibration of a violin string, and the quantum mechanical wave associated with an electron can all be described in a similar way. Light too, often displays properties that are wave-like. We will start the course looking at "ray" optics, but then pause for a general treatment of waves of all types. We will start this waves section by reviewing ideas of oscillations and simple harmonic motion and go on to look at the physics of travelling and standing waves i.e. wave motion. We will apply these ideas to various types of wave and see how all-pervading this topic is in physics. Optics is the study of light and its uses. Light has long captured the fascination of humankind like Why should light bend upon entering water? Why does light spread out after passing through a narrow gap? How does light travel to us from the sun, through the void of space? These sorts of questions have ensured that optics has a long and engaging history. Soin this lecture course we will look at basic ideas of light propagation, interference and diffraction of light, Polarization, and some of the many uses to which light is put.

Objective and Expected Outcome:

Students will acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature. After the completion of course students will be able to identify and illustrate physical concepts and terminology used in optics and to be able to explain them in appropriate detail. They will be able to apply their knowledge to make approximate judgements about optical and other wave phenomena when necessary.

They can acquire skills allowing them to organize and plan simpler laboratory course experiments and to prepare an associated oral and written report.

BSPH133A MECHANICS (Credits 6)

Overview:

Every motion, either linear or rotational is governed by certain laws. Mechanics deals with these laws and formulates them in a scientific manner. Linear motion is a translational motion in a straight line. The concept of *'force'* is fully explained by Newton through his laws of motion. Force is responsible for linear acceleration while torque for angular acceleration. The basic ideas of state of rest and uniform motion were studied by various philosophers. According to Aristotle (384-322 BC), a constant force has to be applied on a body so as to keep it in motion with constant velocity. Later on, Galileo (1564-1642 AD) stated that no force is required for a body to move with uniform velocity. Newton (1642-1727 AD) was the first person who formulated the laws differentiating *'state of rest'* and *'state of uniform motion'*. Newton's notion of space as *'Absolute space'*, isotropic nature for rotational invariance and homogeneity for translational invariance led to understand the laws of motion in inertial frame of reference. Any accelerated frame of reference is a non-inertial frame.

This course is especially appropriate for students planning to specialize in physical science or engineering. The course explores topics such as kinematics; Newton's laws of motion; work, energy and power; systems of particles and linear momentum; circular motion and rotation; and oscillations and gravitation. Introductory differential and integral calculus is used throughout the course.

Objective and Expected Outcome:

Students will be able to articulate and describe relative motion, inertial and non-inertial reference frames, and parameters defining the motion of mechanical systems and their degrees of freedom, study of the interaction of forces between solids in mechanical systems, Centre of mass and inertia tensor of mechanical systems, application of the vector theorems of mechanics and interpretation of their results, Newton's laws of motion and conservation principles, introduction to analytical mechanics as a systematic tool for problem solving, use of mechanical simulation software.

On successful completion of this course, students are expected to be able to interpret and solve problems based on the laws of mechanics and force and equilibrium concepts, perform calculations related to mass moment of inertia, evaluate forces of friction and the principles of rigid body dynamics.

BSPH231A MATHEMATICAL PHYSICS-II (Credits 6)

Overview:

Fourier series is just a means to represent a periodic signal as an infinite sum of sine wave components. A periodic signal is just a signal that repeats its pattern at some period. The primary reason that we use Fourier series is that we can better analyze a signal in another domain rather in the original domain. Fourier series is an expression for a non-sinusoidal periodic function into a fundamental and its harmonics. By Fourier series we can expand continuous and discontinuous both types of functions under certain conditions. The Fourier Series is really interesting, as it uses many of the mathematical techniques that you have learned before, like graphs, integration, differentiation, summation notation, trigonometry, etc.

The Frobenius method enables one to create a power series solution to such a differential equation, provided that p(z) and q(z) are themselves analytic at 0 or, being analytic elsewhere, both their limits at 0 exist (and are finite).

In theory of errors students can get knowledge of different types of errors like absolute, relative, percentage, inherent, rounding off, truncation errors etc.

Objective and Expected Outcome:

Discontinuous function can be represented by Fourier series. It is useful in expanding the periodic functions. Expansion of an oscillating function by Fourier series gives all modes of oscillation (fundamental and all overtones) which is extremely useful in physics. Basic idea of Fourier series is to project periodic signals onto a set of basis functions. The basis functions are orthogonal and span the space of periodic functions. Any periodic signal can be written as a weighted sum of these basis functions.

The Frobenius series is used when we want to solve some differential equations which have regular singular point(s). If we want to have a power series solution about an ordinary point of the differential equation, then Frobenius method is not needed.

BSPH233A THERMAL PHYSICS (Credits 6)

Overview:

This course gives an overview and understanding of the laws and methods of thermodynamics and explores their various applications. Many of these applications will relate to topics in materials science and condensed matter physics. The three laws of classical thermodynamics, which deal with the existence of state functions for energy and entropy, and the value of entropy at the absolute zero of temperature, are developed along phenomenological lines; the existence and properties of the entropy; different thermodynamic potentials and their uses.

