Department of Applied Physics

Delhi Technological University, Delhi-42

Programme: **B.Tech. (Engineering Physics)**

Course Outcomes

I[st] Semester

Subject Code & Course Title: AP 101/ Physics -I	
AP101.1	Apply knowledge of the physics to general real-world situations.
AP101.2	Demonstrate a rigorous analysis of the core theories and principles of physics, which include mechanics, optics, and quantum mechanics.
AP101.3	Outline the applications of physics in industry and the role of physicists as entrepreneurs.
AP101.4	Conduct physics experiments in the laboratory as a team with full efficiency and integrity.
AP101.5	Analyse the impact of physics on society and humanity at large.

2[nd] Semester

Subject Code & Course Title: CO102 /Programming Fundamentals	
CO102.1	The ability to apply the concepts of engineering i.e. collecting data, organize the data in the systematic form , arrange the data in a computational way and this the way in applying mathematics
CO102.2	Identify situations where computational methods and computers would be useful.
CO102.3	Explain the difference between call by value and call by address.
CO102.4	Design programs connecting decision structures, loops and functions.
CO102.5	Approach the programming tasks using techniques learned and write pseudo code.
CO102.6	Program with pointers and arrays, perform pointer arithmetic, and use the preprocessor
CO102.7	Develop effective programs in C language.

Details of Course

Course Title	Course Structure			Pre-Requisite
Fundamentals of Electrodynamics -B.Tech. EP II Sem Lesson Plan	**L**	**T**	**P**	
	3	**1**	**0**	

Course Objectives

This course aims to impart basic knowledge to students regarding electrostatic and magnetostatic fields and its applications. To understand the Maxwell's equations and its solution to the problem related to wave propagation and Transmission lines. To develop understanding of various types of antenna radiation mechanism.

Course Outcomes (CO)

1. To understand basic concept of fields.
2. Knowledge of physical interpretation and ability to solve the problem by applying fundamental laws.
3. Describe Maxwell's equations and its physical consequences for different parameters.
4. To understand the basic mathematical concepts related to Electromagnetic vector fields.
5. To learn about Transmission Lines and their application in EM wave propagation. Also, to analyse radiation patterns for various types of reflectors.

Details of Course:

Course Title/Computational Methods **EP-102**	**Course Structure**			**Pre-requisites**
	L	**T**	**P**	
Physics	03	01	00	Nil

Course Objective: This course is designed for the second semester (first year) students of the B. Tech. (Engineering Physics). This course is offer to familiarize the students with the numerical techniques to solve the problems related to science and engineering.

Course Outcomes (COs):

CO1	To develop the ability to approximate the complex problem into well-known numerical form
CO2	To develop the ability to analyse the variety of errors involved in the problem solving process in order to realize the accuracy of complex solutions
CO3	To apply the problem solving skill to implement the various numerical algorithms for linear and non-linear equations, data prediction using interpolation and approximation
CO4	To solve the complicated numerical differentiation, integration and differential equations using numerical methods related to multi-disciplinary complex problems
CO5	To use the achieved knowledge of this course to design and solve the minor project related activities

3rd Semester

Course Title	Course Structure			Pre-Requisite
	L	T	P	
Quantum Mechanics -B.Tech. EP III Sem Lesson Plan	3	1	0	

Course Objectives

This course focusses on developing the understanding of basic principles of quantum mechanics and their applications to some standard physical systems. The students will be equipped with necessary tools to explain, analyse, and predict a variety of quantum phenomena.

Course Outcomes (CO)

6. To understand the need of Quantum Mechanics.
7. To apply the key concepts and principles of quantum physics and solve the Schrödinger equation for standard systems.
8. To relate the matrix formalism to the use of basis states, and solve simple problems in that formalism.
9. To analyse the theory of angular momentum through some selected problems in quantum mechanics.
10. To apply the approximation techniques to find the solution of some typical quantum mechanical systems.

