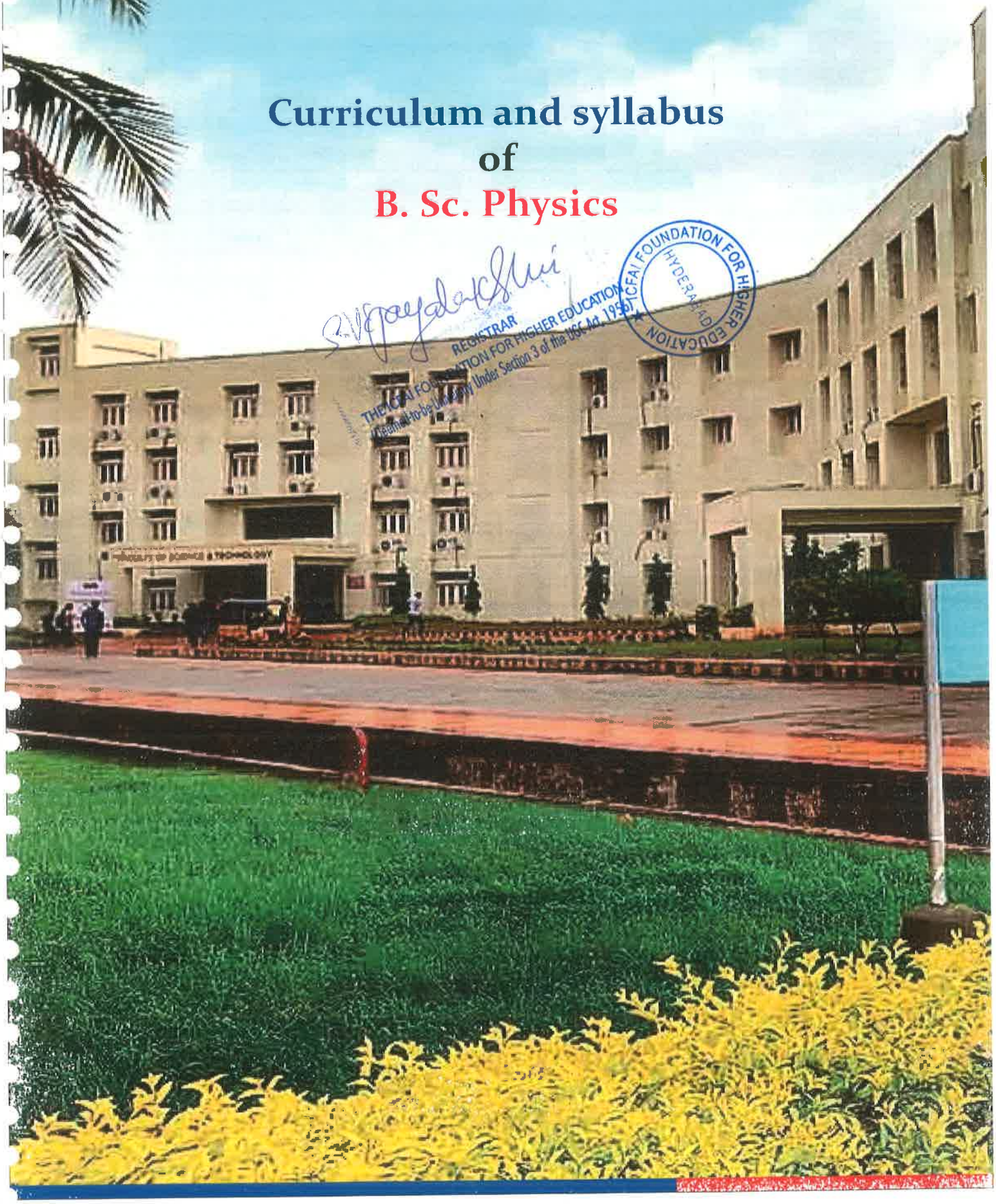
ICFAI Foundation for Higher Education
(Deemed-to-be University under Section 3 of the UGC Act, 1956)

IcfaiTech
Faculty of Science & Technology (FST)

Curriculum and syllabus of B. Sc. Physics



All the precautions have been taken to print the Course Curriculum accurate. However, mistakes if any will be corrected as and when noticed. The University reserves the right to include/exclude any content at any point of time during the progression of the course.

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

ICFAI FOUNDATION FOR HIGHER EDUCATION

Contents

1. INTRODUCTION

1.1 The ICFAI Foundation for Higher Education

The ICFAI Foundation for Higher Education (IFHE) is declared as a Deemed-to-be University, under Section 3 of the UGC Act, 1956. It has evolved a comprehensive student-centric learning approach consisting of several stages, designed to add significant values to the learner's understanding in an integrated manner, covering relevant knowledge, practical skills and positive attitudes. IFHE comprises of:

- Faculty of Management (IBS Hyderabad),
- Faculty of Science and Technology (IcfaiTech), and
- Faculty of Law (FoL).

Vision and Mission of IFHE

The vision of IFHE is to be a top ranking University of choice for students, staff and corporates, recognized for excellence in Higher Education and Research especially relevant to social needs.

The mission of the Deemed University is to offer world class, innovative, career-oriented professional postgraduate and undergraduate programs through inclusive technology- aided pedagogies to equip students with the requisite professional and life skills as well as social sensitivity and high sense of ethics. The University will strive to create an intellectually stimulating environment for Research, particularly in areas bearing on the socio-economic and cultural development of the state and the nation.

1.2 Faculty of Science and Technology (IcfaiTech)

Faculty of Science and Technology (IcfaiTech), Hyderabad is a constituent of the ICFAI Foundation for Higher Education. It has been established to promote quality education in the field of Science andTechnology. IcfaiTech strives to acquire a reputation as a highly purposive, innovative institution setting the pace for workable reforms in professional education suitable and most relevant for the Indian cultural milieu.

VISION

The IcfaiTech campus shall become a leading institute for scientific research as well as innovative teaching and learning, keeping pace with evolving knowledge domains. It shall emerge as an attractive destination for the excellent students and the faculties. IcfaiTech aspires to be highly ranked amongst the group of other peer institutes.

MISSION

The mission of the IcfaiTech is to provide high quality teaching and learning experience through our first degree and higher degree programs.

• Teaching Excellence: IcfaiTech periodically reviews and redesigns existing courses and introduces new courses and programs geared towards current research and industry. It explores new dimensions in teaching and learning and uses various platforms and methodologies.

• Research Excellence: The faculty members of the department carry out research in almost all the major areas. The department is now vigorously scaling up its research activity and giving more visibility to it. The volume of research publications in peer reviewed journals of repute and the research funding received by the department has been increasing steadily.

• Faculty Leadership in Administration: The faculty members of the department make significant contribution to administrative leadership and various institute activities and initiatives.

1.3 Educational Philosophy

The core philosophy of education at IcfaiTech is empowering students with the right knowledge and modern skill sets in order that they are ready to face the challenges of the competitive world. IcfaiTech strives to provide its students with the fine edge that is required in the making of a successful professional. The programs at IcfaiTech have been uniquely designed by including courses drawn from varied areas like humanities, arts, and management combined with science, engineering and industry-based internships. IcfaiTech ensures that students gain exposure and knowledge across different disciplines, develop inter-personal skills and leadership qualities that takes them beyond traditional thinking and practice. Today's era of globalization and integrated economies presents talented professionals huge opportunities

from across the world. The curriculum at IcfaiTech is truly global and modern in perspective and exposes its students to the latest practices and techniques. The curriculum offers a cafeteria approach allowing them to choose courses from across the disciplines. This exposure also helps them to develop interests in tune with the current inter-disciplinary nature of research. The educational philosophy practices at IcfaiTech allows it to integrate into its learning system, an innovative and emerging body of knowledge. The highlights of the academic program are summarized below:

• Cutting-edge course curriculum with contemporary and effective pedagogic methods that lay emphasis on application-oriented learning.

• Encouraging students to not only articulate Science and Technology needs but also provide appropriate solutions.

• Developing appreciation for synthesized multidisciplinary learning by way of workshops, internships and other group learning assignments.

1.4 Objectives of IcfaiTech

• To provide high quality, cutting-edge and career-oriented education programs in Science and Technology.

• To offer practice-oriented, contemporary and flexible programs developed through regular assessment and consultation with leading institutions, academicians, professionals and practitioners.

• To turn out highly motivated and successful Science and Technology graduates to meet the current and projected needs of the knowledge workforce.

1.5 Flexibilities

A few of the flexibilities available to the students are mentioned below. The principle of merit, preference of the students and the facilities available at the Institute generally guide the decisions regarding flexibilities. Transfer: Every year, various branches of engineering are ranked based on the preferences and demands of the admitted batch of students. After two semesters of study (end of the first year), students can seek transfer across branches. Requests from students seeking transfer from a less preferred branch to the most preferred branch of B.Tech would be considered if they maintain a CGPA of not less than 9.00, by the end of the first year of degree program. For a branch transfer to the second most preferred branch, a student should have a CGPA of not less than 7.00 by the end of the first year of degree

program. A branch transfer from a more preferred branch to a less preferred branch would be permitted without any restrictions on CGPA. Audit: Over the years of study at IcfaiTech, a student may develop interest in areas that go beyond the scope of his/her program of studies. IcfaiTech permits students to take such courses as audit courses. Certain courses like Foreign Languages, Music, etc. which are not the part of a degree program could be opted for on an audit basis, on payment of additional fees. Audit courses do not count for the CGPA calculation.

Other Flexibilities: The Academic Regulations also provide flexibilities like choice of electives, number of electives, repetition of courses, departure from normal pace, withdrawal from or substitution of course(s).

1.6 Admissios at IcfaiTech:

Admission Test for IcfaiTech (ATIT) is an All India Admission Test conducted by IcfaiTech, IFHE, Hyderabad for students seeking admission into the 4 year Integrated B.Tech. Programs and 3 year Integrated B.Sc Programs.

ATIT 2020 is an aptitude test conducted through online & offline tests constitute objective type questions in Mathematics, Physics, Chemistry, English and logical reasoning in multiple choice format. Question paper pattern is given below and syllabus given in website www.ifheindia.org/icfaitech.

Eligibility for admission into the B.Tech/BSc Program:

- Pass with 60% and above aggregate marks in Class XII ("or its equivalent") with Mathematics, Physics, Chemistry and English as subjects.
- Class XII (or icfaitech equivalent) students awaiting final examination results may also apply.
- Applicants should have completed 12 years of formal schooling in order to apply for the program.
- The applicant should fulfil the minimum age requirements as prescribed by the respective Board through which the applicant has appeared for the qualifying examination.

1.7 Programs at IcfaiTech

At IcfaiTech, the programs offered are divided into three tiers, namely the first degree programs, the higher degree programs and the doctoral programs falling into the first, second and the third tiers respectively. All the undergraduate, integrated programs fall under the first degree programs. The various masters programs fall under the category of the higher degree programs. The Ph.D. programs offered by various departments fall under the category of doctoral programs. The academic structures of each of these programs are discussed below.

First Degree Programs (First Tier)

There are three first degree programs being offered at IcfaiTech, the details of which are available in the prospectus/view book. Without going into the details of the regulatory processes, it is necessary to touch upon the subject to obtain a better understanding of these processes, which are controlled by these regulations in respect to operation.

There may be some restrictions from time to time in terms of flexibilities like transfer or dual degree concerning these degree programs. This will be notified in the prospectus/view book as per periodic decision of the Academic Council. All operational matters concerning this will be controlled by the PGC.

Program Courses

The various courses prescribed for a program of study may be categorized in terms of their academic affinity or their functional objectives. Depending on overall educational goals of programs, it is possible to have fixed named courses in a particular category, to have fixed number of electives; to have a range of named courses in a particular category and to have a number of electives within a range. Named courses are those indicated by course number and course title in the semester-wise- pattern prescribed for a program

For first degree students the named courses include all mandatory courses under the General Institutional Requirement and the Discipline Specific Core courses, known as Compulsory Discipline courses (CDCs), for the program(s). The Elective courses fall under three categories: Discipline Electives, Humanities Electives and Open Electives. Open Electives enable students to pursue courses that are neither part of the discipline requirement nor part of the humanities requirement. Normally any elective course will be treated as an Open Elective once the student's requirement under Discipline Electives and Humanities Electives have been accounted for. Open elective requirement of Dual degree students is met by counting the Discipline Electives of one

degree as Open Electives of the other degree. A first degree student may also choose, where permitted, up to a certain prescribed maximum of his/her elective courses from the offerings in the higher degree, subject to the approval by the DCA and the prerequisite requirements and clause 3.18 regarding over preparedness and under preparedness. Provided that, if such a student after graduation is admitted to a higher degree program his/her total requirement in the latter cannot ipso facto be reduced.

The prior preparation required of a student who intends to choose courses from a higher degree program of the Institute for the fulfillment of his/her elective requirement(s) are given in clause 3.15.

In a program all courses outside the elective categories are defined as named courses, in view of the fact that they have already been named in the semester-wise-patterns in the prospectus/view book or have been named by an appointed authority through subsequent operation on the basis of guidelines given in the prospectus/view book .The electives are, on the other hand, selected by the student himself/herself from outside the named courses in his/her program. The intended regions where he/she goes for the search will be designated as host regions. Certain specialized courses, Internship programs, Thesis etc., These courses are named courses for some specific programs and they are debarred to other students as electives in the same way as they are debarred to students who wish to take them on audit.

For each program the number of electives, under each of the categories, required to be taken by a student will be prescribed either through the prospectus/view book or through an appropriate committee. Over and above the prescribed number of electives, a student of an integrated first degree program will be allowed to take, on his/her own option, up to a maximum number of four electives. In extraordinary cases, the number may be increased by the DCA without violating limit. For the purpose of eligibility for degree(s),a student should get valid grades in at least the prescribed number of electives – under each of the categories, of his/her program(s). The student above a particular CGPA as prescribed by ACC will be allowed to register in maximum of one higher degree course per semester. This will be counted as open elective unless the course is listed in pool of discipline electives for his/her program.

Once a first degree student is declared to have fulfilled the requirements of graduation the student may be permitted to register for at most one additional semester with prior permission of his/her Coordinator(s)of Department and Chairperson-Academics. Any first degree student who is interested in pursuing open elective(s) above the graduation requirements and/or completing a minor

program he/she is pursuing and if that necessitates overstay, he/she should obtain permission from Chairperson- Academics at least one semester before the start of the overstay period. The overstay period can be at most one semester during which the student must register for at least three new courses of at least 9 units. In case a student withdraws from one or more of his/her courses or otherwise is found not to be pursuing his/her courses in all earnestness Chairperson-Academics in concurrence with the student's department Coordinator is authorized to get him/her graduated and evacuate the student from the campus.

The structure contains a category of courses such as Internship Program (IP)/Thesis (TS), which attempts a synthesis of earlier courses and gives a glimpse of the application of these courses. They carry a large number of units and are to be pursued when student can ensure sufficient time and attention throughout the allotted period. In particular, IP components are to be pursued exclusively full time throughout the allotted period. There is no provision for taking other courses along with an IP component. In case of a Thesis a student may choose between 12 units worth of thesis work or 20 units worth of thesis work with the concurrence of his/her supervisor. A student pursuing a 20 unit thesis must pursue it exclusively full time throughout the allotted period and there is no provision for taking other courses along with it. A student pursuing a 12 unit thesis may concurrently pursue at most 3 courses (totaling at most 9 units) and will not be allowed to pursue any other course/component.

The Higher Degree Programs (Second Tier)

At higher degree level, structure of the program is classified into courses, like, Research Methods, CDCs, electives, IP and thesis. Registration for the IP can be done only after all other required courses have been completed.

In the case of thesis, while normal registration can be done only after completion of all other courses, in extraordinary cases, the DCA may allow registration in Dissertation, spread over various semesters, along with other courses. A student of higher degree program can register up to a maximum of one elective more than those prescribed in a semester. This additional elective can be from the pool of electives of the concerned degree or named/electives courses from other disciplines' with the permission of DCAs – namely the DCA of the student's Department and the DCA of the Department offering the course that the student wants to pursue. The grade obtained in such additional electives will also be counted towards the CGPA. Each course in the Core Requirement or in the List of Electives must be a graduate level (5th or 6th level) course or an advanced under-graduate course (4th level) with the restriction that a student may use at the most

two 4th level courses to meet the requirements in above.

Ph. D Program (Third Tier)

The Ph.D. program is designed for the student to achieve a broad competence before research begins. He/she is required to clear certain course work, if not already cleared, and pass the Qualifying Examination to satisfy the institute that his/her spectrum of knowledge is such as to enable him to undertake the demands of interdisciplinary research. Working knowledge of a modern European language, wherever specified, Teaching Practice, Independent Study, Research Methodology and specified units of Thesis course and Seminar are significant components of the Ph.D. program. The pursuit of research through the Thesis-Seminar course will continue and terminate in a thesis which meets the standards and requirements of the committee of scholars.

1.8 . The Academic Year

At IcfaiTech, the academic year is divided into two semesters (First Semester and the Second Semester) and a term called Summer Term. Each semester is of 18 weeks duration and summer term of 8 weeks duration. There are eight semesters during the four year B.Tech program. After completing the first four semesters, the students undertake an Internship Program (IP-1) for two months. During the final year, students go for five and half month's duration Internship Program-II (IP-II) in either of the two semesters and the adjoining summer term. Instead of the Internship Programs, a student can opt for Thesis/Seminar in the final year.

Structure of B.Tech Program

The program of studies leading to the award of a B.Tech degree consists of the prescribed courses sequentially distributed over the required number of semesters known as Semesterwise pattern.

The program is planned in such a way that in the normal course, a student will complete the program in 8 semesters. Categorization of Courses The courses are categorized as

- Basic Sciences Courses
- Analysis Oriented Courses
- Engineering Science Courses
- Humanities Courses
- Technical Art Course

Discipline Courses

Discipline Courses of the Specific branch of B.Tech Program consists of Compulsory Discipline Course (CDC) and Discipline Courses other than Compulsory (DCOC).The Compulsory Discipline Courses (CDC), twelve in number for each branch are to be completed by every student of the branch taking 2 CDCs in the second semester of the second year, and 10 CDCs in the two semesters of the third year of the Program.

Discipline Courses in the category of DCOC, may be taken as electives. A student must take up a minimum of 6 electives to earn the required credits for the completion of the program. Additionally, a student can take up to 4 optional electives. This is however not mandatory. Students can also opt for DCOCs from other branches as electives, provided he/ she completes all the prerequisites for the same.

Credits calculation

Each course in the program structure is associated with an LPU (three digits) which describes the nature of the course.The first digit denotes the number of lecture hours per week, the second digit denotes the number of practical hours per week and the third denotes the credits or units given to the course for calculation of CGPA. Wherever, a single number appears, it indicates the total number of units only; its break-up may be announced through the time table or the Course Handout.

The effort that has to be put in by a student for a course is quantified in terms of 'units'. One unit in a theory course denotes three hours per week of study. This includes one lecture hour and two hours spent towards self-study. One unit in a laboratory-based course denotes two hours per week of laboratory work and one hour of self-study.

For example, a three unit theory course requires students to work on that course for about 9 hours per week. 3 Hrs of formal contact hours/ week + 6 Hrs of self-study outside classroom/ week = 9 Hrs per week.

The eligibility for a degree is determined on the basis of number of units completed. The minimum stipulated number of units for various degree programs are given below

Integrated First Degree (First tier)

B. Tech.	172
B. Sc.	133
B. Sc. – B. Tech Degree	209
B.Tech – B.Tech Degree	243

Higher Degree (Second tier)

M. Tech	90
Ph.D. (Thesis)	40

PROGRAM EDUCATIONAL OBJECTIVES, PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Program Educational Objectives (PEOs):

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

Program Outcomes (POs):

Program outcomes describe what students are expected to know and would be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program.

Program Specific Outcomes (PSOs):

Program Specific Outcomes are statements that describe what the graduates of a specific engineering program should be able to do.