This subject will give an insight into the behavior of ideal gases by applying various thermodynamic relations and kinetic theory of gases, behavior of real gases and deviation from ideal gas equation. These equations will be applied to study a range of practical phenomenon.

Objective and Expected Outcome:

The objective of this course is to introduce the basic concepts of thermodynamics, such as laws of thermodynamics, work, heat, temperature, internal energy, entropy, and thermodynamic potentials. Applications of thermodynamic concepts to topics such as heat engines, the expansion of gases and changes of phase are considered.
Upon completion of this course, it is intended that a student will be able to:

- State in precise terms the foundational principles of thermodynamics and how they relate to broader physical principles.
- Use the laws of thermodynamics to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines.
- Understand the meaning and significance of state variables in general, and of the variables P; V; T; U; S in particular, especially in the context of a simple fluid, and to manipulate these variables to solve a variety of thermodynamic problems.
- Understand the efficiency and properties of thermodynamic cycles for heat engines, refrigerators and heat pumps.
- Define the enthalpy H, Helmholtz function F and the Gibbs function G and state their roles in determining equilibrium under different constraints.
- Manipulate (using suitable results from the theory of functions of many variables) a

variety of thermodynamic derivatives, including a number of 'material properties' such as heat capacity, thermal expansivity and compressibility, and solve problems in which such derivatives appear.

- Sketch the phase diagram of a simple substance in various representations and understand the concept of an 'equation of state' (as exemplified by the van der Waals' equation for a fluid) and the basic thermodynamics of phase transitions.

BSPH235A DIGITAL SYSTEMS AND APPLICATIONS (Credits 6)

Overview:

We are living in the digital world, everything is being digitized. Digital systems have their own advantages over analog systems. Digital circuits are the basic blocks of modern electronic devices like mobile phones, digital cameras, microprocessors and several other devices. This course aims to familiarize students with digital logic and its applications in real world. This course will emphasize on techniques for converting an analog signal into a digital signal, introduction of various number system (Binary, Octal, Hexadecimal etc.), fundamentals of digital circuits, design of combinational and sequential circuits).

Objective and Expected Outcome:

Students will learn basic concepts of digital circuits and systems which lead to design of Integrated Circuits. On successful completion of this course, students are expected to understand basic differences between analog and digital systems, how to convert an analog signal into a digital system, how to use digital logic gates to make simple digital circuits, use of Boolean Algebra for function minimization. They will be able to design various combinational and sequential circuits such as adder, subtractor, registers, timers and counters which are further used in making other complex digital circuits such as computer microprocessor and memories.

DISCIPLINE ELECTIVE COURSE I: From the following courses choose only one course.

BSPH237A EXPERIMENTAL TECHNIQUES (Credits 6)

Overview:

Physicists can be divided into two main disciplines, Experimental Physics, concerned with the observation and study of physical phenomena and conducting experiments; and Theoretical Physics, which uses mathematical models and simulations to understand, explain, and predict natural phenomena.

This course is designed to aid students in the development of core practical skills in physics. Students will be required to conduct a series of experiments exploring fundamental concepts in mechanics, electricity & magnetism, thermal physics, as well as the experimental basis of quantum physics. There will be a strong emphasis on data and error analysis with a variety of software applications.

Experimental physics regroups all the disciplines of physics that are concerned with data acquisition, data–acquisition methods, and the detailed conceptualization (beyond simple thought experiments) and realization of laboratory experiments. It is often put in contrast with theoretical physics, which is more concerned with predicting and explaining the physical behavior of nature than the acquisition of knowledge about it.

Although experimental and theoretical physics are concerned with different aspects of nature, they both share the same goal of understanding it and have a symbiotic relation. The former provides data about the universe, which can then be analyzed to be understood, while the latter provides explanations for the data and thus offers insight on how to better acquire data and on how to set up experiments. Theoretical physics can also offer insight on what data is needed in order to gain a better understanding of the universe, and on what experiments to devise in order to obtain it.

Objective and Expected Outcome:

Experimental physics uses two main methods of experimental research, controlled experiments, and natural experiments. Natural experiments are used, for example, in astrophysics when observing celestial objects where control of the variables in effect is impossible.

The goal of the experimental physics is to provide the student with a broad understanding of the physical principles of the universe, to help them develop critical thinking and quantitative reasoning skills, to empower them to think creatively and critically about scientific problems and experiments, and to provide training.

Our students become confident and versatile problem-solvers who use physical intuition together with analytic and quantitative skills to study, model, and understand the world around us. They develop laboratory skills throughout our curriculum via hands-on experiences with diverse experimental techniques and tools. They learn various approaches to data analysis and become comfortable using computational methods to analyze and solve problems. Our students develop a solid grasp of core concepts and applications of classical mechanics, electricity and magnetism, quantum mechanics, and statistical physics.

They learn how physics and other disciplines have impacted and continue to impact each other and society.Our students become effective, clear communicators in written and oral work, capable of explaining complex quantitative issues in broadly accessible terms. Upon completing the physics major, our students are well prepared for graduate study in physics and related fields, and some follow that path. Our students' long-term professional pursuits are quite varied, but many are drawn to careers that require scientific or technical expertise or strong quantitative reasoning abilities.