Details of Course

Course Title	Course Structure			Pre-Requisite
	L	T	P	
Introduction to Computing	3	0	2	

-B.Tech. EP III Sem Lesson Plan		

Course Objectives

This course is designed for the third semester (second year) students of the B. Tech. (Engineering Physics). This course offers to familiarize the students with the widely used software Matlab so that they can develop the skill to solve the problem related to applied physics and engineering using Matlab

Course Outcomes (CO)

The students should be able:

1. to develop the ability of the handling the matrix and array operation in order to solve multifaceted problems
2. to design solutions for the complex problem related to engineering sciences using various types of inbuilt functions and user defined functions
3. to efficiently perform data analysis which is exceedingly applicable in various branches of science and engineering
4. to develop the problem analysing skills and to design the algorithms for the solution of complex problems of applied physics and engineering
5. to use the gained knowledge of this course to design the minor-research project related activities

Details of Course

Course Title	**Course Structure**			**Pre-Requisite**
Mathematical Physics -B.Tech. EP 3rd Sem Lesson Plan	**L**	**T**	**P**	Basic knowledge of Vector analysis, Differentiation, Integration and ordinary differential equations (linear algebra)
	3	**1**	**0**	

Course Objective:
To develop student's facility with certain mathematical techniques and to highlight applications of mathematical methods to physical systems

Course Outcomes (CO)

Students will be able to

1. Demonstrate the basics and applications of vector and tensor analysis to solve suitable engineering problems.
2. Understand the basic concepts in complex algebra and solve the problems by applying the various theorems in Complex Analysis**.**
3. Acquire knowledge to derive solutions for various types of partial differential equations and apply these methods to design some experiments related to engineering sciences and technology.
4. Demonstrate the Fourier series to study the behaviour of periodic functions and their applications in Engineering Physics.
5. Apply gained knowledge and skills to carry out advanced tasks and projects, which are useful to contribute to the innovation and application of basic research.

Details of Course

Course Title	Course Structure			Pre-Requisite
Classical Mechanics -B.Tech. EP III Sem Lesson Plan	**L**	**T**	**P**	
	3	**1**	**0**	

Course Objectives

This course is designed to provide students with a foundational understanding of Lagrangian and Hamiltonian canonical equations of motion and their applications to solve some complex mechanical problems. Students will acquire a fundamental grasp of central forces, Kepler's problem, and orbit equations in this course. Overall students will demonstrate proficiency in classical mechanics and effectively apply their knowledge to analyse various physical phenomena.

Course Outcomes (CO)

1. To understand fundamental concept of Newtonian mechanics.
2. Apply classical mechanics equations to solving practical problems.
3. Ability to use the Lagrange and Hamilton equations to solve complex mechanical problems.
4. To Grasp the basic concepts of frame of references and related problems, including the analysis of scattering in laboratory and centre of mass frames.
5. To analyse rigid body dynamics and explore their applications in various contexts.

Details of Course

Course Title	Course Structure			Pre-Requisite
Digital and Analog Electronics -B.Tech. EP III Sem Lesson Plan	**L**	**T**	**P**	
	3	**1**	**0**	

Course Objectives

This course aims to develop the basic understanding of analog circuits which are in line with the day today electronic systems and real time applications. 2. Further, the digital circuits which constitute the base for advanced systems are also covered in this paper. Thus, this course exposes students to understanding of i) various fundamental electronic devices, components and basic circuits. ii) varied digital circuitry and their operation

Course Outcomes (CO)

1. To define the basic concepts and characteristics of various semiconductor devices.
2. To analyze various rectifiers, amplifiers and configurations of analog circuits.
3. To recall basic concepts of boolean algebra, logic gates and logic families.
4. To classify and categorize different semiconductor memories and converters.
5. To analyze and design various combinational and sequential circuits and also implement the circuits using VHDL systems to solve real life problems.

4th Semester

Details of Course

Course Title	Course Structure			Pre-Requisite
Thermal Physics -B.Tech. EP III Semester Lesson Plan	**L**	**T**	**P**	**None**
	3	**1**	**0**	

Course Objectives

This course aims to familiarize the students with laws of thermodynamics and its applications and apply them to various engineering problems. The student will learn the fundamental principles of thermodynamics and its properties by demonstrating the ability to simplify and model real systems and to explain, analyse, and predict a variety of natural phenomena.