STATEMENTS OF PEOs, POs AND PSOs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1-PROFESSIONAL DEVELOPMENT

To develop in the students the ability to acquire knowledge of Mathematics,Science & Engineering and apply it professionally within realistic constraintssuch as economic, environmental, social, political, ethical, health and safety,manufacturability and sustainability with due ethical responsibility.

PEO2-CORE PROFICIENCY

To provide ability to identify, formulate, comprehend, analyze, design and solve engineering problems with hands on experience in varioustechnologiesusing modern tools necessary for engineering practice to satisfy the needs ofsociety and the industry.

PEO3- TECHNICAL ACCOMPLISHMENTS

To equip the students with the ability to design, simulate, experiment, analyze,optimize and interpret in their core applications through multi disciplinaryconcepts and contemporary learning to build them into industry readygraduates.

PEO4- PROFESSIONALISM

To provide training, exposure and awareness on importance of soft skills forbetter career and holistic personality development as well as professionalattitude towards ethical issues, team work, responsiblility, accountability,multidisciplinary approach and capability to relate engineering issues tobroader social context.

PEO5- LEARNING ENVIRONMENT

To provide students with an academic environment and make them aware of excellence, develop the urge of discovery, creativity, inventiveness, leadership, written ethical codes and guidelines and the life-long learning to become a successful professional in Electronics and Communication Engineering.

PROGRAM OUTCOMES (POs):

PO1	**Engineering knowledge**	An ability to apply knowledge of mathematics (including probability, statistics and discrete mathematics), science, and engineering for solving Engineering problems and modeling
PO2	**Problem analysis**	An ability to design, simulate and conduct experiments, as well as to analyze and interpret data including hardware and software components
PO3	**Design / development of solutions**	An ability to design a complex system or process to meet desired specifications and needs
PO4	**Conduct investigations of complex problems**	An ability to identify, formulate, comprehend, analyze, design synthesis of the information to solve complex engineering problems and provide valid conclusions.
PO5	**Modern tool usage**	An ability to use the techniques, skills and modern engineering tools necessary for engineering practice
PO6	**The engineer and society**	An understanding of professional, health, safety, legal, cultural and social responsibilities
PO7	**Environment and sustainability**	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and demonstrate the knowledge need for sustainable development.
PO8	**Ethics**	Apply ethical principles, responsibility and norms of the engineering practice
PO9	**Individual and team work**	An ability to function on multi-disciplinary teams.
PO10	**Communication**	An ability to communicate and present effectively
PO11	**Project management and finance**	An ability to use the modern engineering tools, techniques, skills and management principles to do work as a member and leader in a team, to manage projects in multi-disciplinary environments
PO12	**Life-long learning**	A recognition of the need for, and an ability to engage in, to resolve contemporary issues and acquire lifelong learning

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1	To acquire a coherent and through understanding of the field of Physics by learning the traditional and modern areas like Mechanics, Electrodynamics, Mathematical physics, Condensed matter physics, Laser optics, Modern physics etc., and their connection with related disciplinary areas / subjects like Engineering sciences, Mathematics, Environmental sciences, Information Technology etc.
PSO2	To obtain procedural knowledge that creates different types of professionals, well versed in Physics and related disciplines to be engaged in research & development and teaching.
PSO3	Be aware of the importance of mathematical modelling simulation and computation. To appreciate the role of mathematical and approximation methods in helping us understand the way in which physical world works.
PSO4	To acquire skills required to plan and execute experiments/investigations related to the discipline and to analyse and interpret the acquired data using appropriate tools and prepare a report accurately depicting the methodology, the findings and the conclusions.
PSO5	To acquire and demonstrate problem-solving skills, independent thinking to solve Physics-related problems and obtain well-defined solutions. To develop an open mind to expand the boundaries of ones understanding of Physics to tackle open-ended problems in the inter-disciplinary areas. To acquire analytical skills to construct logical arguments. To develop an ability to comprehend research texts and papers and to develop communication skills to present scientific papers/ results in a compact form to audience groups of various competency levels. To acquire ability to deconstruct difficult scientific concepts/results into simpler parts in order to disseminate the scientific progress to the general public.
PSO6	To acquire an ability to adapt to the rapid changes taking place due technological and scientific developments. To develop an understanding on the impact of these advances on the society and ecology.
PSO7	To acquire an ability to function independently or in a team and to work in a multi-disciplinary work environments. To develop interpersonal and leadership skills to lead a team. To learn to respect intellectual property rights and help in promoting a safe environment for learning and working by following ethical professional behavior.

B.Sc. Program (Physics)

Year	Course Code	Semester-I	L	P	U	Course Code	Semester-II	L	P	U
I	BPCHEM 111	Chemistry	3	0	3	BPES121	Thermodynamics	3	0	3
	BPEGL112	English Language Skills	3	0	3	BPAO122	Probability &Statistics	3	0	3
	BPMATH113	Linear Algebra	3	0	3	BPMATH123	Higher Calculus	3	0	3
	BPPHY114	Physics I	3	0	3	BPPHY124	Physics II	3	0	3
	BPTA115	Engineering Graphics	2	4	4	BPTA125	Scientific Measurements	0	4	2
	BPTA116	Computer Programming-I	3	0	3	BPTA126	Workshop Practice	2	4	4
	BPEVS117	Environmental Science	2	0	2	BPTA127	Computer Programming II	3	0	3
	Total No of Credits				**21**	**Total No of Credits**				**21**
II	**Semester-III**					**Semester-IV**				
	BPES211	Electrical Sciences I	3	0	3	BPES221	Electrical Sciences II	3	0	3
	BPES212	Digital Electronics	2	2	3	BPTA222	Engineering Measurements	1	8	4
	BPES213	Engineering Mechanics	3	0	3	BPTA223	Professional Communication	3	0	3
	BPECON214	Principles of Economics	3	0	3	BPMGTS224	Principles of Management	3	0	3
	BPMATH215	Complex Variables	3	0	3	BPAO225	Optimization Techniques	3	0	3
	BPMATH216	Differential Equations & Fourier Series	3	0	3	BPES226	Structure & Properties of Materials	3	0	3
	PHY211	Optics	3	0	3	PHY221	Partial differential equations & systems of ODEs	3	0	3
	Total No of Credits				**21**	**Total No of Credits**				**22**
Summer Term Internship Program IP 221										**5**
III	**Semester-V**					**Semester-VI**				
	PHY311	Solid State Physics	3	0	3	EVS322	Humanities Electives (2)			6
	PHY312	Introductory Quantum Mechanics	3	0	3					
	PHY313	Classical Electrodynamics	3	0	3	--	Electives (5)			15
	PHY314	Introduction to Statistical Mechanics	3	0	3					
	PHY315	Atomic Molecular & Nuclear Physics	3	0	3					
	PHY316	Instrumental Methods of Analysis	1	6	4					
	PHY317	Introduction to Monte-Carlo Methods	3	0	3					
	Total No of Credits				**22**	**Total No of Credits**				**21**
Total No of Credits										**133**

Table : Compulsory Discipline Courses for the B.Tech Programs

Physics				
Course Code	Course Title	L	P	U
PHY211	Optics	3	0	3
PHY221	Partial Differential Equations & Systems of ODEs	3	0	3
PHY311	Solid State Physics	3	0	3
PHY312	Introductory Quantum Mechanics	3	0	3
PHY313	Classical Electrodynamics	3	0	3
PHY314	Introduction to Statistical Mechanics	3	0	3
PHY315	Atomic Molecular & Nuclear Physics	3	0	3
PHY316	Instrumental Methods of Analysis	1	6	4
PHY317	Introduction to Monte-Carlo Methods	3	0	3

Table : Electives for B.Sc. (Physics)

Course Code	Course Title	L	P	U
PHY323	Classical Mechanics	3	0	3
PHY324	Nanotechnology	3	0	3
PHY325	Special Theory of Relativity	3	0	3
PHY326	Introduction to Acoustics	3	0	3
PHY327	Introduction to Quantum Computation	3	0	3

List of Humanities Electives

Course Code	Course Title	L	P	U
HS311	Dynamics of Social Change	3	0	3
HS312	Introduction to Psychology	3	0	3
HS313	Heritage of India	3	0	3
HS314	Modern Political Science	3	0	3
HS315	Public Administration	3	0	3
HS316	Professional Ethics	3	0	3

3. B.SC Program (Physics) Course Description

Semester-wise Institute Courses

Course Code	Course Title	L	P	U	Course Description
BPCHEM111	Chemistry	3	0	3	Coordination Chemistry: Effective atomic number, Nomenclature of coordination compounds, Shapes of d-orbitals, Valence Bond Theory, Magnetism, Crystal Field Theory of Octahedral Complexes, Tetragonal distortions of Octahedral Complexes (Jahn-Teller Distortions), Square Planar and Tetrahedral Complexes, Thermodynamics-First Law: Work and Heat, Internal Energy and Enthalpy, Thermo chemistry: Enthalpy changes accompanying physical change and chemical change e.g. Thermodynamics -Second Law: Entropy and 2nd Law, The Gibb's Free Energy, Phase equilibria: Pure substances The thermodynamics of phase transition, Phase diagrams, Phase diagrams of typical materials Principles of chemical equilibria: The reaction Gibb's energy, Reactions at equilibrium, The response of equilibria to the conditions Consequences of equilibrium: Proton transfer equilibria, Salts in water, Solubility equilibria, Common ion effect Electrochemistry: The migration of ions, Electrochemical cells. The cell potential. Application of standard potentials, The rates of reactions: Empirical chemical kinetics, Reaction rates, Temperature dependence of reaction rates.
BPEGL112	English Language Skills	3	0	3	Familiarizing students with basic English sound system to enhance their power of articulation. It provides intensive practice and extensive exposure to listening, speaking, reading and writing Skills. It would enhance not only their comprehensive knowledge of vocabulary but also strengthens their all four skills. The design and content of the course are aimed at making students gain language proficiency and also improve their communication skills
BPMATH113	Linear Algebra	3	0	3	Matrices, Elementary row operations, Row and column equivalence, Row Reduced Echelon Matrices, Invertible Matrices, Gauss Jordan method to find the inverse, Solving system of linear equations (homogeneous and non-homogeneous), Vector spaces, subspaces, Bases and Dimension, and Computations of Subspaces, Linear Transformations, The Algebra of linear Transformations, Isomorphism between Matrices and Linear Transformations, Representation of Linear Transformations by Matrices, Eigen values, Eigen vectors, Diagonalization, Quadratic forms, Canonical forms.
BPPHY114	Physics I	3	0	3	Momentum and impulse; two and many particle system; Rotational kinematics and dynamics; work and energy; conservation principles; oscillations and wave motion; interference, diffraction and polarization.
BPTA115	Engineering Graphics	2	4	4	Angle of projections; free hand sketching; orthographic

Course Code	Course Title	L	P	U	Course Description
					views; pictorial views; auxiliary views; lines and planes; intersection and development; AutoCAD command and simple drawings using AutoCAD.
BPTA116	Computer Programming I	3	0	3	Basics of Problem solving, Solve with an example, Introduction to python, Data Types, Python Program Flow Control, Python Sequences, Python Functions, Python Modules, Python Packages, Python Object Oriented Programming, Exception Handling, My First Cloud Program - Powered by AWS (Cloud Inventor) :Overview of computer and internet, Introduction and basics of cyber security, General idea of data analysis, Basics of programming and algorithms, Overview of computing, Introduction to cloud computing, Overview of cloud models, General idea of cloud computing, Problem solving – Case Study
BPEVS117	Environmental Science	2	0	2	Meaning of Environment, Types and components of environment, nature and scope of the subject, Need for environment studies, goals of environmental education, environmental education programs. Man-environment relationship, biogeochemical cycles. Concept of ecology, subdivisions and developmental phases of ecology; concept of the ecosystem, Structural and functional aspects of ecosystems; Productivity concept of ecosystem, food chains & food webs in ecosystems. Ecological energetic, ecological interactions. Population ecology, Population dynamics Soil, Land use patterns, Waste lands, Desertification, Water resources, Air resources, Energy resources, Waste management, Waste water management, Biomedical waste management, Environmental policies and laws
BPES121	Thermodynamics	3	0	3	Concepts and laws of thermodynamics; macroscopic thermodynamic properties; application to closed and open system; microscopic approach to entropy; equations of state; thermodynamics of non reacting mixtures.
BPAO122	Probability & Statistics	3	0	3	Probability spaces; conditional probability and independence; random variables and probability distributions; marginal and conditional distributions; independent random variables; mathematical expectations; mean and variance; binomial; Poisson and distributions; sum of independent random variables; law of large numbers; central limit theorem (without proof); sampling distributions.
BPMATH123	Higher Calculus	3	0	3	Polar coordinates: Definition, graphing and conics , Cylindrical and spherical coordinates, Jacobian, Limits, continuity and Differentiability of vector functions, Velocity & unit Tangent vector, Normal vectors,

Course Code	Course Title	L	P	U	Course Description
					Curvature, Torsion and the Bi normal, Tangential & normal components of velocity and acceleration, Functions of several variables, Limits and continuity in higher dimensions, Partial derivatives, differentials, linearization, Taylors formula for two variables, Chain rule for derivative, Directions derivatives, Gradient and Tangent planes, Maxima, Minima with application Convergence of sequences and series , Maclaurin, s Series, Taylors series, Vector calculus inRn, Vector analysis, Theorem of Green Gauss and Stokes
BPPHY124	Physics II	3	0	3	Electrical fied; magnetic field; electric current; electromagnetic induction; Max well's equation; Electromagnetic waves; wave particle duality; uncertainty principle and Bohr model of atom.
BPTA125	Scientific Measurements	0	4	2	A laboratory course that covers the lab components associated with six core science courses in the integrated first degree structure. While the exact component and assignments may vary from time to time. The assignments would invariably be illustrative of the theory covered in this portion as well as aim to emphasize the aspects of measurement as a theme in experimental science. This course is a compulsory requirement for all students who have to compulsorily do the six core science courses.
BPTA126	Workshop Practice	2	4	4	Basics of manufacturing processes, Technical and economical considerations of manufacturing, Significance of material properties with respect to selection of manufacturing processes, Fitting & Carpentry, Metal forming processes, Sheet-metal working, Mechanical joining processes, Smithy tools and making various parts, Casting processes, laboratory exercises involving machining, fitting & carpentry, joining, CNC, house wiring, foundry and smithy etc.
BPTA127	Computer Programming II	3	0	3	Java Programming Fundamentals, features of Object oriented programming, primitive data types and operators, various program control Statements, Classes, Objects and Methods, more data types and operators, Strings and other Operators, A closer look at methods and Classes, learn and implement Inheritance, Interfaces and Packages, Exception Handling, File I/O, Multithreading, database connectivity, Exploring My Cloud Powered by AWS : Essentials in Cloud Computing, Fundamentals of Big Data and Analytics, Introduction to Database Management System, Basics of Web Technologies, Basics of Storage and Networking, Cloud Computing Fundamentals and Services, AWS Analytics and Database Services, AWS Developer and Management Tools, AWS Storage Services, AWS Networking and Content Delivery Services.
BPES211	Electrical Sciences I	3	0		Introduction; basic circuit elements; sources (dependent and independent); Kirchoff's current and voltage law, source representation and conversion; Network theorems, response of RL, RC and RLC circuits; sinusoidal steady state analysis

Course Code	Course Title	L	P	U	Course Description
					of circuits; three phase circuits, transformers; basics of rotating machines; DC machines; induction machine
BPES212	Digital Electronics	2	2	3	Number systems and machine representation, Boolean algebra, minimization techniques, combinational and synchronous sequential circuits, logic minimization, programmable logic devices, state table and state diagrams, digital integrated circuits, asynchronous circuits, arithmetic operations and algorithms. The course will also consist of laboratory practice
BPES213	Engineering Mechanics	3	0	3	Introduction, System of Forces; Laws of Mechanics; Types of Supports and their reactions; Equilibrium of rigid bodies; Force resolution and Resultant force; Friction; Moments and couples; Varignon's Theorem; Center of Gravity; Moment of Inertia, product of inertia, Mass moment of inertia; Dynamics of particles- displacement, velocity and acceleration, D' Alembert's principle; Rectilinear motion; Impulse momentum principle; Impact of elastic bodies; Curvilinear motion; Work-energy principal.
BPECON214	Principles of Economics	3	0	3	Nature and Scope of economic science, its relationship with other social sciences; quantification of economic variables, theories of consumer behavior and of the firm; linear economic models; market structures; social accounting and basic elements of economic planning
BPMATH215	Complex Variables	3	0	3	Regions in the Complex plane, Functions of Complex Variable, limits. Mappings, Theorems on limits, Continuity, Derivatives, Cauchy-Riemann equations, Analytic Functions, harmonic functions, Exponential logarithmic functions, complex exponents, Trigonometric, Hyperbolic functions and their inverses, Contour integrals, Anti derivatives, Cauchy theorem, Cauchy Integral Formula, Morera's theorem, Liouville's Theorem, Maximum Modulus Principle, Convergence of sequences of series, Taylor's and Laurent series, Residues poles and zeros of analytic functions, Applications of residues, Conformal mapping, Fourier Transforms and Z Transforms.
BPMATH216	Differential Equations & Fourier Series	3	0	3	First order differential equations, Reduction of order, Second order equations with applications bending of beams and electrical circuits, The homogeneous equation with constant coefficients and the Method of Undetermined Coefficients, Variation of parameters, Higher order linear equations, Power series solutions and ordinary points, Frobenius Method &Regular singular points, Gauss' hyper-geometric equation, Legendre polynomials & Bessel functions, Laplace Transform & Inverse Laplace Transform, Convolution of Laplace Transform & application to differential equations, Fourier series and convergence, Cosine and Sine series, Sturm-Liouville problem, one dimensional Heat and Wave equations and Laplace equations in rectangular form.
ES221	Electrical Sciences II	3	0	3	Semiconductor physics, doped semiconductors, junction diode, ideal diode, non-ideal diode models, Zener diode

Course Code	Course Title	L	P	U	Course Description
					and their applications, effects of capacitance, PNP transistor, NPN transistor, cut off and saturation, application to digital logic circuits, Junction Field effect transistors, MOSFETs, MOSFET Logic gates, Complementary MOSFETs, BJT Amplifiers, FET amplifiers biasing and small signal analysis ,Frequency response, power amplifiers, IC amplifiers, Operational amplifiers
BPTA222	Engineering Measurements	1	8	4	Measurement of basic electrical and non-electrical quantities; system performance measurements; analysis of experimental data. The course shall aim to train the student in the skill of operation of instruments in the electrical and electronics, chemical, civil and mechanical engineering applications. Precise lab exercises will be prescribed from time to time.
BPTA223	Professional Communication	3	0	3	Basics of Communication; Verbal and Non-verbal Communication; Barriers to Communication; Business Correspondence; E-mail Communication; Memo-Reports; Notice, Agenda and Minutes of Meetings; Effective Writing; Report: Its Features: Types of Reports; Formal Reports; Gathering Information; Organization of the Material; Uses of Visual Aids; Writing Abstract and Summaries; Writing Definitions; Reading and Listening Skills; Note-making; Précis Writing; Audio Visual Aids; Oral Presentation; Editing; Mechanics of Writing.
BPMGTS 224	Principles of Management	3	0	3	Fundamental concepts of management-planning-organizing; staffing; directing and controlling; production, financial, personnel, legal and marketing functions; accounting and budgeting, balance sheets.
BPAO225	Optimization Techniques	3	0	3	Optimization of functions of one and more variables with and without constraints, Kuhn-Tucker conditions, Gradient Methods, Linear Programming, Simplex based and integer programming methods, Duality Theory, Transportation and assignment problems, Dynamic programming, Branch and bound methods, Models of linear production systems
BPAO311	Numerical Methods	3	0	3	Solution of non-linear algebraic equations; interpolation and approximation; numerical differentiation and quadrature; solution of ordinary differential equations; system of linear equations; matrix inversion; Eigen-value and Eigenvector problems.
BPAO312	Control Systems	3	0	3	Mathematical models of physical systems, feedback characteristics of control systems, control system components, time response analysis, stability, frequency response, state-space analysis
HS311	Dynamics of	3	0	3	Nature of Society, social institutions; concept and nature

Course Code	Course Title	L	P	U	Course Description
	Social Change				of socio-cultural change, obstacles, rate and direction of change; factors of social change ideological, economic, technological and political demographics; agencies of social change-education, leadership, propaganda, legislative reforms; five-year plans and social change, peasant and land reform, bhoodan and gramdan; changing pattern of family, marriage, caste and religion
BPHS312	Introduction to Psychology	3	0	3	The development of psychology as a science individual and the environment; nature; kinds and determinants of perceptions; response mechanism and kinds of responses, motivations, modifications of behaviour through learning, memory and transfer of training; thought process, problem solving and creative thinking; nature and evaluation techniques of intelligence and personality.
BPHS313	Heritage of India	3	0	3	Foundations of India; India and its ancient culture; life of the people; systems of Indian philosophy; art and archeology; languages and literature; impact of world civilization; Western influence.
BPHS314	Modern Political Science	3	0	3	Nature and scope of political science; emergence and basis of the state; rights and duties; forms of government; democracy, fascism, capitalism, socialism, anarchism, communism, Maoism, radicalism and Gandhism.
BPHS315	Public Administration	3	0	3	Definition, nature and scope of public administration; the chief executive; leadership qualities of an administrator; principles of organization; organization of Ministries of Home and Finance; personnel administration-bureaucracy; recruitment, promotion, conduct and discipline, employer employee relations; administration at work-planning, policy formulation, decision making, supervision, coordination; integrity in administration; public corporations in India; financial administration in India; local administration in India.
BPHS316	Professional Ethics	3	0	3	Ethics, nature and purpose; ethical theories; ethics in business and management; ethics in engineering, global ethical issues.
BPDS491 BPCE491 BPCS491 BPEC491 BPEE491 BPME491 BPMEC491	Special Projects	0	0	3	This is an unstructured open ended where under the overall supervision of an instructor-in-charge, batches of students will be attached to different instructors. Each batch will work on a specific time bound which is of basic or peripheral concern of student's discipline. Each student must submit a project report as a culmination of his endeavor and investigation. The instructor-in-charge will determine the choice of the project and also whether or not the project report is to be submitted jointly by a group or individually by a student. This course will aim to evaluate the student actual ability to use the fundamentals of knowledge and to meet the new unknown situations as demonstrated by the student's interaction with the instructors and instructor-in-charge. The instructor-in-charge may assign specific hours of formal brain storming sessions.