BSPH239A ATMOSPHERIC PHYSICS (Credits 6)

Overview:

Motion of atmosphere causes winds. Winds and precipitation are important components for weather and climate. Extreme weather events directly affect human life and economy. This course serves to introduce fundamental physical principles upon which the atmospheric sciences are based and to provide an elementary description and interpretation of the wide range of atmospheric phenomena. Atmospheric physics is related with atmospheric structure and composition, the transfer of different waves through the atmosphere, the physical processes involved in the formation of clouds and precipitation etc.

Objective and Expected Outcome:

Understanding atmospheric physics is essential for understanding climate variability and prediction. After completing the course the candidate will gain competence in determining if the atmosphere is stable or unstable from a vertical temperature profile, creation of precipitation and different aspects of wind motion in the atmosphere. They will be introduced to the effect of aerosols and clouds on the solar radiation in the atmosphere causing halos, rainbows and various thermo dynamical concepts for the atmosphere. In addition to this, they will be exposed to the signal detection processes using Radar and Lidar.

BSPH232 MATHEMATICAL PHYSICS-III (Credits 6)

Overview:

Complex analysis is the branch of mathematics investigating holomorphic functions, i.e. functions which are defined in some region of the complex plane, take complex values, and are differentiable as complex functions. Analytic function is a function that is locally given by a convergent power series. There exist both real analytic functions and complex analytic functions, categories that are similar in some ways, but different in others.
Integral transform maps an equation from its original domain into another domain where it might be manipulated and solved much more easily than in the original domain. The solution is then mapped back to the original domain using the inverse of the integral transform. The Laplace transform has a number of properties that make it useful for analyzing linear dynamical systems. The transform turns integral equations and differential equations to polynomial equations, which are much easier to solve. Once solved, use of the inverse Laplace transform reverts to the time domain.

Objective and Expected Outcome:

Upon successful completion, students will have the knowledge and skills to:

- Explain the fundamental concepts of complex analysis and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of complex analysis techniques.
- Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from complex analysis.
- Apply problem-solving using complex analysis techniques applied to diverse situations in physics, engineering and other mathematical contexts.

Students will be able to:

- Find the Laplace transform of a function by definition and by use of a table.
- Find the inverse Laplace transform of a function.
- Write piecewise functions using the unit step function.
- Find transforms using the first and second translation theorems.
- Find the convolution of two functions and the transform of a convolution.
- Find the transforms of derivatives and integrals.
- Find the transform of a periodic function.
- Solve a basic integration & differential equation using the Laplace transform.
- Solve linear differential equations with constant coefficients and unit step input functions using the Laplace transform.

BSPH234A ELEMENTS OF MODERN PHYSICS (Credits 6)

Overview:

Modern" physics means physics based on the two major breakthroughs of the early twentieth century: relativity and quantum mechanics. Physics based on what was known before then. This course traces in some detail just how the new ideas developed. We examine the experimental and theoretical paradoxes that forced thinking out of the traditional path. So in this lecture course we will look at basic ideas on Relativity, with an emphasis on dynamics, Quantum mechanics, Applications of quantum mechanics to atomic physics, Radio activity, Fission and Fusion.

Objective and Expected Outcome:

Students will be introduced the basic physics concepts in the special theory of relativity and quantum mechanics. They will understand the fundamental principles and laws of relativistic and quantum physics. They will be introduced elements of atomic, nuclear, solid-state, and particle physics. After the completion of course students should be able to explain the concepts, principles, and measurement in the theory of relativity, use the physics laws and advanced mathematical tools to determine the dynamics of physical bodies at different scales. They will be able to illustrate how observation, experiment, and theory work together to continue to expand the frontiers of knowledge of the physical Universe.

BSPH236A ANALOG SYSTEMS AND APPLICATIONS (Credits 6)

Overview:

The analog nature of electronic signals is of importance as the real world is analog, Our world is analog and requires us to deal with ever varying physical phenomena (light, sound, touch, taste etc.) Analog systems have many applications in real world such as amplifiers, sensors, voltage regulators, power supplies, oscillators, image processing etc. This course deals with basics of analog components such as semiconductor diodes, transistors, power amplifiers, operational amplifiers etc. and their various applications.

Objective and Expected Outcome:

Students will learn basic concepts of junction diode, their types and various applications. They should be able to demonstrate use of pn junction diode as wave shaping/clipping circuits in computers, radios, radars etc., as switches in digital logic designs, as clamping circuits in TV receivers as well as voltage multipliers, and as rectifiers in DC power supply manufacturing. They should understand the working of Zener diode and its application in voltage regulation, LED, photodiode and solar cell. After successful completion of this course, students will be able to understand basic design of amplifiers and oscillators using bipolar junction transistor and feedback. They will be able to design simple circuits such as adder, subtractor, differentiator, integrator, Log Amplifier, Zero Crossing detector, Wien Bridge Oscillator using Operational Amplifier.

DISCIPLINE ELECTIVE COURSE II: From the following courses choose only one course.

BSPH238A SOLID WASTE MANAGEMENT (Credits 6)

Overview:

Solid waste is any discarded or abandoned solid or semi-solid, non-soluble material of domestic, industrial, or commercial origin. Proper management of the disposed material reduces the impacts on health and environment, by properly disposing of polluting elements and by recovering utilizable resources from the solid waste.