Course Outcomes (CO)

By the end of this program, students should have the following knowledge, skills and values:

1. Would be able to explain basic principle and laws of thermodynamics, thermodynamic description of systems and thermodynamic potentials
2. Derive thermodynamic parameters and apply fundamental laws to solve thermodynamic problems
3. Understanding the fundamental concept of heat, temperature, entropy and free energies
4. Devise and implement a systematic strategy for solving a complex problem in thermodynamics by breaking it down into its constituent parts and apply a wide range of mathematical techniques to build up its solution.

Details of Course

Course Title	Course Structure	Pre-Requisite

Artificial Intelligence for Material Science-B.Tech. EP IV Sem Lesson Plan	**L** / **3**	**T** / **0**	**P** / **2**	Students should have a foundational knowledge of programming and statistics.

Course Objectives

This course introduces AI and ML techniques and their applications in materials science. It covers the fundamentals of AI and ML, including supervised, unsupervised, and reinforcement learning, and explores their use in predicting material properties, discovering new materials, and optimizing materials for specific applications. The course includes a lab component where students will work on projects using AI tools and datasets to solve real-world materials science problems.

Course Outcomes (CO)

1. To understand the basic principles and algorithms of AI and ML.
2. To analyse different databases for material science applications.
3. To Apply AI and ML techniques to solve problems in materials science.
4. To evaluate the effectiveness of various AI models.
5. To use AI tools and software for materials design and analysis.

Details of Course

Course Title	**Course Structure**			**Pre-Requisite**
Microprocessors Architecture and Programming -B.Tech. EP IV Sem Lesson Plan	**L**	**T**	**P**	
	3	**1**	**0**	

Course Objectives

This course aims to familiarize the students with the concept of Microprocessors, memory organization, addressing modes and programing; to understand the interfacing of peripheral devices with microprocessor; and to analyse the programming of microcontrollers.

Course Outcomes (CO)

1. Recall and apply a basic concept of digital fundamentals to Microprocessor based personal computer system.
2. Design and develop 8086 Microprocessor based systems for real time applications using low level language like assembly language program.
3. Familiarise the architecture and operation of Programmable Interface Devices and realize the programming & interfacing of it with 8086 microprocessor.
4. Interface various peripheral IC's with 8086 microprocessor for its various applications
5. Analyze the architecture, operation and programming of Microcontrollers.

Details of Course

Course Title	Course Structure			Pre-Requisite
Communication System- B. Tech. EP (4th Sem Lesson Plan)	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objectives

This course aims to impart basic knowledge to students regarding communication systems and its applications. To understand the modulation techniques and signal processing methods and their solution to the problem related to real-world transmission challenges. To develop an understanding of various types of modern communication and basic understanding of satellite communication also.

Course Outcomes (COs)

1. Understanding the fundamental principles and concepts of communication systems.
2. Learning various modulation techniques and signal processing methods.
3. Exploring the design and analysis of communication networks and protocols.
4. Gaining practical skills in the implementation and troubleshooting of communication systems.
5. Developing critical thinking and problem-solving abilities to address real-world communication challenges.

Details of Course

Course Title	Course Structure			Pre-Requisite
Condensed Matter Physics - B.Tech. (EP), 4th Sem Lesson Plan	**L**	**T**	**P**	**NIL**
	3	**0**	**2**	

Course Objective:
The course provides a valuable theoretical introduction, principles, techniques and an overview of the fundamental applications of the physics of solids/materials.

Course Outcomes (CO)

Students will be able to

1. Understand the significance and value of condensed matter physics scientifically and the underlying physics of solid-state materials
2. Enable students with knowledge of lattices and describe the crystallographic structural properties of materials and their analysis for engineering and technological applications.

3. Describe various electronic theories of the electronic structure of materials with the knowledge of energy band structures of solids.
4. Equip the students with fundamentals, theory and analysis of dielectric and magnetic materials in engineering and technology for social applications.
5. Impart theoretical knowledge, principles and applications of advanced materials in science, engineering and technology, which are useful to contribute for materials innovation.