B.Sc. Program (Physics)

Course Description

Course Code	Course Title	L	P	U	Course Description
PHY211	Optics	3	0	3	Matrix method in Paraxial optics: Introduction, The Matrix method, Unit planes, Nodal planes and a system of two thin lenses. Wave theory of light, Two beam interference by division of wave front and amplitude, Phase change on reflection, Interference in thin films; Diffraction; Rayleigh's criterion; Fresnel diffraction; polarization; Fresnels Formulae for perpendicular and parallel polarization cases, Reflection & Transmission coefficients, Brewster's law, Malus law, Double refraction, Nicol prism as an analyzer, Huygen's explanation of double refraction in uniaxial Crystals, optics axis, Plane, circular and elliptical polarized light. Wave plates, optical activity, specific rotation.
PHY221	Partial Differential Equations & Systems of ODEs	3	0	3	Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients(Two Equations in two unknown functions). Simultaneous linear first order equations in three variables, methods of solution, Pfaffian differential equations, methods of solutions of Pfaffian differential equations in three variables. Formation of first order partial differential equations, Linear and non-linear partial differential equations of first order, special types of first-order equations, Solutions of partial differential equations of first order satisfying given conditions. Linear partial differential equations with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients, Partial differential equations with variable coefficients, Separation of variables, Non-linear equation of the second order.
PHY311	Solid State Physics	3	0	3	Crystal Structure: Lattices, Brillouin Zones, Diffraction of X-rays by Crystals; Lattice Vibrations and Phonons: Acoustical and Optical Phonons, Dulong and Petit's Law, theories of specific heat of solids. Magnetic Properties of Matter: Classical Theories, Quantum Mechanical Treatment, B-H Curve; Dielectric Properties of Materials: Polarization, Electric Susceptibility, Clausius Mosotti

Course Code	Course Title	L	P	U	Course Description
					Equation, Classical Theory of Electric Polarizability, Langevin-Debye equation, Complex Dielectric Constant; Elementary band theory: Kronig Penny model, Band Gaps, Conductivity of Semiconductors, and Superconductivity.
PHY312	Introductory Quantum Mechanics	3	0	3	The Need for quantum mechanics: Black body radiation, Planck's formula, double slit experiment, quantum theory of light. Postulates of quantum mechanics, Schroedinger picture, Heisenberg picture and Dirac picture, the Schroedinger equation: Time independent Schroedinger equation, Stationary states, eigenvalues and eigen functions, Probability density, Properties of the wave function, Bound State problems: Particle in one, two and three Dimensional Box, Barrier problems, One Dimensional Simple Harmonic Oscillator, Zero Point Energy, Spherically symmetric potentials, quantum theory of angular momentum. Radial Quantization of Energy and Angular Momentum
PHY313	Classical Electrodynamics	3	0	3	Recapitulation of electrostatics, divergence and curl of a vector field, electric potential, work, energy and conductors, introduction of the Dirac delta function, Poisson's equation and Laplace's equation: Boundary conditions and uniqueness theorems, method of images, multipole expansion, Electric field in matter: polarization and dielectrics. Boundary value problems with linear dielectrics. Recapitulation of Magnetostatics: Magnetic fields, magnetic vector potential, multipole expansion, magnetic fields in matter: magnetization torques and forces on magnetic dipoles, Ampere's law. Electrodynamics: electromotive force, electromagnetic induction, induced electric fields, Inductance, Maxwell's equations, modification of Ampere's law, magnetic charge, Maxwell's equations in matter.
PHY314	Introduction to Statistical Mechanics	3	0	3	The Statistical Basis of Thermodynamics: The macroscopic and the microscopic states, Gibbs paradox, Elements of Ensemble Theory: Phase space of a classical system, Liouville's theorem and its consequences, The microcanonical ensemble, Quantum states and the phase space The Canonical Ensemble, Equilibrium between a system and a heat reservoir, A system in the canonical ensemble, Equipartition and the virial theorems, A system of harmonic oscillators, The statistics of paramagnetism, Thermodynamics of magnetic systems. The Grand Canonical Ensemble: Equilibrium between a system and a particle-energy reservoir, Physical significance of the various statistical quantities. Simple gas: An ideal gas in a quantum-mechanical microcanonical ensemble, Ideal Bose gas: Thermodynamic behavior of an ideal Bose gas, Ideal

Course Code	Course Title	L	P	U	Course Description
					Fermi gas: Thermodynamic behavior of an ideal Fermi gas. Special topics: One dimensional fluid model-Hard Spheres on a ring, The Ising model in one dimension in the absence of external field
PHY315	Atomic Molecular & Nuclear Physics	3	0	3	Atoms and light in a magnetic field, orbital magnetic moments, the Stern-Gerlach experiment, the Vector atom model, properties of electron spin, magnetic resonance, addition of orbital and spin angular momenta, the spin-orbit interaction, the Zeeman effect: Normal and Anomalous, the Pauli exclusion principle, the ground states of atoms and the periodic table, electron anti-symmetry, the hydrogen and the helium atoms, Molecules: Rigid diatomic molecules, Rotation, Vibration and electronic Spectra
PHY317	Introduction to Monte-Carlo Methods	3	0	3	Recapitulation of Probability theory, Special probability distributions and Central limit theorem. Statistical errors, Markov Chains and master equations, Random number generators, Simple sampling Monte Carlo methods- Comparisons of methods for numerical integration ofgiven functions, Boundary value problems, Simulation of radioactive decay, Simulation of transport properties, The percolation problem, Generation of 'random' walks, Importance sampling Monte Carlo methods- Ising model , Algorithm, Boundary conditions, Finite size effects, Finite sampling time effects, Critical relaxation. Potts model, Quantum Monte Carlo methods -- The Ising model in a transverse field, Fermions on a lattice, Continuous time simulations, Monte Carlo simulations at the periphery of physics and beyond-Astrophysics, Materials science, Chemistry, 'Biologically inspired' physics, 'Traffic' simulations, Econophysics, Finance.
PHY323	Classical Mechanics	3	0	3	Review of Newtonian mechanics, Lagrangian mechanics, generalized coordinates, constraints, principle of virtual work, Lagrange's equation, calculus of variations, collisions, and scattering, small oscillations. Hamilton's equations, phase space & phase trajectories, canonical transformations, Poisson brackets, Hamilton-Jacobi theory.
PHY324	Nanotechnology	3	0	3	Nanoscale Systems: Nanostructures, Band structure and density of states of materials at nanoscale, Size Effects, Applications of Schrodinger equation- quantum confinement of carriers in nanostructures and consequences; Synthesis: Top down and Bottom up approach, Gas phase condensation, Vacuum deposition PVD, CVD. Characterization: XRD, Microscopy, Optical properties: Coulomb interaction in nanostructures, Concept of dielectric constant for nanostructures and charging of nanostructure, Electron Transport: Carrier transport in nanostructures, thermionic emission,

Course Code	Course Title	L	P	U	Course Description
					tunneling and hoping conductivity; Applications: photonic devices, Single electron transfer devices, CNT based transistors, Nanomaterial Devices.
PHY325	Special Theory of Relativity	3	0	3	Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations, Simultaneity and order of events. Lorentz contraction, Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic Kinematics, Doppler effect, Stellar aberration. Time dilation, four vectors. Relativistic Dynamics, Equivalence of mass and energy. Collisions elastic and inelastic. Applications like Mossbauer effect and creation of particles. Field of a moving charge, forces and fields near a current carrying wire, invariance of maxwells equations, limitations of special relativity.
PHY326	Introduction to Acoustics	3	0	3	Introduction to acoustics, Human voice, Physiological and Psychological acoustics, Types of acoustics, Propagation of sound: History of acoustics: speed of sound in air, liquids and solids, determining frequency, Basic linear acoustics, equations of continuum mechanics and linear acoustics, variational formulations, waves of constant frequency, plane waves, attenuation of sound, acoustic intensity and power, impedance, reflection and transmission, spherical waves, cylindrical waves, simple sources of sound, Integral equations in acoustics, waveguides, ducts and resonators, ray acoustics and diffraction. Sound propagation in the atmosphere: Non-linear acoustics in fluids, , lossless finite-amplitude acoustic waves, thermoviscous finite-amplitude acoustic waves, shock waves, interaction of non-linear waves, bubbly liquids, sonoluminescence and acoustic chaos Acoustic signal processing, , Power, energy and power spectrum, statistics, Discrete Fourier transform, The z-transform, Maximum length sequences and Information theory.
PHY327	Introduction to Quantum Computation	3	0	3	Dirac notation and Hilbert spaces, dual vectors, linear operators. The spectral theorem, functions of operators. Tensor products, Schmidt decomposition theorem. State of a quantum system, time-evolution of a closed quantum system, measurement in quantum mechanics. Pure and mixed states, density operator, partial trace, general quantum operators. Bloch-sphere representation of single qubit states, qubit rotations, single qubit gates. The

Course Code	Course Title	L	P	U	Course Description
					quantum circuit model, single and multi-qubit operations, universal sets of quantum gates. Efficiency of approximating unitary transformations, implementing measurements with quantum gates. Probabilistic versus quantum algorithms. Phase kick-back. The Deutsch and Deutsch-Jozsa algorithms. Quantum phase estimation and quantum Fourier transform, error analysis inarbitrary phase estimation. Finding orders, Shor's algorithm for order estimation. Quantum algorithms based on amplitude amplification, Grover's quantum search algorithm and related topics. Mathematical and physical conceptions of quantum entanglement, entanglement distillation, entanglement of formation. Entanglement in pure and mixed states. No-cloning theorem for quantum states.

4. Institute Core Courses Handouts

Course No: **BPCHEM111**	Course Title: **Chemistry**	L	P	U
		3	0	3

Course Learning Objectives

- To integrate the principles of Inorganic, Physical and Industrial chemistry with the relevant domains of core engineering courses offered at B.Tech level.
- To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.
- Provides a comprehensive survey of underlying principles that govern the properties and behavior of chemical systems.
- The student will understand the interdisciplinary nature of chemistry and to integrate knowledge of mathematics, physics and other disciplines to a wide variety of chemical problems.

Course Contents

UNIT-I

Werner's work, recent studies on complexes, Effective atomic number, Nomenclature of coordination compounds, Shapes of d-orbitals, Valence Bond Theory, Crystal Field Theory of Octahedral Complexes, Magnetism, Thermodynamic aspects of crystal field splitting, Tetragonal distortions of Octahedral Complexes (Jahn-Teller Distortions), Square Planar and Tetrahedral Complexes.

UNIT-II

Work and Heat, Internal Energy and Enthalpy, Enthalpy changes accompanying physical change and chemical change, Entropy and 2nd Law, Absolute Entropies and 3rd Law, The Gibb's Energy, The thermodynamics of transition, Phase diagrams, and Phase diagrams of typical materials, The reaction Gibb's energy, Variation of reaction Gibbs energy with composition, Reactions at equilibrium, The standard reaction Gibbs energy, Equilibrium composition, Equilibrium constant in terms of concentration, The response of equilibria to the conditions, Proton transfer equilibria, Salts in water, Solubility equilibria.

UNIT-III

The migration of ions, Half reactions and electrodes, Reactions at electrodes, varieties of cells, The cell reactions, Cell potential, Cells at equilibrium, standard potentials, The variation of potential with pH, Determination of pH, Electrochemical series, Determination of thermodynamic functions.

UNIT-IV

Empirical chemical kinetics, Reaction rates, Temperature dependence of reaction rates, Reaction schemes and reaction mechanisms.

UNIT-V

Basic industrial processes like distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, Emulgator, Scaling up operations in chemical industry, Introduction to clean technology, Introduction to synthesis, properties and application of nano-materials

Text Books:

1. Lee J. D., "*Concise Inorganic Chemistry*", 5th Edition, Blackwell Science, Oxford University Press, New Delhi, 1996.
2. Atkins Peter and De Paula Julio, "*The Elements of Physical Chemistry*", 6th Edition, Oxford University Press, New Delhi, 2015.
3. Felder R.M., Rousseau R.W. "*Elementary Principles of Chemical Processes*", Wiley Publishers, New Delhi, 2006.
4. Dieter Vollath, "*An introduction to synthesis, properties and application of nano-materials*", 2nd Edition, Willey, New York, 2013.

Reference Books:

1. Levine Ira N., "*Physical Chemistry*", 5th Edition, Tata McGraw-Hill, 2002.
2. Mahan Bruce M. and Mayers Rollie J., "*University Chemistry*", 4th Edition, Addison, Wesley Longman, 1998.
3. Huheey James E, Keiter Ellen A and Keiter Richard L., "*Inorganic Chemistry*", 4th Edition, Harper Collins College Publishers, 1993.
4. Stocchi E, "*Industrial Chemistry*" Vol-I, Ellis Horwood Ltd. UK.2006.

Course Outcomes

Upon successful completion of the course student will be able to:

- Understand the chemical behaviour of matter and materials using fundamental knowledge of their nature (i.e. electrons and intermolecular forces)
- Correlate the concepts of thermodynamics learnt with the study of engineering devices covered in Mechanical Engineering.
- Use fundamental chemical principles to make predictions about reactivity and general properties of materials of the built environment.
- Predict potential complications from combining various chemicals or metals in an engineering setting.
- Apply concepts learnt to the basic requirements of Civil Engineering, particularly focusing to the built environment
- Collect, represent and interpret experimental results accurately and concisely using technical narrative, graphs, and tables.

Course No: **BPELS112**	Course Title: **English Language Skills**	L	P	U
		2	4	4

Course Learning Objectives

- Tofamiliarizing learners with aspects of pronunciation to attain intelligibility and grammatical accuracy in spoken and written English.
- To provides intensive practice and extensive exposure to the four basic skills; listening, speaking, reading and writing

Course Contents

UNIT-I

English Sound System: distinction between letters and sounds, classification of English sounds, syllable structure, confusing sounds for practice, words and sentences for practicing vowel contrasts.

Accent Patterns: accentual patterns of single words, accentual patterns of compound words, accent change according to function, sentence accent.

Effective speech: elision of sounds or syllables, addition of sounds or syllables, transposition sounds, pronunciation based on semantics, inflectional suffixes and some common word endings, general suggestions for pronunciation, Pronunciation of consecutive consonants.

Listening skills: hearing and listening, phonetic features of listening, purpose of listening, barrier to listening, guidelines for improving listening.

Art of conversation: small talk, body language, principles of a good conversationalist.

Debate: process of organization, purpose, rebuttal, participating in a debate, preparation for the debate.

Group Discussion: conversation, debate and GD, kinds of groups, importance and features of GD (oral communication skill, leadership skills, intensive listening skills, nonverbal communication clues), strategies of a group interaction, barriers to an effective GD, suggestions for self-improvement.

UNIT-II

Uses of dictionary: the meaning, spelling and pronunciation of a word, antonyms and synonyms, grammar, abbreviations and dictionary symbols, use of thesaurus.

Punctuation: end punctuation marks, internal punctuation marks, direct quotation punctuation marks, word punctuation, spacing with punctuation, too much punctuation.

Prepositions and phrasal verbs: prepositions and phrasal verbs prepositions, Idiomatic combinations, phrasal verbs, Vocabulary extension: context clues, word analysis, semantic change, word-formation methods, antonyms, synonyms, one word substitutions.

Effective use of words: word order, words: its meaning, avoid clichés

Common errors in English: errors in using nouns, errors in using pronouns, errors in using prepositions, errors in using verbs, errors in using gerund/infinitive, use an infinitive not a gerund, errors in using adjectives, errors in using adverbs, errors in using conjunction, errors in using punctuation, common errors due to commonly confused words

UNIT-III

Effective use of sentences: unity and emphasis on sentences, coordination and subordination. Paragraph writing: unity, coherence and development of the paragraph, types of paragraphs, paragraph development.

Essay writing: features of an essay, thesis statement, organization of the material, modes of developing essays, Revise and proofread essay, practice essay.

UNIT-IV

Reading Skill: mechanics of reading, types of reading, reading speed.

UNIT- V

Business correspondence: structure and layout of business letters, enquiry letter and important points, complaint and adjustment letters, complaint letter, important points, sales letter.

Resume writing: elements of resume, preparing a resume, writing a job application letter Presentation Skills: Tips for making presentations.

Text Books:

1. Koneru. A. (2011). English Language Skills. McGraw Hill

Reference Books:

1. Langan, J. (2010). College writing skills. McGraw-Hill, Eighth Edition.
2. Langan, J., & Jenkins, L. (2010). Ten steps to advancing college reading skills. Townsend Press.
3. Swan, M. (2016). Practical English Usage 4th edition.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Develop listening skills to distinguish between letters and sound to use them effectively in speech during standard communication or debates and group discussions.
- Use dictionary and grammar effectively to overcome errors in reading and writing.
- Frame sentences and effectively use while writing paragraphs, essays, business letters and resumes etc.

Course No: **BPMATH113**	Course Title: **Linear Algebra**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To solve systems of linear equations
- To compute standard forms of given matrices
- To compute eigenvalues and eigenvectors of 3x3 real matrices
- To compute quadratic forms and diagonalize matrices.
- To introduce complex matrices and obtain analogues of real matrix theorems

Course Contents

UNIT-I Matrices, Matrix addition, Vectors and Scalar Multiplication, Matrix Multiplication, Rank of a matrix Symmetric, Skew-symmetric matrices Row Operation, Row Equivalence, Row Reduced Echelon Matrices

UNIT-II Linear systems of Equations, Gauss Elimination, Determinant method: Cramer's Rule Solutions of Linear systems, Existence and Uniqueness, Inverse, Gauss-Jordan Method

UNIT-III The matrix eigenvalue problem, Determining eigenvalues and eigenvectors, applications

UNIT-IV Vector spaces, Linear Independence, Inner product spaces, subspaces Linear Transformations, Algebra of linear Transformations, Isomorphism between Matrices and Linear Transformations

UNIT- V Similarity of Matrices, Diagonalization, Quadratic Forms, Canonical forms Complex Matrices and Forms Hermitian, Skew-Hermitian, Unitary matrices and Orthogonal matrices

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Text Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig ,10th Edition, John Wiley & Sons, 2012.