Households, schools, hospitals, hotels, markets, shops, offices - everywhere we go we use, consume, or exploit something, which afterwards leaves waste remnants. Thing about all the waste just one individual is responsible for producing a day; a package, a peel, paper, cartons and bottles - all the little things we handle and eventually dispose of on a daily basis. One would be astonished by the amount of trash that we all produce.

Solid waste management is a term that is used to refer to the process of collecting and treating solid wastes. It also offers solutions for recycling items that do not belong to garbage or trash. As long as people have been living in settlements and residential areas, garbage or solid waste has been an issue.

Objective and Expected Outcome:

The objective of Solid Waste Management is to implement integrated solid waste management in ways that are protective to human health and the environment. Recycling the waste that cannot be used and recovery of resources. Residue disposed of in an environmentally sound way.

The student should be able to:

• Define solid waste, garbage, and rubbish (or trash). Distinguish between aerobic and anaerobic processes; combustion and pyrolysis

• Give the approximate percentages of agricultural, mining, and urban wastes as part of the entire solid waste problem.

• Give the approximate percentages of the components of urban solid wastes and discuss why these percentages vary with season, location, etc. What, if any, shifts have been observed over the last 10, 20, or 30 years.

• Distinguish between total and net waste generation (or disposal).

• Explain the basis for the waste strategy hierarchy; waste reduction (prevention), reuse, recycling, incineration with waste heat recovery, and sanitary landfill. Especially explain why waste reduction is so much better than recycling; also explain how previous steps in the process affect later steps.

• List and discuss at least 4 or 5 methods of waste prevention (minimization).

• Define compost and list its attributes and the critical parameters for its formation.

• Discuss collection and separation of wastes. Explain the role of psychology and economics in recycling; also discuss different strategies for collecting and dealing with recyclables and other wastes.

• Discuss different methods that can be used to separate and process wastes and the applicability of them. Discuss air and water classifiers and their use in solid waste management. Discuss MRF's and methods used with them.

• Discuss the purpose and operation of the basic parts of an incinerator including refuse pit, loading cranes or chutes, grates, boilers, and air pollution controls.

• Discuss the pollution problems with bottom ash, flyash, dioxins, and furans; i.e. their sources and controls for them.

• Discuss heat content of wastes and compare them with fuels such as coal and petroleum.

• Discuss methods of waste heat recovery, particularly generation of steam heat and use of RDF. Give advantages and disadvantages associated with them.

• Discuss how a sanitary landfill differs from an open dump or refuse fill. Discuss in detail cells, covers, liners, leachate, and gas formation together with appropriate siting and monitoring.

• Explain how thermodynamics can be used to conduct life cycle analyses and assessments. Give and discuss the thermodynamic property R.S. Berry used for his analyses and why he used it. Explain in reasonable detail the conclusions he reached from his study of the auto. Define his waste factor and its interesting relationship to manufacturing processes.

• Explain the results of applying this type of analysis to beverage containers and the potential flaws in such an analysis.

• Explain the difference between a closed and open earth and its relationship to concepts of solid waste management (and the Law of Conservation of Matter).

• Define home, prompt industrial and obsolete scrap. Explain some of the problems with scrap and recycling. Discuss some of the discrimination encountered by the scrap industry.

BSPH240A COMMUNICATION SYSTEM (Credits 6)

Overview:

The communication that occurs in our day-to-day life is in the form of signals. These signals, such as sound signals, generally, are analog in nature. When the communication needs to be established over a distance, then the analog signals are sent through wire, using different techniques for effective transmission. This conventional Analog communication suffers from many losses such as distortion, interference, and other losses including security breach. In order to overcome these problems, the signals are digitized using different techniques. The digitized signals allow the communication to be more clear and accurate without losses.

This course gives an in-depth knowledge of modulation techniques used for both analog as well as digital communication system for example techniques of transmitting and receiving information signals using analog carrier modulation techniques (AM, FM, PM) and digital techniques (ASK, FSK, PSK, BPSK). Apart from this, it also covers satellite communication and Mobile communication technology and recent trends adopted in cellular systems and wireless standards.

Objective and Expected Outcome:

The students are expected to describe and analyze the techniques of generation, transmission and reception of amplitude modulation (AM), frequency modulation (FM) and phase modulation (PM) signals. They should be able to demonstrate conversion of analog signals to digital format using sampling and quantization techniques along with digital modulation techniques (Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK). They will be able to describe and analyze the methods of satellite and mobile communication. They will get to know some of the upcoming technologies like Multiuser-communication technologies.

BSPH331A QUANTUM MECHANICS AND APPLICATIONS (Credits 6)

Overview:

All the matters in the world are made up of small kinds of particle known as atoms. The study of such small and minute particles underlies and illuminates so many aspects of physics, chemistry, and modern technology. This course gives an elementary introduction to quantum physics, starting with a description of the experiments and ideas that led to the theory of quantum mechanics such as black-body radiation, the photoelectric effect, and Compton scattering. From this starting-point, the concept of wave particle duality is introduced, followed by the wave function, its probability interpretation and the Schrödinger equation. The course then discusses the use of these solutions to calculate their time evolution, associated probabilities, expectation values, and uncertainties, as well as give concise physical interpretations.