5th Semester

Subject Code & Course Title: EP 301/Semiconductor Devices	
EP301.1	To calculate carrier concentration and fermi level position in semiconductors using quantum theory and Fermi-Dirac distribution function.
EP301.2	How to design a PN Junction, which play a vital role in transport phenomenon of semiconductor and in designing the semiconductor chips.
EP301.3	How to design Bipolar Junction Transistors (BJT) and Field Effect Transistors FET) useful in designing the semiconductor chips playing a vital role in science and technology.
EP301.4	How to fabricate Metal Oxide Semiconductor Field Effect Transistor (MOSFET) and Hetero Junction FETs having certain superior characteristic features over FET in fabricating semiconducting chip technology.
EP301.5	How optoelectronic devices are useful in converting one form of energy into another.

Subject Code & Course Title: EP 303/Electromagnetic Theory, Antennas and Propagation	
EP303.1	Formulate potential problems within electrostatics, magneto statics and stationary current distributions in linear, isotropic media, and also solve such problems in simple geometries using separation of variables and the method of images
EP303.2	Use the concept of impedance matching in transmission lines and its significance. Use the smith chart as a graphical tool to solve impedance matching issues.
EP303.3	Analyse electromagnetic wave propagation in guiding structures under various matching conditions.
EP303.4	Analyse the concept of radiation through mathematical formulation. Analyse the radiation mechanism of antenna. Measure the antenna parameters.
EP303.5	Demonstrate the knowledge of antenna in communication system. Ability to discriminate between antennas on the basis of their performance.

6th Semester

Subject Code & Course Title: EP 302/Fiber Optics and Optical Communication

EP302.1	To analyse essentials of an optical fibre communication system and the factors leading to signal degradation in optical fibres leading to the design of low loss optical fibres.
EP302.2	To identify and evaluate the performance various components of an optical fibre communication system.
EP302.3	To engineer the design parameters of low loss fibres in the optical communication window.
EP302.4	To efficiently perform the characterization of the optical fibres which are exceedingly applicable in optical engineering.
EP302.5	To use the gained knowledge of this course to design the minor-research project related activities.

Subject Code & Course Title: EP 304/ Fabrication and Characterization of Nanostructures	
EP304.1	To describe fundamentals of nanoscience and apply it to solve complex engineering problems at the nanoscale domain.
EP304.2	To justify and formulate literature review, analyse scientific information.
EP304.3	To analyse different synthesis route for the nanostructures keeping in mind limitations and use it to design systems for the benefits of society, environment and contribute towards sustainable development.
EP304.4	To apply different characterization techniques and draw valid conclusions from the collected data.
EP304.5	To design and manage projects in multidisciplinary fields with new novel ideas

Subject Code & Course Title: EP 306/ Microwave Engineering	
EP306.1	Recognize the limitations of existing vacuum tubes and solid state devices at microwave frequencies.
EP306.2	Analyse the performance of specialized microwave tubes such as klystron, reflex klystron, magnetron and travelling wave tube.
EP306.3	Design impedance matching network for any transmission line or system.
EP306.4	Analyse and find applications and limitations of microwave semiconductor devices
EP306.5	Demonstrate a concept for microwave devices, this will be helpful for boosting industrial, Research and Development activities in telecommunications and other microwave specific areas.

Subject Code & Course Title: HU 302/Engineering Economics

HU302.1	Apply economic techniques on solving engineering problems by evaluating the economic theories, cost concepts and pricing policies, describe the market structures and integration concepts.
HU302.2	Analyse the measures of national income, the functions of banks and concepts of globalization.
HU302.3	Assess the impact of inflation, taxation, depreciation. Financial planning, economic basis for replacement, project scheduling, and legal and regulatory issues are introduced and applied to economic investment and project-management problems.
HU302.4	Analyse methods and tools for Project Management and apply economic analysis of an investment and employ concepts such as cash flows, interests' rates, evaluation criteria, like Simple Payback Period, Rate on Return.
HU302.5	Net Present Value, Break Even Analysis, all these, with special application on the design and operation of engineering projects.