2. An Introduction to Linear Algebra, V. Krishnamurthy, V. P. Mainra, J. L. Arora, East West Press,2002

Reference Books:

1. Linear Algebra and its Applications, Gilbert Strang,
2. 4th Edition, Thomson Brooks, 2006

Course Outcomes

Upon successful completion of the course, student will be able to:

- Systematically solve sets of linear equations of small size
- Analyse eigenvalue/eigenvector problems and compute the same
- Apply the concept of rank for a variety of problems
- Perform diagonalization and related operations on quadratic forms

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Course No: **BPPHY114**	Course Title: **Physics-I**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

Develop an understanding of the basic principles of Mechanics and wave optics and the application of the principles with emphasis on problem solving skills.

Course Content:

UNIT I

Conservation of Momentum: Collisions, Impulse-Momentum Theorem, Conservation of Momentum, Two-body collisions, Complex Motions, Many-particle systems, Center of Mass and Conservation of momentum

UNIT II

Rotational motion: Rotational Kinematics, Relation between linear and angular variables, Torque and Rotational inertia, rolling without slipping, Angular momentum for system of particles, Conservation of angular momentum

UNIT III

Conservation of Energy: Work, Energy and Power, Work-Energy theorem, Conservative forces, Potential energy, Conservation of mech. Energy, Work done by ext. force, Frictional force, Conservation of total energy

UNIT IV

Oscillators and Waves: Simple Harmonic Oscillator, Free, Damped and Forced Oscillations, Types of waves, Traveling waves, Interference of waves, Standing waves etc

UNIT V

Optics: Double-Slit interference, Interference due to thin films, Single Slit diffraction Intensity calculation, Multiple slits, Diffraction gratings, Dispersion and Resolving power

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Text Books:

1. Robert Resnick, David Halliday and Kenneth S. Krane "Physics", Vol. I and II, 5th Edition John Wiley Inc, Singapore, 2002.

Reference Books:

1. Robert Resnick, David Halliday and Jearl Walker "*Fundamentals of Physics*", 6th Edition, John Wiley Inc, Singapore, 2001.
2. Cutnell and Johnson, "*Physics*", 5th Edition, John Wiley, Asia, 2001.

Course Outcomes

- Apply conservation of linear momentum to two/many body systems in lab and centre of mass frame of reference.
- Apply conservation of angular momentum to two/many body systems in lab and centre of mass frame of reference.
- Apply the conservation of energy principle and find the work done by a body under the influence of conservative/non-conservative forces.
- Understand the types of oscillations/waves and the fundamental equations governing them.
- Understand the physics of the most important phenomena in wave optics, namely, interference, diffraction.

Skill Development:
This being a first level course, the following aspects are included into the curriculum to enhance the analytical, mathematical and logical thinking abilities of the students. These following tasks will help them to apply physical concepts to various real life situations and areas of engineering and enhance their intuitive abilities with respect to concepts taught in this course.

1. Assignments: The course has assignments as a component of evaluation and these are spread over the entire semester. In this, students are given numerical and situational questions are given, related to the concepts taught.

a) These will help them to acquire problem solving and critical thinking skills and reasoning abilities allowing them to apply the concepts of physics to real life problems
b) Social and organizational skills like time management, team work are the skills which can be acquired

2. Experiments: The scientific measurement course which runs in parallel to this course has experiments related to the concepts taught in the physics courses. The experiments relavent to this course are

1. Graphical analysis
2. Error analysis

3. Simple Pendulum
4. Compound Pendulum
5. Fly wheel
6. Law of parallelogram

The skills that can be developed include

1. Associating the experiment to the relevant concepts
2. Understanding the principles and the working of various equipment and tools used.
3. Correct usage of equipment
4. data collection and organization
5. graphical and numerical analysis of data
6. interpretation of experimental results and arriving at conclusions
7. Writing a technical report

   In addition, the social and organizational skills developed are team work, coordination, time management, collaboration and communication.

Course No: **BPTA115**	Course Title: **Engineering Graphics**	**L**	**P**	**U**
		2	**4**	**4**

Course Learning Objectives

- To enhance the visualization and imagination abilities
- To promote creative thinking for solving engineering problems.
- To take data and transform it into drawings.
- To learn basic Auto CAD skills
- To learn basic Engineering formats

Course Contents

UNIT-I

Drawing conventions & Practices, Dimensioning, Geometrical terms, bisecting a line, angle, arc. Regular polygons, curves.

Introduction to CAD, limits, toolbars, starting new drawing, saving new drawing, etc. Simple commands like line, circle, polygon, etc and formatting commands, 2D exercises

UNIT-II

First and third angle projections, Multi view drawing from pictorial views. Projections of points, Projection of lines, true lengths, true inclinations, shortest distances between lines.

UNIT-III

Projections of planes, Primary and Secondary auxiliary views, true shapes. Projections of solids inclined to both the planes.

UNIT-IV

Construction of Sectional views of truncated solids, Development of surfaces - Parallel Line method, Radial Line Method, Intersection of surfaces

UNIT- V

Construction of isometric views from orthographic projections, Missing Views- identifying missing Views.

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Text Books

1. Engineering Drawing with an Introduction to AutoCAD, D.A.Jolhe, TMH, 5th edition, 2010
2. Fundamentals of Engineering Drawing, Warren J. Luzzader & Duff J. M., PHI, 11th edition., 2015

Reference Books

1. Engineering Drawing, K.Venugopal, New Age International (P)., 2006
2. Engineering Drawing, N.D.Bhatt, V.M.Panchal , Charotar Publishing, 53rd edition, 2014
3. Engineering Graphics with Auto CAD 2002", James D. Bethune, PHI, 2002

Course Outcomes

Upon successful completion of the course, student will be able to:

- To specify units, limits of drawing. It also includes creating and editing 2 D computer geometry, and constructing lines, arcs, chamfers and fillets.
- Draw parallel and perpendicular lines, and to construct circles, arcs, tangencies and curves.
- Apply standard vertical, horizontal, radius, diameter, and other dimensions to an engineering drawing.
- Generate Engineering Drawings using drafting tools
- Visualize geometrical solids in 3D space through exercises in Orthographic Projections
- Draw auxiliary views and isometric views
- Develop the surfaces of geometrical solids

Course No: BPTA116	Course Title: **Computer Programming I**	L	P	U
		3	0	3

Course Learning Objectives

- To introduce the basic concepts of UNIX operating systems.
- To understand the fundamentals of Problem Solving.
- To learn how to design and program Python applications.
- To learn how to design object-oriented programs with Python classes.
- To learn how to use exception handling in Python applications for error handling.

Course Contents

UNIT-I

Introduction to UNIX: Multi-programming, Time sharing, personal computer, and UNIX operating system, etc. **General Purpose Utilities & File System:** cal, date, and echo, etc directory related commands: pwd, cd, mkdir, rmdir, file related commands.**Simple and Advanced Filters:** head, tail, paste, sort, uniq, grep and sed, etc, **Basics of Problem solving: Building** blocks of algorithms (statements, state, control flow, functions), notation.

UNIT-II

Algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion), Example: find minimum in a list, insert a card in a list of sorted cards, and Towers of Hanoi etc. **Introduction to python:** History of Python, Need of Python Programming, Applications Basics of Python Programming, Data Types: Declaring and using Numeric data types.

UNIT-III

Data Types string data type and string operations, fining list and list slicing, Tuple, string, list and dictionaries **Python Program Flow Control:** if, else and else if, for loop, while loops continue, and break **Python Sequences:** String in build methods, List and dictionary manipulation, Programming using string, list and dictionary

UNIT-IV

Python Functions: Organizing python codes using functions **Python Modules:** Organizing python projects into modules, importing own module as well as external modules **Python Packages:** Lambda function, Programming using functions, modules and external packages

UNIT-V

Python Object Oriented Programming: Class, object and instances Constructor, class attributes and destructors, Real time use of class in live projects Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, **Exception Handling:** Avoiding code break using exception handling, Safe guarding file operation is using exception handling, Handling and helping developer with error code.**AWS Educate:** Introduction to Cloud Computing, Overview of Cloud Models, Cloud Inventor Certification.

Text Books:

1. Learning Python, Mark Lutz, Orielly, 5 Edition, 2013.

Reference Books:

1. How to Think Like a Computer Scientist: Learning with Python 3, Peter Wentworth, Jeffrey Elkner, Allen B. Downey and Chris Meyers, 3rd Edition, 2019.
2. Fundamentals of Python: First Programs, Kenneth A. Lambert, Cengage, 1st Edition, 2011.
3. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition, 2013.
4. UNIX Concepts and Applications, Sumitabha Das, TMH, 4th edition, 2006.

Course Outcomes

After successful completion of the course student will be able to

- To execute shell commands in Linux.
- Understand, analyze and solve problems using algorithmic approach.
- Write Python programs using conditional statements, loops and functions.
- Use Python data structures –- lists, tuples, dictionaries.
- Do input/output with files in Python.
- Understand the Importance of cloud computing and its applications.

Course No: BPEVS117	Course Title: **Environmental Science**	L	P	U
		2	0	2

Course Learning Objectives

- To understand the fundamentals of environment
- To understand the science of interrelationship between the living organisms and their environment
- To understand the relationship between the population and the environment.
- To have an understanding about the land resources, water resources, air recourses and their pollution, control methods
- To have an understanding about the waste management.
- To know about the environmental policies and laws.

Course Contents

UNIT-I

Meaning of Environment, Types and components of environment, nature and scope of the subject, Need for environment studies, goals of environmental education, environmental education programs, Man-environment relationship, biogeochemical cycles.

UNIT-II

Concept of ecology, Subdivisions and developmental phases of ecology, Concept of the ecosystem, Structural and functional aspects of ecosystem, Productivity concept of ecosystem, food chains and food webs in ecosystems, Ecological energitics, ecological interactions, Population ecology, Population characteristics, Population dynamics, population regulation.

UNIT-III

Nature and importance of soil, Formation of soil, soil properties, Nutrients in soil soil erosion, contamination of soil, Land use, Waste lands, Desertification.Introduction, properties of water, hydrological cycle, Water resources, waste water of India-its future, Water pollution, Pollution of ground water.

UNIT-IV

Origin of the atmosphere, composition of the air, structure of the atmosphere, Air pollution, Effects of air pollution on human health, flora and fauna, Global effects of air pollution.

UNIT-V

Energy, sources of energy, conventional and non conventional sources of energy, Waste water management, biomedical waste management, Air pollution control, Environmental policies and laws.

Text Books:

(1) A Text Book of Environment, Agarwal, K.M., Sikdar, P.K and Deb.S.C Mac Millan India Ltd., 2002.

Reference Books:

(1) A Text Book on Environmental Science, V. Subramanian, Third reprint, Narosa Publishing House, 2005.

(2) Environment, Raven, Peter H., and Linda R. Berg. 3rd ed., Fort Worth: Harcourt College Publishers, 2001.

Course Outcomes

After successful completion of the course student will be able to

- Understand the natural environment and its relationships with human activities.
- Characterize and analyze human impacts on the environment.
- Integrate facts, concepts, and methods from multiple disciplines and apply to environmental issues.
- Acquire practical skills; devise methodologies for scientific problem-solving, including familiarity with laboratory and field instrumentation.
- Understand and implement scientific research strategies, including collection, management, evaluation and interpretation of environmental data.
- Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Course No: BPES121	Course Title: **Thermodynamics**	L	P	U
		3	0	3

Course Learning Objectives

- To study the properties of pure substances and their use in widely used devices such as steam power plant, fuel cells, refrigerator, Turbine and Pumps.
- To know how to use the thermodynamic tables to identify the phase of a given state of matter and estimate the quality of saturated liquid vapor mixture
- To understand the concept of heat and work and estimate the same at the boundary of real time systems
- To know the application of first law for closed systems and the interpretation of thermodynamic properties such as Internal Energy and Enthalpy and determine their change during a process; To know the application of first law for control volume systems and to understand the transient process
- To know the application of second law of thermodynamics and to know the thermodynamic temperature scale; To understand the concept of entropy and entropy change in solid, liquid and liquids and gases
- To delimit the application of second law for control volume systems and to understand the concept of efficiency of engines

Course Contents

UNIT-I

Introduction to some devices like steam power plant, fuel cells etc.; Thermodynamic system, properties and state, processes and cycles, force, energy, pressure, specific volume, Zeroth law and numerical problems; Phase equilibrium, independent property, compressibility factor; Study of steam tables and solving numerical problems.

UNIT-II

The concept of heat and work: Definition of work, understanding of piston work; Understanding of heat concept, modes of heat transfer and numerical problems on it; Definition of first law, first law for a change of state, internal energy and enthalpy; Specific heat, internal energy and enthalpy of an ideal gas, first law as a rate equation and numerical problems

UNIT-III

Application of first law for control volume systems: Conservation of mass in control volume, first law for a control volume, SSSF process and examples on it viz. Heat exchangers, Nozzles and diffusers, Throttle, Compressor & Pump, Steam Power Plant and Refrigerator; Transient process: Study of USUF process, numerical problems on it

UNIT-IV

Application of second law of thermodynamics: Heat engines and refrigerators, the Clausius and the Kelvin plank statement, reversible and irreversible processes, study of Carnot cycle and efficiency of a cycle; Thermodynamic and ideal gas temperature scale, numerical problems on it

UNIT-V

The concept of entropy: Clausius inequality, study of entropy as a property, thermodynamic property relations, entropy change of reversible and irreversible processes, entropy generation and principle of increase of entropy; Entropy change in solid, liquid and gases, polytropic process, entropy as rate equation, numerical problems; Second law for control volume, study of entropy for both reversible and irreversible processes, principle of increase of entropy; Understanding efficiency and related numerical problems

Text Books:

1. Fundamentals of Thermodynamics ISV, Sonntag R E & Claus B John Wiley, 7th Edition, 2009.

Reference Books:

1. Thermodynamics, P.K.Nag, Tata Mc Graw Hill Publishing Company limited, New Delhi, 3rd Edition, 2004.
2. Fundamentals of Engineering Thermodynamics, Michael J Moran and Howard N Shapiro, John Wiley, 5th Edition, 2004.
3. Thermodynamics- An Engineering Approach, Yunus A. Cengel and Michael A Boles, Tata Mc Graw Hill Publishing Company limited, New Delhi, 5th Edition, 2006.

Course Outcomes

Upon successful completion of the course, student will be able to:

- *Identify* and explain the basic concepts of thermodynamics like system, properties and their quantification
- *Calculate* thermodynamic properties using steam tables and *analyze* the processes on T-v diagrams to solve advanced engineering problems
- *Explain* the concept of thermodynamic work. *Calculate* and *compare* work for systems executing different thermodynamic processes or different thermodynamic cycles
- *State* and *apply* the first law of thermodynamics for closed and open systems undergoing different thermodynamic processes. *Evaluate* the performance of steam power plants, refrigeration plants and their components
- *Evaluate* the feasibility of a thermodynamic cycle using the second law of thermodynamics for typical engineering problems
- *Quantify* the second law of thermodynamics for a cycle by establishing the inequality of Clausius. *Apply* the inequality of Clausius and *establish* the property, entropy of a system. *Apply* principle of increase of entropy to *evaluate* the feasibility of a thermodynamic process

Course No: BPAO122	Course Title: **Probability & Statistics**	L	P	U
		3	0	3

Course Learning Objectives

- This course introduces the concept of probability and enables the student to become familiar with probabilistic concepts,
- A selected study of discrete & continuous distributions and their characteristics

Course Contents:

UNIT-I

Sample Spaces and Events, Counting, Probability, The Axioms of Probability, Some elementary Theorems, Conditional Probability, Bayes' Theorem

UNIT-II

Random Variables, The Binomial Distribution, The Hypergeometric Distribution, The Mean and the Variance of a Probability Distribution, Chebyshev's Theorem, The Poisson Distribution, Poisson Processes, The Geometric and Negative Binomial Distribution, The Multinomial Distribution.

UNIT-III

Continuous Random Variables, Normal Distribution, Normal Approximation to the Binomial Distribution, Other Probability Densities, the Uniform Distribution, Log-Normal Distribution, Gamma Distribution, Beta Distribution, TheWeibull Distribution.

UNIT-IV

Joint Distributions—Discrete and Continuous, Moment Generating Functions.

UNIT- V

Populations and Samples, The Sampling Distribution of the Mean (σ known), The Sampling Distribution of the Mean (σ unknown), The Sampling Distribution of the Variance, representations of the Normal Theory Distributions.

Text Books:

1. Miller & Freund's Probability & Statistics for Engineers: Johnson Richard A., Eastern. Economy Edition, PHI, 7th Edition, 2006

Reference Books:

1. Mathematical Statistics: Freund, J.E.: Prentice Hall, 6th Edition,2002
2. Applied Statistics and Probability for Engineers: Douglas C. Montgomery, & George C. Runger, John Wiley & Sons, Inc., 3rd Edition, 2004

Course Outcomes

Upon successful completion of the course, student will be able to:

- Calculate probabilities and other relevant quantities by selecting suitable probability distributions.
- Work with certain multivariate distributions and derive marginal and conditional probability distributions.

Course No: BPMATH123	Course Title: **Higher Calculus**	L	P	U
		3	0	3

Course Learning Objectives

- Use calculus to study the paths, velocities, and accelerations of moving bodies
- To study the applications of derivative motion in space
- To understand the frame of mutually orthogonal unit vectors
- To study the functions of more than one independent variable, the way to graph them
- To understand the idea of directional derivatives and the equations of tangent planes and normal lines
- To find extreme values of functions of several variable
- To find the volume of three dimensional shapes using triple integrals
- To calculate the work done by variable forces alone paths in space and rates at which fluids flow along curves and cross boundaries
- To describe the relationship between the way an incompressible fluid flows across the boundary of a plane region and the way it moves inside the region
- To understand Infinite summations

Course Contents:

UNIT-I
Limits, Continuity and Differentiability of vector functions, Velocity & Unit tangent vector, Normal vectors, Curvature, Torsion and the binormal, Tangential & normal components of velocity and acceleration.

UNIT-II
Functions of several variables, Limits and continuity in higher dimensions, Partial derivatives, differentials, linearization, Taylors formula for two variables, Chain rule for derivative, Directions derivatives, Gradient and Tangent planes, Maxima,Minima with application, Polar coordinates: Definition, graphing and conics.

UNIT-III
Double integrals in rectangular coordinates, Double integrals in polar coordinates, Cylindrical and spherical coordinates, Triple integrals in rectangular, cylindrical and spherical coordinates (moments, masses and centroids), Substitution in multiple integrals, Jacobian.

UNIT-IV
Lines integrals, potential & Conservatives fields, Green's, Gauss, and Stokes theorems, Surface area and surface integrals.

UNIT-V
Infinites series, convergence & divergence, Integral, Comparison & Ratio Tests, Alternating series and absolute Convergence.

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Text Books:

Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2012.

Reference Books:

1. Thomas G.B. and Finney R. L., Calculus and Analytic Geometry, Pearson Education, 11th ed., 2008.
2. Salas S. L., Einar Hille and Garret J. Etgen, Calculus (One and Several variables), John Wiley, 8th Edition, 1999.

Course Outcomes

After successful completion of the course student will be able to

- Students will learn important tools of calculus in higher dimensions.
- Engineering applications will help the student appreciate the role of the course in B.Tech
- Geogebra software exposure for mathematical problem solving
- Students will become familiar with 2- and 3-dimensional coordinate systems.
- Students will also learn how to represent motion of objects in 3D using vector functions, how to represent velocity and acceleration using vector projections into tangential and centripetal coordinates of acceleration, and how to characterize curves in space by computing arc length and curvature.
- For functions of 3D surfaces, students will be able to characterize aspects of surfaces and volumes using partial derivatives and the gradient vector.
- Partial derivatives will also be used to describe approximating tangent planes to points on surfaces, and how to compute derivatives of multi-dimensional function compositions can be performed using a multidimensional version of the chain rule.
- Evaluating Double and Triple Integrals.