Objective & Learning outcome:

This science determines to explain the properties of molecules, atoms and their constituents i.e. electrons, protons, and neutrons. It emphasizes on the interaction of particles with one another and with electromagnetic radiation. After completing this course, student will be familiar with the main aspects of the historical development of quantum mechanics and be able to discuss and interpret experiments that reveal the wave properties of matter. They will be able to establish the mathematical properties of the waves that describe free particles. Understanding the basic postulates will help them formalize the rules of quantum mechanics on the physical systems. They will be equipped to solve the Schrödinger equation on simple systems in one to three dimensions such as tunneling, step and barrier potentials, harmonic oscillator.

BSPH333A SOLID STATE PHYSICS (Credits 6)

Overview:

In the universe, matter is observable in everyday life in four states: solid, liquid, gas and plasma. There are other states of matter known to exist only under extreme situations. Matter, whatever the states, is made of atoms. The states are defined in terms of interatomic distance, atomic arrangement and atomic ionization in matter. In solid state of matter, the arrangement of atoms forms different structures of materials. The structure of materials is the key deciding factor for different kind of properties, such as thermal, electrical, optical, magnetic, dielectric etc. In this course we will learn the structure of solid materials and their different physical properties along with underlying physics.

Objective and Expected Outcome:

Students will get the basic understanding of symmetry, electronic and thermodynamic properties of solid state systems and their technological applications. They will to describe basic experimental measurements, to show typical data sets and to compare these with theory. After the completion of the course students should be able to explain the basic concepts that are used to describe the structure and physical properties of crystalline substances. They will be able to explain the fundamental concepts of solid state physics such as what types of matter exist and the methods available to determine their structure and properties. They will understand the magnetic and optical properties of condensed matter. They will formulate the theory of lattice vibrations (phonons) and use that to determine thermal properties of solids.

BSPH335A STATISTICAL MECHANICS (Credits 6)

Overview:

Thermodynamics and Statistical Physics is a professional basic course for physics. It is a theoretical course to study the thermal phenomena and the laws of thermal motion of macroscopic systems composed of a large number of microscopic particles. Thermodynamics is based on basic laws obtained from a large number of experimental results, and research on the macroscopic properties of the object and the thermal phenomena by strict logical reasoning and mathematical operation, so its results are universal and reliable, but can't derive specific characteristics of concrete material.

Statistical physics starts from the microscopic structure of material, to consider the thermal motion of microscopic particles, and by the statistical average method to study the thermal properties of macroscopic objects and the laws related to the thermal phenomena. It can reveal the characteristic of concrete material, but the reliability depends on the assumption of microstructure.

The tasks of the two research ways are the same, and they are complementary to each other, although the research methods are different. Through the study of this course, students should master the basic concepts, basic principles and basic methods of thermodynamics and statistical physics. Thermodynamics and statistical physics is the most widely used course, and we hope students achieve the goal of applying what they have learned.

Objective and Expected Outcome:

To acquire working knowledge of the zero-th and first law of thermodynamics outcomes are:

• Student recognizes the difference between temperature and heat.

• Student can apply the equipartition theorem and counts correctly the number of degrees of freedom of a thermodynamical system.

• Student identifies the relationship and correct usage of infinitesinal work, work, energy, heat capacity, specific heat, latent heat, and enthalpy.

• Student uses some empirical equations of state to compute the final state of thermodynamical systems such as the ideal gas, the two-level paramagnet, the Einstein solid.

To acquire working knowledge of the second law of thermodynamics outcomes are:

• Student can compute entropy by counting the number of allowed states for simple systems such as the ideal gas (Sakur-Tetrode equation), the Einstein solid, and the two- level paramagnet.

• Student identifies the role of the small fluctuations due to unaccounted terms in the Hamiltonian.

• Student can relate to each other the different statements of the second law of thermodynamics.

• Student uses the thermodynamical identity to derive the Maxwell relations. To apply the laws of thermodynamics outcomes are:

• Student can compute the value of selected thermodynamical variables at thermal, mechanical, and/or diffusive equilibrium.

• Student can compute the ef iciency of idealized engines such as the Carnot cycle, the Otto cycle, and the Diessel cycle.

• Student takes advantage of the Helmholtz free energy and the Gibbs free energy for calculations regarding the available work and/or phase transformations.

• Student can give a quantitative description of the phase transformation of pure substances.

• Student can give a qualitative description of the phase transformation of mixtures.

To link thermodynamics to the micro description used in classical Statistical Mechanics outcomes are:

• Student can recover the laws of thermodynamics and the equipartition theorem from the statistical description using microstates.

• Student uses the partition function for calculations about the canonical ensemble.

• Student uses the appropriate normalization for the Boltzmann factor and the appropriate degeneracies and densities of states.

To introduce advanced topics related to Quantum Statistical Mechanics outcomes are:

• Student uses either Fermi-Dirac or Bose-Einstein statistics according to the spin of the particles.

• Student gets acquainted with advanced topics such as the Fermi energy of a system of noninteracting Fermions and its relation to the chemical potential.