7th Semester

Subject Code & Course Title: EP 401/ B.Tech. Project-I	
EP401.1	Identify of scientific preferably a research problem of interest.
EP401.2	Demonstrate knowledge and understanding of the engineering and scientific principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
EP401.3	Technical report writing
EP401.4	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations

Subject Code & Course Title:	
EP403.1	Identification of real world problems
EP403.2	Awareness of current trends in specific area of interest
EP403.3	To enhance their leadership and participation abilities
EP403.4	Report Writing

Subject Code & Course Title: EP 405/ VLSI and FPGA Design

EP405.1	Identify the various types of MOSFETs.
EP405.2	Derive the expressions for gain, driving current and other electrical parameters associated to the MOSFETs.
EP405.3	Ability to identify faults in the VLSI chips using various techniques.
EP405.4	Analyse and differentiate the different memories: SRAM and DRAM; Floating Gate EEPROM and Flash Memories
EP405.5	Conceptual knowledge of modelling a digital system using hardware description Language on FPGA.

Subject Code & Course Title: EP 407/ Mobile and Satellite Communication	
EP407.1	Provide knowledge of digital wireless communications system and compare the core differences between traditional and new communication technologies.
EP407.2	Identify different modulation techniques required for digital communication and analyze the different multiple access techniques along with switching communication networks.
EP407.3	Differentiate between design of second and third generation wireless networks and standards.
EP407.4	To identify and demonstrate advanced networking techniques with satellite systems.
EP407.5	To be able to devise link budget model of satellite communication for specific applications and compare the knowledge to upgrade satellite communication systems.

8th Semester

Subject Code & Course Title: EP 402/ B.Tech. Project-II	
EP402.1	Identification of scientific preferably a research problem of interest.
EP402.2	Demonstrate knowledge and understanding of the engineering and scientific principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
EP402.3	Technical report writing
EP402.4	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations,

Subject Code & Course Title: EP 404/Alternate Energy Storage and Conversion Devices	
EP404.1	Create awareness among students about various Non-Conventional sources of energy technologies.
EP404.2	Enable students to understand various primary renewable energy technologies and engineering systems.
EP404.3	To impart the knowledge and process of solar, wind, and bio-fuel based systems and their applications to society.
EP404.4	Equip the students with knowledge, principle and design of energy storage & conversion technologies form the autonomous renewable energy sources.

Departmental Electives

Subject Code & Course Title: EP 305/Atomic and Molecular Physics	
EP305.1	Gain knowledge of fundamentals of atomic physics and its application to the complex system.
EP305.2	Implement the external perturbation concerning electric and magnetic fields to materials of optoelectronic interest.
EP305.3	Deal with various advance molecular spectroscopic techniques used to characterize optoelectronic materials.
EP305.4	Predict behaviour of ground and excited electronic states of materials used for light emitting devices and other sensors.
EP305.5	Work professionally in the area of vibrational, rotational and electronic spectroscopy of molecular systems responsible for modern age advance materials.

Subject Code & Course Title: EP 307/Biophysics	
EP307.1	Enhance the basic understanding of Bio-Physics
EP307.2	Describe the basic structure and composition of membrane.
EP307.3	Design of modelling and simulation of channels.
EP307.4	Design of modelling and simulation of whole shell

Subject Code & Course Title: EP 309/Quantum Information and Computing	
EP309.1	Compare the problems of different computational complexity and explain why certain problems are rendered tractable by quantum computation.
EP309.2	Explain the basic notions of quantum information and computing in terms existing quantum mechanics and gain the sufficient knowledge to apply it to tackle real world problems.
EP309.3	Analyse how basic quantum mechanics fundamental be the building block of quantum information and computing
EP309.4	Solve some of the basic problems using quantum algorithms and justify the need of quantum computers
EP309.5	Weigh the basic requirements for implementation of quantum computers and classify the schemes for implementation of quantum computer in future.

Subject Code & Course Title: EP 311/Computer Networking	
EP311.1	To learn the Concepts, Goals and Applications of Networks, OSI reference model
EP311.2	To analyze the capabilities of Process to Process communication at Transport layer, To understand Routing, addressing and other design issues of network layer protocols
EP311.3	To understand the design issues data link layer and Local Area Networks
EP311.4	To apply and understand the commonly Wide area network technologies, also develop basic understanding of Network management capabilities of Process to Process communication at Transport layer

Subject Code & Course Title: EP 314/ Instrumentation and Control	
EP314.1	Explanation ability about instruments like transducers, gauges, thermistors, thermocouples, photodiodes, photo transistors etc.
EP314.2	Ability to identify open loop and closed control system and plotting their signal flow graph
EP314.3	Deep idea to implement the formulae of mathematical model for physical systems
EP314.4	Ability to simplification of complex system using block reduction technique and mason's gain technique. And idea about characteristics of first order and second order systems.
EP314.5	Realize the concept of Hurwitz and root locus techniques for stability analysis.