Course No: BPPHY124	Course Title: **Physics-II**	L	P	U
		3	0	3

Course Learning Objectives

Develop an understanding of the basic principles of electromagnetism and the application of the principles with emphasis on problem solving skills.

Course Content:

UNIT I

Coulomb's law, continuous charge distributions. Electric field of point charges, continuous charge distributions, field lines, point charge and dipole in an electric field. Flux of a vector field, flux of electric field, Gauss' law, its applications, Gauss' law and conductors.

UNIT II

Electric potential, potential due to point charges and continuous charge distribution, calculating field from potential, potential from field, equipotential surfaces, potential of a charged conductor. Types of materials, conductor in an electric field, Ohm's law, Ohmic materials. Capacitance, calculation of capacitance, capacitors in series and parallel, energy storage in an electric field, capacitor with dielectric

UNIT III

Magnetic interactions, magnetic poles, force on a moving charge, circulating charges, force on a current carrying wire, Hall effect, torque on a current loop. Magnetic field due to moving charge, due to current, parallel currents, field of a solenoid, Ampere's law.

UNIT IV

Faraday's law, Lenz' law, motional emf, induced electric fields. Magnetic dipole and force on a magnetic dipole in a non-uniform field, Magnetization, Gauss' law for magnetism. Inductance, calculating the inductance, energy storage in magnetic field

UNIT V

Equations of electromagnetism, Maxwell's equations, induced magnetic fields and Displacement currents. Concept of photons, Thermal radiation, photoelectric effect. Matter waves, de Broglie's hypothesis, experimental verification by Davison and Germer experiment, uncertainty principle.

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Text Books:

1. Physics, Robert Resnick, David Halliday and Kenneth S. Krane Vol. 2, John Wiley, 5th ed., 2002.

Reference Books:

1. Fundamentals of Physics, Robert Resnick, David Halliday and Jearl Walker, John Wiley, 6th ed., 2001.
2. Physics, Cutnell and Johnson, John Wiley, 5th ed., 2001.
3. Introduction to Electrodynamics, David J Griffiths, PHI, 3rd ed., 2002.

Course Outcomes

Upon successful completion of the course student will be able to:

- Understand the main concepts of electromagnetic theory
- Develop the mathematical framework to explore electricity and magnetism
- Apply the mathematical framework quantitatively for solving relevant problems
- Appreciate qualitatively how they play a role in many aspects of daily life.

Skill development:

Physics-II is a first level course, and the following aspects are included into the curriculum to enhance analytical, mathematical and logical abilities of the students. These following tasks will help them to apply physical concepts to various real life situations and areas of engineering and enhance their intuitive abilities, with respect to concepts taught.

1. Assignments:
   these will help students acquire problem solving and critical thinking skills, reasoning abilities and allow them to apply the concepts of physics to solve real life problems. Social and organization skills like team work and time management can be acquired through assignments.

   The course has assignments as a component of evaluation spread over the entire semester. Students are assigned numericals and situational questions related to concepts taught.

2. Experiments:
   Scientific measurement course run parallel to the first level Physics courses and has experiments related to the concepts taught.
   The experiments relevant to Physics-II are

- Stewart and Gees experiment
- Hall effect
- Solar cell
- LCR circuit
- Plancks constant
- e/m measurent

The skills that can be developed include associating the experiment to the relevant concept use of various equipments and tools understanding the principles and the working of th equipments used correct usage of the equipments data collection and organization graphical and numerical analysis of data interpretation of experimental results arriving at conclusions technical report writing.

In addition, the social and organizational skills developed are team work, coordination, time management, collaboration and communication.

Course No: BPTA125	Course Title: **Scientific Measurements**	L	P	U
		0	4	2

- **List of Physics experiments:**

No.s	Experiments	Duration
1.	Vernier calipers and Screw gauge	1:40 H
2	Graphical Analysis	1:40 H
3.	Error analysis and Graph drawing	1:40 H
4.	Compound pendulum	1:40 H
5.	Parallelogram law of forces and Lami's Theorem	1:40 H
6.	Dispersive power of the material of the a prism	1:40 H
7.	Fly Wheel	1:40 H
8.	Diffraction Grating	1:40 H
9.	Magnetic Field along the Axis of Current Carrying Coil – Stewart and Gees Method	1:40 H
10	Hall Effect	1:40 H

- **List of Chemistry experiments:**

No.s	Name of the Experiment	Duration
1.	Estimation of iron (Fe^{+2}) by Dichrometery	1:40 H
2.	Estimation of copper by Iodometry	1:40 H
3.	pH curve of an Acid Base titration	1:40 H
4.	Dissociation constant of a weak electrolyte by conductometry	1:40 H
5.	Colorimetric estimation of Iron	1:40 H
6.	Estimation of strength of oxalic acid using potassium permanganate as an intermediate solution	1:40 H
7.	Synthesis of Nickel(II)-Dimethylglyoxime complex	1:40 H
8.	Determination of rate constant and activation energy of the given ester catalysed by an acid	1:40 H

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Course No: BPTA126	Course Title: **Workshop Practice**	L	P	U
		2	4	4

Course Learning Objectives

1. To learn how the physical artifacts we use are manufactured and gain technical knowledge and skills.
2. The practical knowledge is supplemented by the lectures to provide the knowledge and genesis of various manufacturing processes.
3. To check the dimensional tolerances of machined components and acquire knowledge of handling basic machine tools for different applications.
4. To develop skills required for machining components by advanced manufacturing methods like CNC programming.
5. To analyse the difference between conventional and non-conventional manufacturing processes.

Course Contents

UNIT-I

Basics of Manufacturing: Basics, ethics and safety in workshop, Material properties, fracture, selection, mechanical properties, common engineering materials, Metrology, quality, Inspection measuring and gauging, Limits & fits, Examples.

UNIT-II

Metal Cutting Basics: Metal cutting, Machine tools, Cutting tools, Tool material, Types of tools, Tool geometry, Chips, Cutting fluid, Tool life, Lathe machine tool, Turning and other operations,Operating conditions, MRR, Examples.

UNIT-III

Machine Shop Activities: Introduction to other Machines, tools, operating conditions, Shaping & planing machines, Milling machine, types of milling operations, Operating conditions, Milling operations, MRR, Abrasive machine, abrasives, Grinding, Grinding wheel, Grinding machines, fine finishing operations.

UNIT-IV

Sheet metal working: Production of parts by forming processes, Metal forming processes, rolling, extrusion, forging, Punches and dies, Sheet metal operations.

UNIT- V

Mechanical joining processes: Production of parts by casting processes, Mechanical joining, Welding (arc, gas), Soldering, Brazing, Fasteners, Examples, Application of Computers in Manufacturing, CNC programming for machining components using co-ordinate system, Automation, Comparison between conventional machines and NC machines.

Text Books:

1. B S Nagendra Parashar and R K Mittal, Elements of Manufacturing Process, Prentice Hall of India, 2011, 10th reprint.

Reference Books:

1. Campbell J.S., Principles of Manufacturing Materials and Processes, Tata Mc-Graw-Hill, New Delhi, 1999 print.
2. Serope Kalpakjain, Steven Schmidt, Manufacturing Engineering and Technology, Pearson, 7th Edition, 2014.

Course Outcomes

Upon successful completion of the course, student will be able to:

- The course will provide an overview of the techniques and applications of basic manufacturing processes used for producing finished articles from raw materials.
- The course is practice-orientated and requires that basic skills in handling of tools, machines and machine tools used in different manufacturing processes are acquired through the hands-on experience.
- Much of the knowledge in the course is conceptual and this knowledge will be useful in whatever discipline the students are going to specialize.

Course No: BPTA127	Course Title: **Computer Programming II**	L	P	U
		3	0	3

Course Learning Objectives

- To introduce object-oriented programming (OOP) using the Java programming language.
- To learn how to use the Java SDK environment to create, debug and run simple Java programs.
- To introduce Arrays, Abstract Classes, Exception Handling, File I/O and Multithreading.
- To provide hands-on experience in developing Java applications using database connections.

Course Contents

UNIT-I

Introduction to Java: Java Development Kit, Keywords, Identifiers, Class libraries, Key Attributes of OOP, Primitive Data types, Literals, Variables, Scope and lifetime of variables, Operators, Type casting, Operator precedence, Expressions. If Statement, Loops, Nested loops. **Class Fundamentals**: Objects, Reference Variables and Assignment, Methods, Constructors, Parameterized Constructors, new operator, Garbage collection, finalizers, and this keyword.

UNIT-II

Arrays: Multidimensional arrays, Alternative Array declaration syntax, using length member, Constructing Strings, Operating on Strings, Array of Strings, Using a string to control switch statement, Command line arguments, Conditional operator. Controlling access to class members, passing objects to methods, Returning Objects, Method Overloading, Overloading Constructor, Recursion, static keyword, Nested and inner classes, vararags

UNIT-III

Inheritance: Basics, Member access, Constructor and Inheritance, using super keyword, multi-level hierarchy, method overriding, abstract classes, creating and implementing an interface, multiple interfaces. **Package:** Packages and member access, Importing packages, static import

UNIT-IV

Exception: Exception Hierarchy, Multiple catch clauses, catching sub class exception, nested try blocks, throwing an exception, finally, throws, Java's Built in Exceptions. Introduction to I/O, Byte stream and Character stream, Reading and writing files using byte stream, Multithreading: Fundamentals, Life Cycle, Thread class, Runnable Interface, Multiple Threads, Thread priorities, Synchronization.

UNIT-V

Database Connectivity: Overview of RDBMS, Call Level Interface (CLI), JDBC, JDBC Architecture, types of JDBC Drivers, JDBC Connection using Statement, Prepared Statemen and Callable Statement, Scrollable and Updatable Result Set, Inserting & Fetching from BLOB Columns, Managing Transactions in JDBC. **Exploring My Cloud Powered by AWS:** Virtualization, Types of Virtualization, Cloud Containers, Client server computing, Big Data, Data Analytics, Data Visualization, DBMS, Relational and Non-Relational DBMS, Data Warehouse Basics, HTML basics to design a Web Page, QoS Factors, File System, Load Balancing, and Domain Name System.

Text Books:

1. Java Fundamentals A Comprehensive Introduction, Herbert Schildt, Dale Skrien. Tata McGraw Hill, 1st Edition, 2013.

Reference Books:

2. Java The Complete Reference, Herbert Schildt, 7th Ed. TataMcGrawHill (2007)
3. Programming with Java A Primer, E. Balaguruswamy,3rd Ed,TataMcGrawHill 2007
4. Object Oriented Programming with Java: Essentials and Applications, Rajkumar Buyya, Thamarai Selvi Somasundaram, Xingchen Chu, 1st Ed. TataMcGrawHill 2010
5. Java How to Program, Paul Dietel and Hervey Dietel, 9th Edition

Course Outcomes

After successful completion of the course student will be able to

1. Understand object-oriented programming concepts and basics of java programming
2. Solve real world problems using OOP techniques
3. Understand the use of abstract classes, packages and interfaces.
4. Expand their knowledge of AWS cloud computing models, services and tools through narrative-based scenarios and short interactive tasks.

Course No: BPES211	Course Title: **Electrical Sciences I**	L	P	U
		3	0	3

Course Learning Objectives

- To equip the students with a basic understanding of Electrical circuits and machines for specific types of applications.

Course Contents

UNIT-I

DC Circuits, Kirchhoff's Laws, Mesh & Nodal analysis, D.C transients- First order & second order circuits- The natural and complete Response

UNIT-II

Thevenins & Nortons theorem, Linearity, Superposition, Maximum power transfer theorems, Star- Delta transformation and Concept of Duality

UNIT-III

AC Circuits: Current, voltage, power, - circuit elements R, L and C, phasor diagram, impedance, real and reactive power in single phase circuits, Steady state analysis of AC circuits using Phasor Method, Resonance in series and parallel circuits

UNIT-IV

Transformers- Introduction, Ideal transformer with and without core losses, Transformer circuit model, Determination of parameters and voltage regulation & efficiency.

UNIT- V

Induction motor, circuit model & Rotating magnetic field, Torque-Slip characteristics, Synchronous machines and and applications.

Text Books:

1. Hughes revised by Mckenzie Smith with John Hilcy and Keith Brown, *'Electrical and Electronics Technology', 8th Edition, Pearson, 2012*

Reference Books:

1. D. P. Kothari and I. J. Nagrath, *Basic Electrical Engineering*, Tata McGraw Hill, 2009, Third edition
2. Leonard Bobrow, *Fundamentals of Electrical Engineering*, Oxford University Press 2nd edition 2005
3. W.H.Hayt, J.E. Kemmerly, *Engineering circuit analysis*, McGraw Hill Company, 6th Edition, 2000.

Course Outcomes

- The students shall develop an intuitive understanding of the circuit analysis, basic concepts of electrical machines and be able to apply them in practical situation.

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Course No: BPES212	Course Title: **Digital Electronics**	L	P	U
		2	2	3

Course Learning Objectives

- To obtain the knowledge of basic tools for the design of digital circuits.
- To understand the methods, procedures suitable for a variety of digital computers and related applications.

Course Content

UNIT-I

Review of number systems-representation-conversions, Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms-minterm and maxterm.

UNIT-II

Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Quine Mc Cluskey method, Implementation of Boolean expressions using universal gates.

UNIT-III

Combinational logic circuits- adders, subtractors, BCD adder, ripple carry look ahead adders, parity generator, decoders, encoders, multiplexers, demultiplexers, Realization of Boolean expressions- using decoders-using multiplexers. Memories – ROM- organization, expansion. PROMs. Types of RAMs – Basic structure, organization, Static and dynamic RAMs, PLDs, PLAs, PALs, Dual Data RAM (DDR), FPGA

UNIT-IV

Sequential circuits – latches, flip flops, edge triggering, asynchronous inputs. Shift registers, Universal shift register, applications. Binary counters – Synchronous and asynchronous up/down counters, mod-N counter, Counters for random sequence.

UNIT-V

Synchronous circuit analysis and design: structure and operation, analysis-transition equations, state tables and state diagrams, Modelling- Moore machine and Mealy machines, Serial binary adder, sequence detector, state table reduction, state assignment. Hazard; Overview and comparison of logic families.

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Text Books

1. M Morris Mano, *Digital Design*, 5th edition, Pearson Education ,New Delhi,2013.

Reference Books

1. Charles H. Roth, Jr, Fundamentals *of Logic Design*, 5th Edition, CENGAGE Learning, India, 2004.
2. ZVI Kohavi and Niraj K Jha, *Switching and Finite Automata Theory*, 3rd Edition, Cambridge University Press, New Delhi, 2011.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Realize complex logic functions utilizing programmable logic.
- Apply the digital design principles in real time applications.

Course No: BPES213	Course Title: **Engineerng Mechanics**	L	P	U
		3	0	3

Course Learning Objectives

- To introduce the basic principles of engineering mechanics.
- To introduce concepts of equilibrium of bodies at rest and in dynamics, the motion of bodies and the forces that cause them.
- To emphasize analysis and application to practical engineering problems.
- To promote thinking and problem solving capacity of students.

Course Content

UNIT I

Concurrent forces on a plane – composition, Resolution and equilibrium of concurrent coplanar forces, Methods of moment, Friction, Parallel forces in a plane – General case of parallel forces,

UNIT II

Center of parallel forces and center of gravity- centroids of composite plane figure and curves, Moments of inertia - Plane figure with respect to an axis in its plane and perpendicular to the plane – parallel axis theorem

UNIT III

General case of forces in a plane – composition and, equilibrium of forces in a plane –plane trusses – method of joints and method of sections, Principle of virtual work equilibrium of ideal systems

UNIT IV

Rectilinear Translation – Kinematics – Principles of Dynamics - D' Alembert's Principle- Momentum and impulse- work and energy- impact

UNIT V

Curvilinear translation – Kinematics – equation of motion – projectile – D' Alembert's Principle for curvilinear motion – Kinetics of Rotation of rigid body

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

Text Books

1. S Timoshenko & D.H Young , "*Engineering Mechanics*"McGraw Hill, 4th Edition

Reference Books

1. Fundamental of Engineering Mechanics: S. Rajesekharan& G. SankaraSubramanium ; Vikas Publishing House Pvt. Ltd., (2nd Edition)
2. Engineering Mechanics : K.L Kumar; Tata McGraw Hill, 4th Edition
3. A K Tayal, Engineering Mechanics, Umesh Publication, Delhi, 14th Edition.

Course Outcomes

Upon successful completion of this subject students should be able to:

- Apply the concepts of equilibrium to system of forces on rigid bodies.
- Simplify and clarify mechanics problems using free body diagrams.
- Analyze equilibrium of rigid bodies with frictional forces.
- Determine force couples, centre of gravity and moment of inertia of rigid bodies.
- Determine simple dynamic variables and solve simple dynamic problems involving kinematics, energy and momentum.
- Analyze simple statically determinate structures such as beams, pin jointed trusses and pin jointed frames subjected to various loading and supporting conditions.

Course No: **BPECON214**	Course Title: **Principles of Economics**	L	P	U
		3	0	3

Course Learning Objectives

The course aims to provide to the students an insight into the scientific & analytical methods, techniques and tools of economics, a precise and comprehensive coverage of fundamental concepts in economics; and give suitable examples to expose him/her to possibilities of applications of these concepts in business and economic policy.

Course Content

- Introduction to Economics
- Application of Supply & Demand & Elasticity
- Demand and Consumer Behaviour
- Production & Business Organization
- Analysis of Costs
- Input Pricing by marginal productivity
- Perfectly Competitive Markets
- Imperfect Competition and its polar case of monopoly
- Oligopoly and Monopolistic Competition
- Externalities, Public Goods & Imperfect Information
- Macroeconomic concerns and its components
- GDP, Growth, Unemployment & Inflation
- Multiplier, Fiscal Policy at work
- Monetary Policy at Work and Money Supply.
- Open Economy

Text Books

1. Principles of Economics, Case E. Karl & Fair C., Pearson Education, 6th Edition, 2002.

Reference Books

1. Economics, Samuelson & Nordhus, TMH, 16th Edition, 1998.
2. Principles of Economics, Lipsey, RG & K.A. Chrystal, Oxford University Press, 9th Edition, 1999

Course No: BPMATHC215	Course Title: **Complex Variables**	L	P	U
		3	0	3

Course Learning Objectives

- Identify and construct complex-differentiable functions.
- Use the general Cauchy integral theorem and formula.
- Use conformal mapping.
- Express functions as infinite series or products.

Course Content:

UNIT I: Regions in the Complex plane, Functions of Complex Variable, limits.Mappings, Theorems on limits, Continuity.

UNIT II: Derivatives, Analytic Functions, Cauchy-Riemann equations, harmonic functions, Exponential, logarithmic functions, complex exponents, Complex Trigonometric, Hyperbolic functions and their inverses.

UNIT III: Contour integrals, Anti derivatives, Cauchy theorem, Cauchy Integral Formula,

UNIT IV: Morera's theorem, Liouville's Theorem, Maximum Modulus Principle, Convergence of sequences of series, Taylor's and Laurent series,

UNIT V: Residues poles and zeros of analytic functions, Applications of residues, Conformal mapping, Fourier Transforms and Z Transforms.

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Latest Indian Edition

Reference Books:

1. Complex Variables and Applications, J.W. Brown, R.V. Churchill, Mc Graw-Hill, 7th ed, 2003.

2. Complex analysis for Mathematics & Engineering, , John H Mathews & Russel W Howell, Jones & Barlett Publishers, 2001

3. NPTEL Videos http://nptel.ac.in/courses/111103070/

Course Outcomes

Upon successful completion of the course, student will be able to:

- Define continuity and differentiability for complex functions,
- Prove the Cauchy-Riemann equations and apply them to complex functions in order to determine whether a given continuous function is complex differentiable,
- Compute the radius of convergence for complex power series,
- Define the complex exponential function, trigonometric and hyperbolic functions and use their basic properties,
- Evaluate integrals along a path - directly from the definition and also via the Fundamental Theorem of Contour Integration and Cauchy's Theorem,
- Compute the Taylor and Laurent expansions of simple functions, determining the nature of the singularities and calculating residues,
- Prove the Cauchy Residue Theorem and use it to evaluate integrals.