• Student can derive Planck's law of blackbody radiation.

BSPH337A ELEMENTARY NUCLEAR PHYSICS (Credits 6)

Overview:

Nuclear Physics originated with Geiger and Marsden bombarding alpha particles on metal foils including gold. This course is extremely important in developing experimental techniques to probe at the subatomic level and also studying theoretical models to understand the vigorous activities going on inside a nucleus. It will give an introductory but still rigorous description of both experimental and theoretical aspects of the present understanding of nuclei and their interaction, different nuclear models and radioactive decay. Moreover, the course also provides the introduction to how radioactive substances and the physical properties of the atomic nucleus are used in medicine, both for diagnostics and therapy.

Objective & Learning outcomes:

The course gives thorough theoretical and experimental knowledge on atomic nucleus. After passing the course the student should be able to apply the models describing the basic nucleon and nuclear properties, explain the different forms of radioactivity and interaction of ionising radiation with matter. They will be introduced to the kinematics of various reactions and the conservation laws driving them. In addition to this, they will be able to account for the fission and fusion processes, and the basic properties of the nuclear and fusion reactors. They will also be exposed to the study of the effects of radioactivity on biological matter.

DISCIPLINE ELECTIVE COURSE III: From the following courses choose only one course.

BSPH339A PHYSICS OF THE EARTH (Credits 6)

Overview:

The subject presents the holistic understanding of our dynamic planet through fundamental geophysical methods and an introduction to the general characteristics and origin of universe. The course also provides a comprehensive view of the earth's structure and different factors disturbing the dynamic planet by covering the effect on atmosphere, hydrosphere, geosphere and biosphere. It also emphasizes the interpretation and understanding of different dynamic processes like sea floor spreading, continental drifts, earthquakes and volcanoes.

Objectives and Learning outcome:

The subject presents the investigation of the Earth's inner structure, and an introduction to understanding various dynamic processes occurring on it. At the end of this course, student should have a broad, comprehensive overview of the physical processes operating in the solid Earth and its core. They will be able to explain the generation of earthquakes and their distribution on the Earth, and how they are related to global tectonic processes. In addition to this, they will be familiar with the effect of greenhouse gas emissions, nuclear waste, and human population growth on earth.

BSPH341A NATURAL HAZARDS DISASTER MANAGEMENT (Credits 6)

Overview:

A natural hazard is a natural phenomenon that might have a negative effect on humans or the environment. Natural hazard events can be classified into two broad categories: geophysical and biological. Geophysical hazards encompass geological and meteorological phenomena such as earthquakes, volcanic eruptions, wildfires, cyclonic storms, floods, droughts, avalanches and landslides. Biological hazards can refer to a diverse array of disease, infection, infestation and invasive species.

Many geophysical hazards are related; for example, submarine earthquakes can cause tsunamis, and hurricanes can lead to coastal flooding and erosion. Floods and wildfires can result from a combination of geological, hydrological, and climatic factors. It is possible that some natural hazards are intertemporally correlated as well. An example of the distinction between a natural hazard and a natural disaster is that the 1906 San Francisco earthquake was a disaster, whereas living on a fault line is a hazard. Some natural hazards can be provoked or affected by anthropogenic processes (e.g. land-use change, drainage and construction).

Objective and Expected Outcome:

The broad objectives of the Natural Hazards Disaster Management are: Improve the understanding of disaster risk, hazards, and vulnerabilities. To prevent disasters and achieve substantial reduction of disaster risk and losses in lives, livelihoods, health, and assets (economic, physical, social, cultural and environmental).

Disaster plan is systematic procedures that clearly detail what needs to be done, how, when, and by whom before and after the time an anticipated disastrous event occurs. The part dealing with the first and immediate response to the event is called emergency plan.

Learning outcomes of Natural Hazards Disaster Management are:

• Capacity to integrate knowledge and to analyse, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.

• Capacity to describe, analyse and evaluate the environmental, social, cultural, economic, legal and organisational aspects influencing vulnerabilities and capacities to face disasters.

• Capacity to work theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery) and relate their interconnections, particularly in the field of the Public Health aspects of the disasters.

• Capacity to manage the Public Health aspects of the disasters.

• Capacity to obtain, analyse, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios with the ability to clearly present and discuss their conclusions and the knowledge and arguments behind them.

• Capacity to design and perform research on the different aspects of the emergencies and disaster events while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.

• Capacity to analyse and evaluate research work on the field of emergencies and disaster while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.

BSPH332A ELECTROMAGNETIC THEORY (Credits 6)

Physicists believe that the Universe contains 24 elementary particles which interact with each other via four fundamental forces. Each of the four forces is transmitted by quantum carriers which are themselves elementary particles.

Elementary-particle physics deals with the fundamental constituents of matter and their interactions. In the past several decades an enormous amount of experimental information has been accumulated, and many patterns and systematic features have been observed. Highly successful mathematical theories of the electromagnetic, weak, and strong interactions have been devised and tested. These theories, which are collectively known as the standard model, are almost certainly the correct description of Nature, to first approximation, down to a distance scale 1/1000th the size of the atomic nucleus. There are also speculative but encouraging developments in the attempt to unify these interactions into a simple underlying framework, and even to incorporate quantum gravity in a parameter-free "theory of everything." In this article we shall attempt to highlight the ways in which information has been organized, and to sketch the outlines of the standard model and its possible extensions.