Subject Code & Course Title: EP 406/ Introduction to Spintronics	
EP406.1	Able to summarize the role played by electron spin in solid state physics, and possible devices.
EP406.2	Able to describe and calculate the main characteristics of the spin transport effects.
EP406.3	Able to explain the causes of the main spin transport effects and analyses their relevance in relation to technological applications.
EP406.4	Able to identify different kinds of spin relaxation, spin dephasing and spin injection mechanisms.
EP406.5	Able to construct new transport devices based on spin using the knowledge acquired in the course.

Subject Code & Course Title: EP-410/ Robotic Engineering	
EP410.1	Describe and compare various robot sensors and their perception principles that enable a robot to analyze their environment.
EP410.2	Program different robot operations and appreciate applications of robots in industry.
EP410.3	Explain how to derive and solve forward and inverse kinematics of serial and parallel manipulators.
EP410.4	Reconstruction of Image using sensory feedback mechanism, and information processing.
EP410.5	Model different control techniques (linear and nonlinear) used to control the motion of a Robot.

Subject Code & Course Title: EP-415/ Nanoscience and Technology	
EP415.1	Ability to differentiate the nanomaterial with bulk.
EP415.2	Study the properties of material on nanoscale.
EP415.3	Compare the dimensionality of solids
EP415.4	Highlight applications of nanomaterials.

Subject Code & Course Title: EP-419/ Introduction to Automation and Motion Control	
EP419.1	To develop the ability to analyze and design the motion for articulated systems.
EP419.2	To acquire the knowledge on advanced algebraic tools for the description of motion.
EP419.3	Obtain knowledge and understand the basic concepts of industrial robotics, namely in terms of classification, kinematics, sensors, and typical applications.
EP419.4	Program Industrial (manipulators) Robots.
EP419.5	Describe current status of robotics technology and new developments in the context and importance of robotics in the different society sectors.

Subject Code & Course Title: EP-423/Space and Atmospheric Sciences-1	
EP423.1	To describe the usage of various radars needed to measure meteorological parameters.
EP423.2	To analyse how primary and secondary pollutants are produced in atmosphere and their effect on global warming along with their measurement techniques.
EP423.3	To analyse the effect of aerosols on living species and describes the techniques needed to measure aerosols in atmosphere.
EP423.4	To describe the formation of clouds and thunderstorms and other related phenomenon on the surface of earth.

Subject Code & Course Title: EP-414/Space and Atmospheric Sciences-1I	
EP414.1	To describe the usage of various radars needed to measure meteorological parameters.
EP414.2	To analyse how primary and secondary pollutants are produced in atmosphere and their effect on global warming along with their measurement techniques.
EP414.3	To analyse the effect of aerosols on living species and describes the techniques needed to measure aerosols in atmosphere.
EP414.4	To describe the formation of clouds and thunderstorms and other related phenomenon on the surface of earth.

Subject Code & Course Title: EP-351/Physics of Engineering Materials	
EP351.1	Apply core concepts in Physics of Engineering Materials to solve complex engineering problems.
EP351.2	Identify and describe the structure, bonding and defects found in the crystalline materials and also be able to categorize the various types magnetic and dielectric materials for the modern technological applications.
EP351.3	Acquire knowledge to demonstrate the properties of semiconducting and superconducting materials for industrial applications and also be knowledgeable of contemporary issues relevant to Materials Science and Technology.
EP351.4	Synthesis and characterization of advanced functional materials and also to enhance the properties of materials for their better use in the present scenario.
EP351.5	Predict appropriate environmental friendly materials required for various engineering applications and also to design projects in the field of materials science to contribute for the innovation and application of basic research.