Course No: BPMATH216	Course Title: **Differential Equations and Fourier Series**	L	P	U
		3	0	3

Course Learning Objectives

- To solve first and second order Ordinary Differential Equations by standard methods
- To gain exposure to Engineering applications of Ordinary Differential Equations.
- Introduction to Laplace Transforms for future Engineering courses
- Basics of Fourier series required for Engineering
- Solving important Partial Differential Equations (Simple cases of Wave & Heat equations).

Course Contents

UNIT-I First order differential equations, Reduction of order, second order equations with applications bending of beams and electrical circuits.

UNIT-II Second order homogeneous equations with constant coefficients and the Method of Undetermined Coefficients, Variation of parameters, higher order linear equations.

UNIT-III Power series solutions and ordinary points, Frobenius Method & Regular singular points, Gauss' hyper-geometric equation, Legendre polynomials & Bessel functions.

UNIT-IV Laplace Transform & Inverse Laplace Transform, Convolution of Laplace Transform & application to differential equations,

UNIT- V Fourier series and convergence, Cosine and Sine series, Sturm-Liouville problem, one dimensional Heat and Wave equations and Laplace equations in rectangular form.

Text Books:

Advanced Engineering Mathematics, Erwin Kreyszig 10th Edition, John Wiley & Sons, 2012.

Reference Books:

1 George F.Simmons and Steven. G. Krantz, Differential Equations: Theory, Technique and Practice Tata Mc-Graw Hill, 2007.

2 Elementary Differential Equations, W.E.Boyce and R.C.Diprima, 7th Edition, John Wiley, 2001.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Solve standard ODEs of First and Second Order
- Compute Laplace and Inverse Laplace Transforms for functions in Engineering
- Expand functions in Fourier/Sine/Cosine series
- Obtain series solutions for standard PDEs in two variables

Course No: BPES221	Course Title: **Electrical Science II**	L	P	U
		3	0	3

Course Learning Objectives

- Characterize semiconductors, diodes, transistors and FETs
- To study behavior of Diod and its applications
- To study characteristics of electronic devices to understand their behavior.
- To design simple analog circuits using BJTs, FETs and Diodes.
- To design and evaluate audio, Power and Feedbak amplifiers.

Course Contents

UNIT-I

Semiconductors: intrinsic and doped; p-n junction. Junction Diode & its characteristics.Defferent types of modeling of Diodes. Ideal Diode and Practical diodes. Zener Diode & its characteristics. Applications of Zener Diode. Application of Practical Diodes: Clamper and Peak to Peak Detector.

UNIT-II

Introduction to transistors, PNP Transistor, NPN transistors and their characteristics & operation.

Types of biasing the transistors.CE & CB Configuaration. Different catergories of operation: active region, Cutoff and Saturation. Application to Digital Logic Circuits. Introduction to JFETs, their operation & characteristics. MOSFETs & its characteristic (Depletion and Enhancement MOSFET). Introduction MOSFET logic gates and characteristics. Introduction CMOS logic gates and characteristics.

UNIT-III

Introduction to JFETs, their operation & characteristics. MOSFETs & its characteristic (Depletion and Enhancement MOSFET). Introduction MOSFET logic gates and characteristics. Introduction CMOS logic gates and characteristics.

UNIT-IV

Biasing the BJT and Amplifier, Small Signal AC Models, Additional Amplifier Principles. FET Amplifier with common source, fixed biasing and self-bias. Biasing Enhancement MOSFETs. Small Signal AC Models, MOSFET feedback amplifiers. Effect of bypass capacitors, FET amplifiers. Class A Power Amplifier, Power terminology, Class B power amplifier maximum output power.

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

UNIT- V

Ideal Op-amp characteristic, equivalent circuit & Block diagram, Parameters of practical Op-amp, CMRR, skew rate, offset voltage and current Series parallel FB amplifier, non-ideal op-amp.

Text Books:

1. Leonard Bobrow, *Fundamentals of Electrical Engineering*, Oxford University Press, Asian Edition Adapted by Navneet Gupta.

Reference Books:

1. Alan R. Hambley, *Electrical Engineering: Principles and Applications*, Publisher, 6nd Edition 2013.
2. W.H.Hayt, J.E. Kemmerly, *Engineering circuit analysis*, McGraw Hill Company, 8th Edition, 2013.
3. Vincent Del Toro, *Electrical Engineering Fundamentals*, Phi Learning, 2nd Edition.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Study and analyze the behavior of PN junction diodes.
- Characterize the current flow of a bipolar transistor in CB and CE configurations
- Bias the transistors and FETs for amplifier applications.
- Realize simple amplifier circuits using BJT and FET.

Course No: BPTA223	Course Title: **Professional Communication**	L	P	U
		3	0	3

Course Learning Objectives

The course aims at acquiring the students

- to understand various aspects of business communication.
- to gain knowledge regarding the various ways of assembling information,
- to write clearly and concisely and to present information in an effective manner
- to train them for oral presentation.

Course Contents

UNIT-I

Basics of Communication process, Features of Techincal communication, differences between general purpose communication and technical communication, Verbal and non verbal communication and their differences, understanding and overcoming barriers of communication.

UNIT-II

Definition and characteristic features of a technical report, Classification of reports, Strucutre and Layout of report, Various elements of a report and features of each of the elements, Various ways of collection of data, principles of preparing a questionnaires, Practicing questionnaire preparation, Organization of materials, Preparation of the outline, Formatting techniques.

UNIT-III

Elements of effective writing, Mechanics of writing, Writing styles and use of suitable words and phrases for technical writing according to the context, Revision practices, Principle steps of writing a précis, making notes, abstract and executive summary.

UNIT-IV

Oral presentation features, Use of illustrations, tables and visual aids in presentation and technical writing, Non –verbal aspects in oral presentations, Reading skills for different purposes.

UNIT- V

Distinctive features of memo reports and letter reports, Preparing Notice, Minutes of meeting Brochures,Instructions manual and User's Manual, Understand the difference between Preparing Notice. Minutes of meeting Brochures,Instructions manual and User's Manual, Business Letter formats, layouts and its significance.

Text Books:

1. Koneru. A. (2008).*Professional Communication.* McGraw Hill

Reference Books:

1. Omfort, Jeremy et al (1984). *Business Report in English.* Cambridge University Press
2. Gerson & Gerson (2000). *Technical Writing Process and Product.* Pearson Education.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Understand the aspects of verbal and non verbal communication in its significane in professional and personal communication
- Utilize their knowledge of report writing and write appropriate technical reports.
- Make oral presentations
- Distinguish between various busniness communicational formats and use them appropriately.

Course No: BPMGTS224	Course Title: **Principles of Management**	L	P	U
		3	0	3

Course Learning Objectives

The course aims at acquainting the students with various aspects of modern management. During the past two decades a revolution has taken place in the area of management. The new era is one in which entrepreneurship; innovation & technology are seen as the backbone of management. The emphasis is on the modern management essentials, drawing up from the earlier principles & practices, so as to enable the students to be familiar with the basic concepts of management when they enter the professional world.

Course Content

- Introduction to Management: Science, Theory & Practice
- Management & Society: Social Responsibility and Ethics
- Essentials of Planning
- Setting Objectives
- Strategies, Policies & Planning Premises
- Decision- Making
- The Nature of Organizing
- Organizational Structure: Departmentation
- Line/ Staff Authority, Empowerment, & Decentralization
- Managing Change through Manager and Organization Development
- Human Resources Management and selection
- Performance Appraisal & Career Strategy
- Motivation
- Leadership
- Communication
- The System & Process of Controlling
- Control Techniques
- Marketing Management
- Production & Operations Management
- Information Technology
- International Management

Text Books

1. "Essentials of Management", Koontz H. and Weihrich H., 7th edition, Mcgraw Hill Int. ed., 2007.

Reference Books

1. "Management, Principles and Practices for Tomorrow's Leaders", Gary Dessler, 3rd edition, Prentice Hall, 1998.
2. Engineering Management, Fraidoon Mazda, 1st edition, Addison-Wesley, 1999

Course No: BPAO225	Course Title: **Optimization Techniques**	L	P	U
		3	0	3

Course Learning Objectives:

- Introduction to optimization techniques using both linear and non-linear programming.
- Students will learn to frame minima maxima problems in the framework of optimization problems.

Course Content:

UNIT-I:

Introduction to Linear Programming, Assumptions of Linear Programming, the Simplex Method in Tabular Form, the Revised Simplex Method, Duality Theory, Primal-Dual Relationships

UNIT-II:
The Transportation Problem, Methods of solutions to transportation problem, The Assignment Problem, Hungarian Metod

UNIT-III:
Dynamic Programming, Characteristics of Dynamic Programming Problems, Deterministic Dynamic Programming

UNIT-IV
Integer Programming, Formulation, the Branch-and-Bound Technique, a Branch-and-Bound Algorithm for Mixed Integer Programming

UNIT-V:
Nonlinear Programming , Graphical Illustration of Nonlinear Programming Problems , Types of Nonlinear Programming Problems , One-Variable Unconstrained Optimization , Multivariable Unconstrained Optimization , The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization.

Text Books:

1. F.S.Hillier, G.J. Lieberman, Introduction to Operations Research, 9e, TMH, 2012

Reference Books:

1. H.A. Taha, Operations Research- An Introduction, 7e, PHI,

2. Ravindran, Phillips, Solberg, Operations Research: Principles and Practice, 2e John Wiley & Sons, 2007

Course Outcomes:

By the end of the course, students should be able to:

- Cast minima/maxima problems into optimization framework.
- Learn efficient computational procedures to solve optimization problems.

Course No: BPES226	Course Title: **Structure and Properties of Materials**	L	P	U
		3	0	3

Course Learning Objectives

- The course is interdisciplinary in nature, predominantly covering the fields of physics, chemistry, mechanical and metallurgical engineering
- The course is offered to students of all branches of engineering, and provides an excellent understanding of the structure of materials at the atomic and microscopic level
- The main objective is to show how the type of bonding and crystal structure affects properties of metallic, ceramic, electronic and polymeric materials
- The course aims at to establish correlation between processing/Structure/Performance of materials of importance and shed light on interesting materials and their applications

Course Contents

UNIT-I

General understanding of materials science, Bonding forces and their types: Atomic bonding in solids. Crystal structures and systems: Unit cells, crystallographic directions and planes, Crystalline and non crystalline materials, Single crystals and polycrystalline Materials, Metallic structures, Ceramic and polymer crystal structure, Density computations, Linear and planar densities, Polymorphism and allotropy, Imperfections in solids: Impurities in solids, specification of composition, Defects and dislocations, point defects, Linear defects, Interfacial and bulk defects.

UNIT-II

Diffusion in solids: Diffusion mechanisms, steady and non-steady state diffusions, Factors that affect diffusion, Diffusion in Ionic and polymeric materials. Dislocations and strengthening mechanism in metals: Dislocation characteristics, Slip systems, slip in single crystals, plastic deformation of polycrystalline solids, strengthening mechanisms and strain hardening. Mechanical Properties of solids: Concepts of stress and strain, Elastic and Plastic deformation, Hardness

UNIT-III

Structure and properties of ceramics: Mechanical test behavior of ceramics, Types and application of ceramics, Applications and processing of ceramics, Fabrication and processing of glasses: Glasses - Glass forming – properties, heat treatment of glasses and glass ceramics. Polymer structures: Molecular size, shape & structure of polymers, Important Characteristics of polymeric materials, Mechanical behavior, Crystallization and processing of polymers

UNIT-IV

Phases, microstructures, phase equilibrium: Phase diagrams, unary, binary and binary Eutectic phase diagrams, Lever Rule. Iron carbon systems: Fe-Fe_3C phase diagram, development of micro-structure in Fe-C alloys. Kinetics of phase transformations: Avarami rate equation, Correlation of properties to microstructures, Isothermal transformation diagrams - continuous cooling diagrams, Mechanical behavior of Fe-C alloys, tempered martensite

UNIT-V

Thermal properties of materials; Electronic properties: Energy band in semiconductors etc., Piezoelectricity and Ferro electric materials, applications. Magnetic properties: Super conductivity, superconducting materials and applications, Nanotechnology: Carbon Nano Tubes and their applications.

Text Books:

1. Callister's Materials Science & Engineering Adopted by R. Balasubramaniam, Wiley India Pvt. Ltd., 9th Edition, Reprint 2016.

Reference Books:

1. Engineering Materials: Properties and Selection, K.G. Budinski and M. K. Budinski, Prentice Hall of India, 9th Edition, 2008.

2. The Science and Engineering of Materials, Donald R. Askeland and Pradeep P. Phule, 4th Edition, Thomson book Company, 2003.

3. Principles of Materials Science and Engineering, William F. Smith, Mc Graw-Hill 3rd Edition 1996.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Identify bonding in different material types; describe the lattice structure of materials; describe the lattice parameters for 7 crystal systems; specify the Miller indices for the planes in a unit cell of metals, ceramics and polymers. Define isotropy and anisotropy w.r.t. material properties; describe various types of defects and dislocations and interpret atomic structure within the vicinity of grain and twin boundaries.

- Describe the atomic mechanisms of diffusion in metallic, ionic and polymeric materials; distinguish between steady state and non-steady state diffusions; Explain the factors that affect the rate of diffusion; define slip systems and its relation to mechanical properties; Define stress, strain, state Hook's law, Poisson's ratio; Discuss various mechanical properties like strength, toughness, resilience and hardness

- Describe the process used to produce glass-ceramics; describe structure, composition of different types of ionic, covalent ceramics viz. cements, refractories, clay products, abrasives. Compute the flexural strength of ceramics by transverse bending test; Interpret the effect of porosity on strength of ceramics; explain the procedure of thermal tampering of glass; Describe polymer structure, classification based on shape, size, chemistry and molecular configuration; Thermosetting and thermoplastic polymers; Interpret mechanical properties of elastomers

- Describe phase, composition in binary phase diagram of alloys; explain the phase diagram of Fe-C systems and estimate the composition of individual phases Explain the kinetics of phase transformation; describe the microstructure of micro-constituents of iron alloy and cite mechanical characteristics of each; Isothermal cooling and C-C-T diagrams.

- Describe the electronic band structure; electrical conductivity of metals, semiconductors, electronic mobility; Describe the phenomenon of ferroelectricity and piezoelectricity; Describe the phenomenon of superconductivity; Define heat capacity and specific heat, thermal conductivity and thermal stress; Determine the linear coefficient of thermal expansion; explain the phenomenon of thermal expansion from an atomic perspective; Explain the structure, property and applications of nano materials.

Course No: BPAO312	Course Title: **Control System**	L	P	U
		3	0	3

Course Learning Objectives

- To equip the students with the fundamental concepts in control systems.

Course Content

UNIT-I

Modelling of physical systems: Differential equations of physical systems, mechanical systems and electrical analogies, Electrical systems - Electromechanical systems – Mechanical systems – Thermal systems. Concept of Transfer Function, Block diagrams and reduction methods, Construction of Signal flow graphs; Mason's Gain formula and its applications

UNIT-II

Feedback systems and effect of feedback on sensitivity and system dynamics, Effect of feedback on control systems with disturbance signals. Time domain analysis: Test signals and time domain response of first order system, Response of second order system; time domain specifications, Steady state errors and error constants for various types of systems

UNIT-III

Stability of control systems and effect of root locations, Routh-Hurwitz stability criterion. Concept of root locus and magnitude and angle criteria, Root locus construction rules, Effect of pole-zero additions on the root loci.

UNIT- IV

Frequency domain analysis: Bode plot - Polar plot - Nyquist plot - phase-margin - gain margin - Nyquist stability criterion.

UNIT- V

Controller design: Design of P, PI, PID, lag, lead, lead-lag compensator design.

Text Books

1. Katsuhiko Ogata, '*Modern Control Engineering*', 5th Edition, Pearson Education Publishers, New Delhi, 2010.
2. Nagrath I.J. and Gopal M, '*Control Systems Engineering*', 5th Edition, New Age International Publications, New Delhi, 2010.
3. Benjamin C.Kuo and Farid Golnaraghi, '*Automatic Control Systems*', 8th Edition John Wiley & Sons Publications, New Delhi, 2002.

Reference Books

1. Richard C. Dorf and Robert H. Bishop. '*Modern Control Systems*', 12th Edition Pearson Prentice Hall Publications, New Delhi, 2010.
2. Gene F. Franklin, J. David Powell and Abbas Emami-Naeini, '*Feedback Control of Dynamic Systems*', 6th Edition. Pearson Education India Publications, New Delhi, 2008.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Understand the concepts of closed loop control systems.
- Analyze the stability of closed loop systems.
- Apply the control techniques to any electrical systems.
- Design the classical controllers such as P, PI, etc., for electrical systems.

B.Sc. Program (Physics)

Course Handouts

Course No: **BPPHY114**	Course Title: **Physics-I**	L	P	U
		3	0	3

Course Learning Objectives:

Develop an understanding of the basic principles of Mechanics and wave optics and the application of the principles with emphasis on problem solving skills.

Course Content:

UNIT I

Conservation of Momentum: Collisions, Impulse-Momentum Theorem, Conservation of Momentum, Two-body collisions, Complex Motions, Many-particle systems, Center of Mass and Conservation of momentum

UNIT II

Rotational motion: Rotational Kinematics, Relation between linear and angular variables, Torque and Rotational inertia, Rolling without slipping, Angular momentum for system of particles, Conservation of angular momentum

UNIT III

Conservation of Energy: Work, Energy and Power, Work-Energy theorem, Conservative forces, Potential energy, Conservation of mech. Energy, Work done by ext. force, Frictional force, Conservation of total energy

UNIT IV

Oscillators and Waves: Simple Harmonic Oscillator, Free, Damped and Forced Oscillations, Types of waves, Traveling waves, Interference of waves, Standing waves etc

UNIT V

Optics: Double-Slit interference, Interference due to thin films, Single Slit diffraction, Intensity calculation, Multiple slits, Diffraction gratings, Dispersion and Resolving power

Text Books:

1. Robert Resnick, David Halliday and Kenneth S. Krane "Physics", Vol. I and II, 5th Edition John Wiley Inc, Singapore, 2002.

Reference Books:

1. Robert Resnick, David Halliday and Jearl Walker "*Fundamentals of Physics*", 6th Edition, John Wiley Inc, Singapore, 2001.
2. Cutnell and Johnson, "*Physics*", 5th Edition, John Wiley, Asia, 2001.

Course Outcomes

- Apply conservation of linear momentum to two/many body systems in lab and centre of mass frame of reference.
- Apply conservation of angular momentum to two/many body systems in lab and centre of mass frame of reference.
- Apply the conservation of energy principle and find the work done by a body under the influence of conservative/non-conservative forces.
- Understand the types of oscillations/waves and the fundamental equations governing them.
- Understand the physics of the most important phenomena in wave optics, namely, interference, diffraction.

Course No: BPPHY124	Course Title: **Physics-II**	L	P	U
		3	0	3

Course Learning Objectives:

Develop an understanding of the basic principles of electromagnetism and the application of the principles with emphasis on problem solving skills.

Course Content:

UNIT I

Coulomb's law, continuous charge distributions. Electric field of point charges, continuous charge distributions, field lines, point charge and dipole in an electric field. Flux of a vector field, flux of electric field, Gauss' law, its applications, Gauss' law and conductors.

UNIT II

Electric potential, potential due to point charges and continuous charge distribution, calculating field from potential, potential from field, equipotential surfaces, potential of a charged conductor. Types of materials, conductor in an electric field, Ohm's law, Ohmic materials. Capacitance, calculation of capacitance, capacitors in series and parallel, energy storage in an electric field, capacitor with dielectric

UNIT III

Magnetic interactions, magnetic poles, force on a moving charge, circulating charges, force on a current carrying wire, Hall effect, torque on a current loop. Magnetic field due to moving charge, due to current, parallel currents, field of a solenoid, Ampere's law.