All elementary particles are either bosons or fermions (depending on their spin). The spin-statistics theorem identifies the resulting quantum statistics that differentiates fermions from bosons. According to this methodology: particles normally associated with matter are fermions, having half-integer spin; they are divided into 12 flavors. Particles associated with fundamental forces are bosons, having integer spin.

Fermions:

Quarks—up, down, charm, strange, top, bottom

Leptons—electron neutrino, electron, muon neutrino, muon, tauon neutrino, tauon Bosons:

Gauge bosons—gluon, W and Z bosons, photon Other bosons—Higgs boson, graviton

Objective and Expected Outcome:

In elementary particle physics you will learn how cutting-edge research is trying to answer the big questions about our universe. In addition you will learn how new ideas find their way from fundamental research to specific applications that have practical value.

You will have the possibility to be part of a research project which may include everything from development and construction of experimental equipment, signal processing and data analysis, computational simulations, theoretical modelling and interpretation all the way to the publication of scientific results. Depending on the project, you can be part of this entire research process or only parts of it.

The focus of the UG project can be on work in the laboratory, analysis of experimental data, theoretical calculations, computational simulations, or a combination of those tasks. Through your UG project you will learn to collaborate with others in an international team, take responsibility for your own project, and present scientific results both in writing and orally.

BSPH336A APPLIED OPTICS (Credits 6)

Overview:

Far from being just an "old" subject, optics is becoming increasingly important as more and more use is being made of lasers and optoelectronics in industry and society. This course is intended for students who need to understand the basic principles of how lasers work and their main properties. This course provides the students a thorough understanding of the fundamentals of lasers: their unique properties, their operations and their applications. It will equip the students with the knowledge of how a coherent light is generated and amplified, the techniques behind different lasers' design, and applications of lasers in spectroscopy, chemistry, medicine, biology, military and other areas.

Objective and Expected Outcome:

Students will understand the basic laws and phenomena in the area of Optoelectronics and Lasers. They will be introduced and demonstrate a range of optical instruments and techniques including geometrical and physical optics, thin film devices, optical fibers, detectors, interferometry and holography. After the completion of the course students should be able to explain fundamental physical principles of optics, optical phenomena and optical equipment and the technical base of Optoelectronic systems. Students will be able to describe basic laws and phenomena that define behavior of optoelectronic systems, use optical fiber equipment, and data transfer using optical fiber. They can conduct experiments and measurements in the laboratory and on real components, devices and equipment of optoelectronic systems.

BSPH338A DISSERTATION (Credits 6)

Overview:

The process of having to describe your study in detail, in a logical sequence of written words, will inevitably highlight where more thought is needed, and it may lead to new insight into connections, implications, rationale, relevance, and may lead to new ideas for further research.

Objective and Expected Outcome:

• Know the concept, scope of research.

• Enable the students to gain knowledge on particular areas of research.

• Understand the scientific methods to study region.

• Analyze the practical knowledge of research and apply the subject matter knowledge in the field.

• Learn the art of reporting.

• Able to educate the technical skill of writing.

• Demonstrate an ability to present and defend their research work to a panel of experts.

DISCIPLINE ELECTIVE COURSE IV: From the following courses choose only one course.

BSPH340A NANO MATERIALS AND APPLICATIONS (Credits 6)

Overview:

They have been used for fields like electronic and chemistry so they can't be considered as a new material. Two dimensional materials like tubes and wires are the other type of applications of nanotechnology. Nanowires are ultrafine wires or linear arrays of dots that are formed by self- assembly.

Nanotechnology is helping to considerably improve, even revolutionize, many technology and industry sectors: information technology, homeland security, medicine, transportation, energy, food safety, and environmental science, among many others.

Objective and Expected Outcome:

• Cosmetics application of nanoparticle (e.g sunscreen lotions: ray absorb properties)

• Nanocomposite materials: nanoparticle silicate nanolayer (clay nanocomposites) and nanotubes can be used as reinforzed filler not only to increase mechanical properties of nanocomposites but also to impart new properties (optical, electronic etc.).

• Nanocoatings: surface coating with nanometre thickness of nanomaterial can be used to improve properties like wear and scratch-resistant, optoelectonics, hydrophobic properties.

• Hard cutting tools: current cutting tools (e.g mill machine tools) are made using a sort of metal nanocomposites such as tungsten carbide, tantalum carbide and titanium carbide that have more wear and erosion-resistant, and last longer than their conventional (large- grained) materials.

• More performed paint using nanoparticles to improve paint properties.

• Fuel cells: could use nano-engineered membranes to catalytic processes for improve efficiency of small-scale fuel cells.

• Displays: new class of display using carbon nanotubes as emission device for the next generation of monitor and television (FED field-emission displays).

• Using nanotechnology-based knowledge may be produce more efficient, lightweight, high-energy density batteries.

• Nanoparticles can be used as fuel additivities and catalytic more efficient materials.