UNIT IV

Faraday's law, Lenz' law, motional emf, induced electric fields. Magnetic dipole and force on a magnetic dipole in a non-uniform field, Magnetization, Gauss' law for magnetism. Inductance, calculating the inductance, energy storage in magnetic field

UNIT V

Equations of electromagnetism, Maxwell's equations, induced magnetic fields and Displacement currents. Concept of photons, Thermal radiation, photoelectric effect. Matter waves, de Broglie's hypothesis, experimental verification by Davison and Germer experiment, uncertainty principle.

Text Books:

1. Physics, Robert Resnick, David Halliday and Kenneth S. Krane Vol. 2, John Wiley, 5th ed., 2002.

Reference Books:

1. Fundamentals of Physics, Robert Resnick, David Halliday and Jearl Walker, John Wiley, 6th ed., 2001.
2. Physics, Cutnell and Johnson, John Wiley, 5th ed., 2001.
3. Introduction to Electrodynamics, David J Griffiths, PHI, 3rd ed., 2002.

Course Outcomes

Upon successful completion of the course student will be able to:

- Understand the main concepts of electromagnetic theory
- Develop the mathematical framework to explore electricity and magnetism
- Apply the mathematical framework quantitatively for solving relevant problems
- Appreciate qualitatively how they play a role in many aspects of daily life.

Course No: **PHY211**	Course Title: **Optics**	L	P	U
		3	0	3

Course Learning Objectives

- To understand the everyday optics phenomena.
- Fundamentals of optics and some of the principles of interference and diffraction phenomena using ray-nature of light and wave-nature of light are discussed.

Course Content

UNIT I **[7]**

Refraction and reflection by spherical surfaces, Matrix method in Paraxial optics: Introduction, The Matrix method, Unit planes, Nodal planes and a system of two thin lenses, Location of cardinal points.

UNIT II **[2]**

Abberations: Chromatic aberrations, the acromatic doublet, removal of chromatic aberration, Spherical aberration: Lateral and longitudinal spherical aberration: Coma, Astigmatism, Minimization of these defects by proper methods.

UNIT III **[12]**

Wave theory of light: Superposition principle and coherence. Interference: Two beam interference by division of wavefront and amplitude. Young's double slit experiment, Lloyd's mirror and Fresnel biprism. Phase change on reflection, Interference in thin films: parallel and wedge shaped films. Fringes of equal inclination: Fringes of equal thickness: Newtons rings, Michelson interferometer.

UNIT IV **[12]**

Diffraction: Fresnel and Fraunhofer diffraction, Fraunhofer's diffraction due to single slit, double slit, multiple slits, diffraction grating and diffraction by a circular aperture (qualitative). Rayleigh's criterion-Resolving power of telescope, microscope and grating. Fresnel diffraction: Half-period zones, zone plate, Fresnel diffraction of a straight edge, a slit and a wire using half-period zone analysis.

UNIT V **[9]**

Polarization: Transverse nature of light, polarization by reflection, Fresnel's Formulae for perpendicular & parallel polarization cases, Reflection & Transmission coefficients, Brewster's law, Malus law, Double refraction, Nicol prism as an analyzer, Huygen's explanation of double refraction in uniaxial crystals, optics axis, Plane, circular and elliptical polarized light. Quarter wave plate, Half wave plate.

Text Books

1. Optics, Ajoy Ghatak, Sixth edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 20016.

Reference Books

1. Fundamentals of Optics, F. A Jenkins and H.E White, Fourth Edition, Tata McGraw Hill Education Private Limited, New Delhi, 1976.
2. Optics, Eugene Hecht, Fifth Edition, Addison Wesley Publishing Company Incorporated, 2016.
3. A text Book of Optics, N. Subrahmanyam, Brij Lal and M. N. Avadhanulu, S. Chand Limited, 2015.

Course Outcomes

Upon successful completion of the course student will be able to:

- Understand ray-based optical system analysis.
- Understand the properties of light caused by the wave nature such as interference, diffraction and polarization in terms of wave model and their applications.
- Students will develop independent problem solving skills.

Skill development/Employability and Entrepreneurship:

Skill development

List of experiments

1. Angle of the prism
2. Dispersive power of prism
3. Resolving power of grating
4. To determine the wavelength of light using diffraction grating

Simulations:

1. Ray tracing simulators-online

Course No: PHY221	Course Title: **Partial Differential Equations & Systems of ODEs**	L	P	U
		3	0	3

Course Learning Objectives

- Evaluate first order differential equations including separable, homogeneous, exact, and linear.
- Show existence and uniqueness of solutions.
- Solve second order and higher order linear differential equations.
- Create and analyze mathematical models using higher order differential equations to solve application problems such as harmonic oscillator and circuits.
- Solve differential equations using variation of parameters
- Solve linear systems of ordinary differential equations
- Introduce students to partial differential equations.
- Introduce students to how to solve linear Partial Differential with different methods.
- To derive heat and wave equations in 2D and 3D.

Course Contents

UNIT-I

Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients.

UNIT-II

Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients (Two Equations in two unknown functions). Simultaneous linear first order equations in three variables, methods of solution.

UNIT-III

Pfaffian differential equations, methods of solutions of Pfaffian differential equations in three variables.

UNIT-IV

Formation of first order partial differential equations, Linear and non-linear partial differential equations of first order, special types of first-order equations, Solutions of partial differential equations of first order satisfying given conditions.

UNIT- V

Linear partial differential equations with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients, Partial differential equations with variable coefficients, Separation of variables, Non-linear equation of the second order.

Text Books:

1. J.Sinha Roy and S. Padhy, A Course on Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi, Ludhiana, 2012.

Reference Books:

1. Differential Equations: Theory, Technique and Practice, George F.Simmons and Steven. G. Krantz, Tata Mc-Graw Hill, 2007.
2. An Elementary Course in Partial Differential Equations, T Amaranath, Narosa Publishing House, 2013.
3. S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.
4. M.D. Raisinghania-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi
5. An Introduction to Ordinary Differential Equations, Earl A. Coddington, PHI, 2002.

Course Outcomes

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

- The student will be able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.
- The student will be able to find the complete solution of a nonhomogeneous differential equation as a linear combination of the complementary function and a particular solution.
- The student will be introduced to the complete solution of a nonhomogeneous differential equation with constant coefficients by the method of undetermined coefficients.
- The student will have a working knowledge of basic application problems described by second order linear differential equations with constant coefficients.
- Solve linear partial differential equations of both first and second order
- Apply partial derivative equation techniques to predict the behaviour of certain phenomena.
- Apply to specific methodologies, techniques and resources to conduct research and produce innovative results in the area of specialisation.
- Identify real phenomena as models of partial derivative equations.

Course No: PHY311	Course Title: **Solid State Physics**	L	P	U
		3	0	3

Course Learning Objectives

- To know and understand the basic theories of solid state structure
- To gain knowledge of the basic theories of electronic structure of materials
- To describe physical behavior of solids on the basis of solid state theory.

Course Content:

UNIT I

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice with a Basis Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg'sLaw. Atomic and Geometrical Factor.

UNIT II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law

UNIT III

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.

UNIT IV

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena.

UNIT V

Elementary band theory: Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.

Text Books:

1. H. Ibach and H Luth, Solid-state Physics, Springer, 2009

Reference Books:

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Pvt. Ltd., , 8 ed. 2004
2. J.P. Srivastava, Elements of Solid State Physics, Prentice-Hall of India, 2 ed. 2006
3. Leonid V. Azaroff, Introduction to Solids, Tata Mc-Graw Hill, 2004
4. Neil W. Ashcroft and N. David Mermin, Solid State Physics, Cengage Learning, 1976
5. M. Ali Omar, Elementary Solid State Physics, Pearson India, 1999

Course Outcomes:

Upon successful completion of the course, students should be able to:

- formulate the theory of X-ray diffraction in the reciprocal lattice (k-space) formalism and apply this knowledge to generalize the formulation for matter waves
- formulate the theory of lattice vibrations (phonons) and use that to determine thermal properties of solids
- formulate the problem of electrons in a periodic potential, examine its consequence on the band-structure of the solid and develop a framework that explains the physical properties of solids in terms of its band-structure
- identify the materials encountered in the course in a representative modern device/component, analyze why these are used and propose better alternatives if necessary
- Recognize that the developed k-space formalism to describe phonons, electrons, is more general and can be used to describe waves in a periodic media.

Skill Development:

Aquiring measurement skills used in Solid State Physics.

Any five of the below may be introduced:

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)

2. To measure the Magnetic susceptibility of Solids.

3. To study the PE Hysteresis loop of a Ferroelectric Crystal.

4. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.

5. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150°C)

6. To measure the resistivity of a semiconductor (Ge) with temperature by two-probe method and to determine its band gap.

7. Analysis of X-Ray diffraction data in terms of unit cell parameters and estimation of particle size.

8. Measurement of change in resistance of a semiconductor with magnetic field.

The skills that can be developed include associating the experiment to the relevant concept use of various equipments and tools understanding the principles and the working of the equipments used correct usage of the equipments data collection and organization graphical and numerical analysis of data interpretation of experimental results arriving at conclusions technical report writing.

In addition, the social and organizational skills developed are team work, coordination, time management, collaboration and communication.

Course No: **PHY313**	Course Title: **Classical Electrodynamics**	L	P	U
		3	0	3

Course Learning Objectives

- To develop a basic understanding of electric and magnetic fields in the differential form.
- To develop a working knowledge of the underlying principles of electrodynamics.

Course Contents:

UNIT-I

Recapitulation of electrostatics, divergence and curl of a vector field, electric potential, work, energy and conductors, introduction of the Dirac delta function.

UNIT-II

Poisson's equation and Laplace's equation: Boundary conditions and uniqueness theorems, method of images, multipole expansion,

UNIT-III

Electric field in matter: polarization and dielectrics. Boundary value problems with linear dielectrics.

UNIT-IV

Recapitulation of Magnetostatics: Magnetic fields, magnetic vector potential, multipole expansion, magnetic fields in matter: magnetization, torques and forces on magnetic dipoles, Ampere's law.

UNIT- V

Electrodynamics: electromotive force, electromagnetic induction, induced electric fields, Inductance, Maxwell's equations, modification of Ampere's law, magnetic charge, Maxwell's equations in matter.

Text Books:

1. David J. Griffths, *Introduction to Electrodynamics*, 4 Ed., Cambridge University Press, 2017.

Reference Books:

1. R. P. Feynman, *The Feynman Lectures on Physics 2*, 2nd ed, Addison-Wesley, 2005.
2. J. D Jackson, *Classical Electrodynamics*, 3rd ed., 1999.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Calculate fields and potentials for simple charge configurations, both discrete and continuous by applying various laws in electromagnetic theory.
- Have a working knowledge of special techniques like method of images, multipole expansion etc.

Skill Development:

The following aspects are included into the curriculum to enhance the analytical, mathematical and logical thinking abilities of the students. These following tasks will help them to apply physical concepts to various real life situations and areas of engineering and enhance their intuitive abilities with respect to concepts taught in this course.

1. Assignments: Assignments as a component of evaluation and will be spread over the entire semester. In this, students will be given numerical and situational questions will be given, related to the concepts taught.

a) These will help them to acquire problem solving and critical thinking skills and reasoning abilities allowing them to apply the concepts of physics to real life problems
b) Social and organizational skills like time management, team work are the skills which can be acquired

2. Review articles and paer presentation: Electrodynamics, in its current form, developed over two centuries. Numerous scientists contributed to the formulation and development of various concepts, both physical and mathematical. This development in electrodynamics along with the undestaing of the quantum nature of light and matter, paved the way for major technological and engineering advances in material science, semiconductor physics, power generation and transmission and communication to name a few. In order that the students develop an appreciation for the subject and its development both historical and scientific, review articles will be given to the students. The student will have to read and present a paper on the given article. Some of the articles, which can be given below. This exercise will enhance their critical thinking and understanding skills. The paper presentation will help to acquire skills on writing and presenting a paper on scientific topic. It will help in building their confidence and public speaking skills.

1. Electric field lines: The implications of students' interpretation on their understanding of the concept of electric field and of the superposition principle
   Esmeralda Campos, Genaro Zavala, Kristina Zuza and Jenaro Guisasola

American Journal of Physics 87, 660 (2019); https://doi.org/10.1119/1.5100588

2. Experiences with the magnetism of conducting loops: Historical instruments, experimental replications, and productive confusions
American Journal of Physics 71, 156 (2003); https://doi.org/10.1119/1.1507791

3. Ampère's motor: Its history and the controversies surrounding its working mechanism
American Journal of Physics 80, 990 (2012); https://doi.org/10.1119/1.4746698

4. Magnetic monopoles, Galilean invariance, and Maxwell's equations
American Journal of Physics 60, 109 (1992); https://doi.org/10.1119/1.16926
Frank S. Crawford

5. Snapshots of a Physicist's Life
Annual Review of Nuclear and Particle Science
Vol.49:1-33 (Volume publication date December 1999)
https://doi.org/10.1146/annurev.nucl.49.1.1

Course No: PHY314	Course Title: **Introduction to Statistical Mechanics**	L	P	U
		3	0	3

Course Learning Objectives

- To bridge thermodynamics and statistical mechanics
- To develop analytical ability to solve simple problems relevant to statistical mechanics
- To understand approximations making statistical descriptions possible

Course Contents:

UNIT-I

The Statistical Basis of Thermodynamics: The macroscopic and the microscopic states, Contact between statistics and thermodynamics, Further contact between statistics and thermodynamics, The classical ideal gas, The entropy of mixing and the Gibbs paradox, The "correct" enumeration of the microstates

UNIT-II

Elements of Ensemble Theory: Phase space of a classical system, Liouville's theorem and its consequences, the microcanonical ensemble, Quantum states and the phase space

UNIT-III

The Canonical Ensemble, Equilibrium between a system and a heat reservoir, A system in the canonical ensemble, Physical significance of the various statistical quantities in the canonical ensemble, Alternative expressions for the partition function, The classical systems, Energy fluctuations in the canonical ensemble, Equipartition and the virial theorems, A system of harmonic oscillators, The statistics of paramagnetism, Thermodynamics of magnetic systems

UNIT-IV

The Grand Canonical Ensemble: Equilibrium between a system and a particle-energy reservoir, A system in the grand canonical ensemble, Physical significance of the various statistical quantities, Examples, Density and energy fluctuations in the grand canonical ensemble: correspondence with other ensembles

UNIT- V

Simple gas: An ideal gas in a quantum-mechanical microcanonical ensemble, Ideal Bose gas: Thermodynamic behavior of an ideal Bose gas, Ideal Fermi gas: Thermodynamic behavior of an ideal Fermi gas. Special topics: One dimensional fluid model-Hard Spheres on a ring, The Ising model in one dimension in the absence of external field

Text Books:

1. R K Pathria, Paul D. Beale, **Statistical** *Mechanics*, 3rd Edition, Academic Press, 2011

Reference Books:

1. F. Reif, *Statistical Physics: Berkeley Physics Course, Volume 5*, Tata McGraw Hill Education Private Limited, 2010

Course Outcomes

Upon successful completion of the course, student will be able to:

- Learn different statistical ensembles, their distribution functions, ranges of applicability and the corresponding thermodynamic potentials
- Give an account of the macroscopic and microscopic description of temperature, entropy and free energy and their descriptions in terms of probabilities
- Apply the principles of statistical mechanics to selected problems

Skill development/Employability and Entrepreneurship:

a. List of numerical experiments –
   2. Simulation of ideal gas
   3. Simulation of classical models of magnetism
   4. Simulation of hard-sphere fluid model

b. Project work
c. Presentation

Course No: PHY315	Course Title: **Atomic, Molecular & Nuclear Physics**	L	P	U
		3	0	3

Course Learning Objectives

- Understand atomic/molecular models
- Understand the quantum laws governing their spectra
- Obtain a basic knowledge of nuclear models and reactions

Course Contents:

UNIT I

Bohr's theory, correspondence principle. e/m of the electron, isotopes, isobars, X-ray Spectra: Introduction-production of X-ray, continuous and characteristics of X- ray spectrum, Moseley's law- absorption of X-rays

UNIT II

Electron angular momentum, spin and spin angular momentum, space quantization, Larmor's theorem, spin magnetic moment, Stern-Gerlach experiment, Zeeman Effect, Anomalous Zeeman effect, Paschen back effect (qualitative discussion)

UNIT III

Vector atom model: Quantum numbers, L-S and j-j couplings, application of spatial quantization, Pauli's exclusion principle. Hund's rule, Optical spectra-Spectral terms and notations, selection rules, intensity rule and interval rule, fine structure of sodium D lines, hyperfine structure, alkali spectra.

UNIT IV

Molecular spectra: Rotational energy levels, selection rules, vibrational energy levels, selection rules and vibration spectra, Rotation-vibration energy levels, selection rules and rotation-vibration spectra, Raman scattering-classical and quantum theory of Raman scattering, Raman spectra-diatomic molecules, Raman spectrometer.

UNIT V

Nuclear Structure: nuclear composition, some nuclear properties, stable nuclei, binding energy, liquid-drop Model, shell model, meson theory of nuclear forces, half-Life, radioactive Series, alpha Decay, beta Decay, gamma Decay, cross Section, nuclear reactions and conservation laws, nuclear fission, nuclear reactors, fusion reactors.

Text Books:

1. Rita Kakkar , *Atomic and Molecular Spectroscopy*, Cambridge University Press, 2015

2. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th edition, Tata McGraw Hill, 1994

3. Arthur Beiser, Concepts *of modern physics*, McGraw Hill, 6th ed. 2006.

Reference Books:

1. P. F. Bernath , *Spectra of Atoms and Molecules*, 2nd edition, Oxford University Press, 2005

Course Outcomes

Upon successful completion of the course, student will be able to:

- To analyze atomic/molecular spectra and interpret the data to predict some properties of matter.
- Estimating nuclear binding energies.

Course No: PHY317	Course Title: **Introduction to Monte Carlo Methods**	L	P	U
		3	0	3

Course Learning Objectives

- To study some important statistical probability distributions
- To study stochastic modeling and Monte Carlo simulation methods
- To understand the range of applicability of Monte Carlo simulation methods

Course Contents:

UNIT-I

Probability theory -- Elements of Probability and Statistics, Special probability distributions and Central limit theorem. Statistical errors, Markov Chains and master equations, Random number generators

UNIT-II

Simple sampling Monte Carlo methods- Comparisons of methods for numerical integration of given functions, Boundary value problems, Simulation of radioactive decay, Simulation of transport properties, the percolation problem, Generation of 'random' walks

UNIT-III

Importance sampling Monte Carlo methods- Ising model, Algorithm, Boundary conditions, Finite size effects, Finite sampling time effects, Critical relaxation. Potts model

UNIT-IV

Quantum Monte Carlo methods -- The Ising model in a transverse field, Fermions on a lattice, Continuous time simulations

UNIT- V

Monte Carlo simulations at the periphery of physics and beyond- Astrophysics, Materials science, Chemistry, 'Biologically inspired' physics, 'Traffic' simulations, Econophysics, Finance

Text Books:

1.David P. Landau and Kurt Binder , *A Guide to Monte Carlo Simulations in Statistical Physics*, 3rd edition, Cambridge University Press, 2009

Reference Books:

1. Mark E. J. Newman, G. T. Barkema, *Monte Carlo Methods in Statistical Physics*, Clarendon Press, 1999

Course Outcomes

Upon successful completion of the course, student will be able to:

- Generate random numbers from some probability distributions
- Use simple and importance sampling Monte Carlo methods
- Apply Monte carlo methods to lattice models

Skill development/Employability and Entrepreneurship:

Skill development

List of numerical experiments –

i. Generation of pseudo-random numbers from probability distributions
ii. Simulation of radioactive decay
iii. Simulation of Ising model in the absence of field
iv. Simulation of Ising model in the external field

a. Project work
b. Presentation

Course No: **PHY323**	Course Title: **Classical Mechanics**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- This course will introduce the students to very powerful techniques of solving not only problems in mechanics but also to demonstrate the far reaching generality of the same.
- The course will introduce generalized coordinates and phase space
- Understand Systems of particles, rigid body dynamics
- Acquire working knowledge of Lagrangian and Hamiltonian formulations.