• Nanospheres in lubrificants technology like a sort of nano balls bearing Nanoscale magnetic materials in data storage device. Nanostructured membranes for water purification.

BSPH342A EMBEDDED SYSTEMS (Credits 6)
INTRODUCTION TO MICROCONTROLLERS

Overview:

There are many applications of embedded systems in our real life for several devices like microwave, calculators, TV remote control, home security and neighborhood traffic control systems, etc. This course will introduce the students to the fundamental requirements of embedded systems and the interaction between hardware and software in such systems. Microcontroller is the heart of an embedded system. To design any embedded system, knowledge of microcontroller working, basic architecture and programming should be known to students. This course aims to introduce students to the world of microprocessors and microcontrollers, 8051 Microcontroller, Arduino, microcontroller programming and various other components of an embedded system.

Objective and Expected Outcome:

On successful completion of this course, students are expected to do interfacing of various devices/peripherals such as LCD, LED, seven segments display, dc motor, various sensors etc. with microcontrollers. Apart from hardware part, students will also learn to control their device using software part (programming). They will get to learn and use softwares like AVR studio and Proteus.

Students will be able to design embedded systems for example traffic light controller, dc motor speed control, LCD Display etc. After acquiring the knowledge of hardware and software part, students will be able to think and work towards design of Robotos and other advanced embedded systems related to real life problems.

ANNEXURE (According to Choice Based Credit System)

SBAS SCHEME OF STUDIES (YEAR 2019 - 2022) B.SC.(H) PHYSICS

	ODD SEMESTER				EVEN SEMESTER			
YEAR	**SN**	**COURSE CODE**	**COURSE TITLE**	**C**	**SN**	**COURSE CODE**	**COURSE TITLE**	**C**
FIRST	1	BSPH131A	MATHEMATICAL PHYSICS-I	6	1	BSPH132A	ELECTRICITY AND MAGNETISM	6
	2	BSPH133A	MECHANICS	6	2	BSPH134A	WAVES AND OPTICS	6
	3	BSCH125A	ENVIRONMENTAL STUDIES	3	3	BSEL101A	COMMUNICATION SKILLS	5
	4	BSCS102A	INFORMATION TECHNOLOGY FUNDAMENTALS	4	4		OPEN ELECTIVE COURSE II	4
	5		OPEN ELECTIVE COURSE I	4				
	TOTAL			**23**	**TOTAL**			**21**
SECOND	1	BSPH231A	MATHEMATICAL PHYSICS-II	6	1	BSPH232A	MATHEMATICAL PHYSICS-III	6
	2	BSPH233A	THERMAL PHYSICS	6	2	BSPH234A	ELEMENTS OF MODERN PHYSICS	6
	3	BSPH235A	DIGITAL SYSTEMS AND APPLICATIONS	6	3	BSPH236A	ANALOG SYSTEMS AND APPLICATIONS	6
	4		DISCIPLINE ELECTIVE I	6	4		DISCIPLINE ELECTIVE II	6
	TOTAL			**24**	**TOTAL**			**24**

THIRD							
1	BSPH331A	QUANTUM MECHANICS AND APPLICATIONS	6	1	BSPH332A	ELECTROMAGNETIC THEORY	6
2	BSPH333A	SOLID STATE PHYSICS	6	2	BSPH334A	ELEMENTARY PARTICLE PHYSICS	6
3	BSPH335A	STATISTICAL MECHANICS	6	3	BSPH336A	APPLIED OPTICS	6
4	BSPH337A	ELEMENTARY NUCLEAR PHYSICS	6	4	BSPH338A	DISSERTATION	6
		DISCIPLINE ELECTIVE III	6			DISCIPLINE ELECTIVE IV	6
TOTAL			**30**	**TOTAL**			**30**
Electives (Choose any one from each)							
Open Elective Course I				**Open Elective Course II**			
1	BSCH110A	FUNDAMENTALS OF CHEMISTRY & WATER PROCESSES	4	**1**	BSCH207A	TECHNICAL INTERFACE OF CHEMISTRY	4
2	IIIT101A	HARNESSING THE POWER OF WEB AS A KNOWLEDGE DEVICE	4	**2**	IIIT104A	UNDERSTANDING THE POWER OF DATA	4

Discipline Elective Course I				Discipline Elective Course II			
1	BSPH237A	EXPERIMENTAL TECHNIQUES	6	**1**	BSPH238A	SOLID WASTE MANAGEMENT	6
2	BSPH239A	ATMOSPHERIC PHYSICS	6	**2**	BSPH240A	COMMUNICATION SYSTEM	6
Discipline Elective Course III				**Discipline Elective Course IV**			
1	BSPH339A	PHYSICS OF THE EARTH	6	**1**	BSPH340A	NANO MATERIALS AND APPLICATIONS	6
2	BSPH341A	NATURAL HAZARDS DISASTER MANAGEMENT	6	**2**	BSPH342A	EMBEDDED SYSTEMS INTRODUCTION TO MICROCONTROLLER	6
Total Credits [C]		**152**					

Student can choose two non-credit courses (2 hours per week), one in odd semester and one in even semester during the entire duration of Programme from the pool of courses provided by the university.