Course Content:

UNIT I

Review of Newtonian Mechanics; Application to the motion of a charge particle in external electric and magnetic fields- motion in uniform electric field, magnetic field- gyroradius and gyrofrequency, motion in crossed electric and magnetic fields.

UNIT II

Generalized coordinates and velocities, Hamilton's principle, Lagrangian and the Euler-Lagrange equations, one-dimensional examples of the Euler-Lagrange equation.

UNIT III

Canonical momenta & Hamiltonian. Legendre transformation and Hamilton's equations of motion. Examples using of the Hamiltonian equations of motion. The principle of least action.

UNIT IV

Canonical transformations, examples of canonical transformations. The Symplectic approach to canonical transformations. Poisson brackets and other canonical invariants. Liouville's theorem.

UNIT V

Hamilton-Jacobi equation for Hamilton's principal function. Separation of variables in Hamilton-Jacobiequation. Action-angle variables. [10 Lectures]

Text Books:

1. Classical Mechanics, N. C. Rana and P. S. Joag, Tata McGraw-Hill, 2017.
2. Classical Mechanics, H. Goldstein, C. P. Poole, and J. Safko, 3rd Ed., Tata McGraw-Hill, 2011.

Reference Books:

1. Variational Principles of Mechanics, C. Lanczos, Dover 1987.
2. Theoretical Mechanics, M.R. Spiegel, Tata McGraw Hill, 2006.

Course Outcomes

Upon successful completion of the course student will be able to:

- Use variational calculus to find the Euler – Lagrange equations
- Obtain Hamilton's equations of motion for different systems.
- Understanding algebraic structure of Poisson brackets.
- The student would have understood small oscillations and the motion of rigid bodies.

Course No: PHYC324	Course Title: **Nanotechnology**	L	P	U
		3	0	3

Course Learning Objectives

- To introduce and provide a broad view of the field of nanoscience and nanotechnology to undergraduates
- To provide knowledge on the various synthesis and characterization techniques.
- To introduce students to the applications of nanomaterials

Course Content:

UNIT I

Nanoscale systems: Length scales in physics, Nanostructures: nano dots, thin films, nanowires, nano rods, Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation-Infinite potential well, potential step, potential box, quantum confinement and its consequences.

UNIT II

Synthesis and characterisation of nanostructure: Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. PVD, CVD and MBE growth of quantum dots.

UNIT III

Characterisation: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy.

UNIT IV

Optical Properties: Coulomb interaction in nanostructures. Concept of dielectric constant for nano structures and charging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals.Electron Transport: Carrier transport in nanostructures. Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities

UNIT V

Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices. Single electron transfer devices. CNT based transistors. Nanomaterial Devices: Quantum dots hetero-structure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots -magnetic data storage

Text Books:

1. K.K. Chattopadhyay and A. N. Banerjee, *Introduction to Nanoscience and Technology*, PHI Learning Private Ltd, 2009

Reference Books:

1. Charles P.Poole.Jr.& Frank J.ownes, *Introduction to Nano technology,* John Wiley & sons Inc. Publishers, 2006
2. Guozhong Cao, *Nano structures and Nano materials: Synthesis, properties and Applications,* Imperial College Press, 2 ed, 2004.
3. Jackie Ying, *Nano structured Materials,* Academic press, 2001**Learning outcomes**

Course Outcomes

Upon successful completion of the course student will be able to:

- describe the basic science behind the properties of materials at the nanometre scale,
- understand the various techniques of preparation of nano-materials
- describe the principles behind experimental techniques for studying nanomaterials.
- understand the inter-disciplinary applications of nanotechnology

Course No: **PHY325**	Course Title: **Special Theory of Relativity**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To understand the inadequacy of Newtonian mechanics for exteremely fast moving objects.
- Einstein's solution to the breakdown of Galilean relativity.
- Relativistic kinematics and Reltivistic dynamics.

Course Contents:

UNIT-I

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity.

UNIT-II

Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number.

UNIT-III

Relativistic Kinematics: Relativistic addition of velocities, Doppler Effect, Stellar aberration. Time dilation, four vectors.

UNIT-IV

Relativistic Dynamics: Redefining momentum, Equivalence of mass and energy. Collisions elastic and inelastic. Applications like Mossbauer Effect and creation of particles.

UNIT- V

Field of a maoving charge, forces and fields near a current carrying wire, invariance of maxwells equations, limitations of special relativity.

Text Books:

1. R. Resnick, *Introduction to Special Relativity*, John Wiley and Sons, 2005.

2. A.P. French, *Special Relativity*, MIT Introductory Series, 1968.

Reference Books:

1. WGV Rosser, *Introductory Special Relativity*, Taylor and Francis, London, 1991.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Understand the role of Newtonian mechanics in the larger framework of mechanics.
- Understand the theoretical underpinnings of the mass-energy equivalence.
- Understand the role of special relativity in electrodynamics.

Skill development/Employability and Entrepreneurship:

The following aspects are included into the curriculum to enhance the analatycal, mathematical and logical thinking abilities of the students. These following tasks will help them to apply physical concepts to various reallife situations and areas of engineering and enhance their intuitive abilities with respect to concepts taught in this course.

1. Assignments: The course has assignmensts as a component of evaluation and these are spread over the entire semester. In this, students are given numericals.

a) These will help them to acquire problem solving and critical thinking skills and reasoning abilities allowing them to apply the concepts of physics to real life problems
b) Social and organizational skills like time management, team work are the skills which can be acquired

2. Experiments: Michelson-Morley experiment

The skills that can be developed include

1. Associating the experiment to the relavent concepts
2. Understanding the principles and the working of various equipment and tools used.
3. Correct usage of equipment
4. data collection and organization
5. graphical and numerical analysis of data
6. interpretation of experimental results and arriving at conclusions
7. Writing a technical report

In addition, the social and organizational skills developed are team work, coordination, time management, collaboration and communication.

3. Research paper study and presentation

The students will be asked to read and present the research paper by **John P. Costella, Bruce H. J. McKellar, and Andrew A. Rawlinson, Thomas Rotation, American Journal of Physics 69, 837 (2001).** This paper is specifically written for the undergraduates and this will help the students to self learn, improve their presentation skills and also their reasoning abilities.

Course No: **PHY326**	Course Title: **Introduction to Acoustics**	L	P	U
		3	0	3

Course Learning Objectives

- To provide an introductory view to a wide range of acoustic phenomena, including the theory and principles of acoustics.
- Sound propagation in the atmosphere and non-linear acoustics in fluids.
- Understanding of acoustic measurements and analysis of acoustic signals.

Course Contents:

UNIT I

Introduction to acoustics: Acoustics: The science of sound, sounds we hear, sounds we cannot hear: Ultra sound and infra sound, Sounds we would rather not hear: Environmental noise control, Aesthetic sound: Music, Sound of the Human voice: Speech and singing, How we Hear: Physiological and Psychological acoustics, Architectural acoustics, Harnessing Sound, Medical Acoustics, sounds of the sea. Propagation of sound: History of acoustics: Acoustics in ancient times, early experiments on vibrating strings, membranes and plates, speed of sound in air, liquids and solids, determining frequency, acoustics in 19th and 20th century, conclusion.

UNIT II

Basic linear acoustics: Introduction, equations of continuum mechanics, equations of linear acoustics, variational formulations, waves of constant frequency, plane waves, attenuation of sound, acoustic intensity and power, impedance, reflection and transmission, spherical waves, cylindrical waves, simple sources of sound, Integral equations in acoustics, waveguides, ducts and resonators, ray acoustics and diffraction.

UNIT III

Sound propagation in the atmosphere: A short history of outdoor acoustics and its applications, spreading losses, atmospheric absorption, diffraction and barriers, ground effects, attenuation through trees and foliage, wind and temperature gradient effects on outdoor sound.

UNIT IV

Non-linear acoustics in fluids: Origin of nonlinearity, equation of state, The non-linearity parameter, the coefficient of nonlinearity, simple nonlinear waves, lossless finite-amplitude acoustic waves, thermoviscous finite-amplitude acoustic waves, shock waves, interaction of non-linear waves, bubbly liquids, sono luminescence and acoustic chaos.

UNIT V

Acoustic signal processing: Definition, Fourier Series, Fourier transform, Power, energy and power spectrum, statistics, Hilbert transform and the envelop, Filters, Noise, sampled data, Discrete Fourier transform, The z-transform, Maximum length sequences and Information theory.

Text Books:

1. Handbook of Acoustics, Edited by Thomas D. Rossing, Second edition, Springer, 2015.

Reference Books:

1. Fundamentals of Acoustics, Lawrence E. Kinsler, Austin R.Frey, Alan B. Coppens and James V. Sanders, Fourth edition, John Wiley and Sons, Inc., 2000.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Develop a strong understanding of scientific principles underlying the generation and propagation of sound.
- Obtain working knowledge of advanced methods for acoustic signal processing.

Skill development/Employability and Entrepreneurship:
Skill development.

List of activities:
(a) Literature survey.
(b) Report writing

Experiments

Hands on experience how to collect the acoustic data in laboratory-field visit.

Training on Software

Hands on experience through the analysis of acoustic data using Origin Pro software.

Course No: PHY327	Course Title: **Introduction to Quantum Computation**	L	P	U
		3	0	3

Course Learning Objectives

- To expose the students to the fundamental concepts of quantum computation and information.
- Generalisation of the usual bit concept from computer science that incorporates the quantum phenomena.
- To learn three quantum algorithms and show that they are sueprrior to classical algorithms

Course Contents:

UNIT-I

Dirac notation and Hilbert spaces, dual vectors, linear operators. The spectral theorem, functions of operators. Tensor products, Schmidt decomposition theorem.

UNIT-II

State of a quantum system, time-evolution of a closed quantum system, measurement in quantum mechanics. Pure and mixed states, density operator, partial trace, general quantum operators. Bloch-sphere representation of single qubit states, qubit rotations, single qubit gates.

UNIT-III

The quantum circuit model, single and multi-qubit operations, universal sets of quantum gates. Efficiency of approximating unitary transformations, implementing measurements with quantum gates.

UNIT-IV

Probabilistic versus quantum algorithms. Phase kick-back. The Deutsch and Deutsch-Jozsa algorithms. Quantum phase estimation and quantum Fourier transform, error analysis in arbitrary phase estimation. Finding orders, Shor's algorithm for order estimation. Quantum algorithms based on amplitude amplification, Grover's quantum search algorithm and related topics.

UNIT- V

Mathematical and physical conceptions of quantum entanglement, entanglement distillation, entanglement of formation. Entanglement in pure and mixed states. No-cloning theorem for quantum states.

Text Books:

1. M. A. Nielsen and I. L. Chuang, *Quantum Computation and Quantum Information,* Cambridge University Press, 2012.

Reference Books:

1. D.M. McMahon, *Quantum computing explained*, John Wiley & Sons, 2007.

Course Outcomes

Upon successful completion of the course, student will be able to:

- Apply concepts from linear algebra to construct quantum gates.
- Understand the working of three quantum algorithms.
- Will understand the crucial concept of entanglement.

Skill development/Employability and Entrepreneurship:

The following aspects are included into the curriculum to enhance the analatycal, mathematical and logical thinking abilities of the students. These following tasks will help them to make a connection between basic science course and engineering.

1. Assignments: The course has assignmensts as a component of evaluation and these are spread over the entire semester. In this, students are given numericals.

a) These will help them to acquire problem solving and critical thinking skills and reasoning abilities allowing them to apply the concepts of physics to real life problems
b) Social and organizational skills like time management, team work are the skills which can be acquired

5. REGISTRATION

The structuring of the courses in terms of lecture hours, lab hours, etc., is done through the timetable for each semester/term. On the first day of the semester/term, every student, whether newly admitted or already on rolls, is required to make his/her own timetable for all the courses for which he/she is permitted to register. The student next completes a process of registration for each of the courses in his/her timetable. It shall be the responsibility of the student to complete his/her registration in person, failing which he/she shall not be permitted to attend classes or use the facilities of the Institute.

Eligibility Conditions for Registration

Every student on the rolls of the institute is required to register for the courses to be taken in the semester. A student is not permitted to register in a semester/term if

(i) He/she has dues outstanding to the institute, hostel, library or any recognized organ of the institute.

(ii) His/her results of the preceding semester/term are withheld.

(iii) He/she has an Incomplete (I) report in the immediately preceding semester/term.

(iv) He/she has been specifically asked to stay away from that semester.

Original Registration

On the first day of the semester, every student must register for all the courses to be taken in the given semester. The Chairperson, Academic Registration and Counseling Division along with his/her team of registration coordinators, ensures smooth completion of the registration process. After ensuring that there is no default of fee payment, every student is given a randomly generated priority number for registration. The order /queue followed by students for registration are based on the priority number. Every student is provided with a master timetable with the following information: course titles, course codes and units of courses offered in the semester, number of sections for each course, timings and venue, common hour details, tests and examination schedules and faculty names. The student is expected to make his/her own timetable exercising his/her choices while ensuring that the sections of his/her choice are still available and there are no clashes in the timings of different courses. The choices that he/she can exercise will in general be decided by his/her priority number. The

registration process is completed once he/she submits the filled in registration card with details of courses taken and the same is approved by the Chairperson.

Conditions for registration of Backlog courses

If a student has not cleared a named course (other than electives) mentioned in his/her semester-wise chart by the time under consideration, then the said course becomes a backlog course until he/she clears it at the next possible opportunity. During registration, the student should first register for all backlog courses which are offered in that semester before taking other courses.

Provisional Registration

A student may be permitted for a provisional registration even if he/she has some outstanding dues. The student can complete his/her registration with the written permission from the Director. The dues must be cleared within the stipulated time decided by the Institute. The provisional registration is subject to cancellation without notice, if the student is found defaulting after the grace period.

Late Registration

Under exceptional circumstances, a student may be permitted to opt for late registration. The student should apply to the Director through Chairperson-Academic Registration and Counseling Division and obtain prior permission for late registration. Late registration is done on the 8th day of the semester. A student who fails to meet the late registration deadline has lost the last opportunity to register for that semester. Students are advised to avoid late registrations as the choice of sections for various courses can be limited by the delay.

Amendment to Registration

The Chairperson-Registration can amend the registration of a student under the following circumstances:

(i) If the registration of a student in a course is not found to be in accordance with the regulations, like a student not fulfilling prior preparation conditions or pre-requisite conditions for a course his/her registration in that course will be cancelled.

(ii) In case of timetable clashes or clashes in tests/examination schedule, the registration is amended by removing the said course(s) from the students registration card.

Substitution of Courses

Course substitution can be done when

(i) Any time within one week from the beginning of the semester, a student requests for substitution of a course in which he/she has already registered, with another course.

(ii) ACC recommends for substitution of one course with another for a student under its purview.

Withdrawal from Courses

(i) If a student desires to withdraw from a course, he/she may submit a formal application for withdrawal within ten weeks from the beginning of the semester.

(ii) In exceptional circumstances, a student may be permitted to completely withdraw from all the courses and drop the semester/term when the Director is satisfied with the reasons that warrant the withdrawal.

Pre-requisite Courses

Certain courses have pre-requisite conditions attached to them which the student should have fulfilled before registering in such courses. If a course is a pre-requisite,then the student should have a valid grade, not a report, in the pre-requisite course

Prior Preparation

For certain courses or a group of courses, a specified prior preparation is required.These requirements are described in the following table.

For first degree students:	
IP I for single/dual degree	Normally all courses in the semesters preceding IP I for his/her program/composite program.
IPII/TS for single/dual degree	All named courses of his/her program/composite program, other than TS/IP-II.
For any other prescribed semester of single / dual degree	All named courses in semesters and terms preceding this set of courses in his/her program / composite program

* If IP-I is delayed by one year for a student with the permission of the appropriate authority, he/she would be permitted to register for CDC's with prior preparation package not including IP I.

6. TEACHING AND EVALUATION

Teaching

The objective of classroom education is to awaken curiosity, generate habits of rational thinking and train students to be independent and face unfamiliar situations. Classroom instructions help a student to organize and correlate facts, comprehend ideas and to use knowledge creatively.

Multi-Section Operations

A number of courses offered in the first two years at IcfaiTech are multi-section in operation and many of these are interdisciplinary in nature. Some of the salient features of multi-section operation are enumerated below:

• Every course, is conducted by a member of the faculty called an Instructor-in-Charge (IC), with the assistance of required number of Instructors - who will partner in meeting the full academic responsibilities and organizational needs of teaching and evaluation.

• The IC with the team of instructors makes a comprehensive plan with respect to the conduct of the course. The team remains in continuous interaction throughout the semester, to ensure smooth operation of the course.

• While the style of teaching may vary from instructor to instructor, the team makes all effort to ensure that the pace of delivery of the content is uniform.

• The question papers, its solutions and detailed break-up of marks for tests/quizzes and other examinations are prepared by the entire team.

To ensure uniformity in marking, a given question is marked by the same instructor for all the students registered in the course. All this ensures that the operational aspects including grading are free from arbitrariness.

Course Handout

For a smooth conduct of a course, the instructors share all the important details of the course, including assessment scheme with students at the beginning of the semester. This is done through a 'Course Handout' that provides information like the

• scope & objectives of the course

• text books, reference books, and other digital resources like NPTEL, SWAYAM

• content and operational aspects (pace, coverage and level of treatment)

• frequency/duration of classes, credits

• components of evaluation like quizzes/tests (announced or unannounced, open-book or closed-book), laboratory exercises, list of experiments, home assignments and their relative weights

• course outcomes

• attendance policy

• policy on make-up tests

• chamber consultation hours

Evaluation Components

Teaching and evaluation form a coherent function and operate on the basis of mutual understanding and trust at IcfaiTech. All components of evaluation are internal; conducted and evaluated by the Instructors/team of instructors handling the course. The evaluation components are evenly spread out in the semester. Various attributes like spontaneous recall, practical application of concepts, ability to work on their own, competence in conceptualized arguments, aptitude to face unfamiliar situations are put to test. The various components of evaluation that the instructor may employ to evaluate a student are tests, quizzes, seminars, presentations, assignments, projects, laboratory-based experiments etc. The evaluation methods, components and their weights depend on the nature of the course. The suggested components normally include two or three written tests, quizzes, and assignments. The quizzes and assignments are interspersed between the tests. All tests and quizzes are conducted during the common hours without disturbing the normal academic schedule. All test and end semester examinations are conducted as per the schedules announced to the students through Course Handouts. One of the components of evaluation (End-Semester examination) is comprehensive enough to include the entire course and is held at the end of the semester. The written examination normally consists of objective questions, short-answer questions, descriptive-answer questions, problems etc. The pattern and type of questions may vary depending on the nature of the course.

Component	Weights	Duration
Test-I	15%	50 minutes
Test-II	15%	50 minutes
Test-III	15%	50 minutes
Assignments/quizzes/presentations/projects	15%	
End Semester Examination	40%	3 hours

Evaluation components and their weights for a typical theory course.

Evaluation and Feedback on performance

Just as evaluation is done in a continuous and transparent manner, feedback on performance in the evaluation components is also made available at regular intervals. The answer scripts are promptly evaluated and shown to the students. The performance of the students with reference to the highest, lowest and average marks is discussed in the class. Solutions with the marking scheme are displayed immediately on the department notice board after every test and examination.

In case of any subjectivity in the evaluation, or discrepancy from the discussed/displayed evaluation scheme, or any totaling errors in the answer script, the student reserves the right to request for a rechecking or retotalling.

Mid-semester grading for each course, based on the evaluation components conducted until the middle of the semester, is made available to the students. This grade alert will help the students to improve their performance in the remaining evaluation components.

Attendance Policy

Every student is normally expected to maintain a minimum of 75% attendance in every course for which he/she is registered. In courses with both theory and laboratory components, the student must maintain a minimum of 75% attendance in both the components.

The IC/instructor in consultation with the Chairperson Academics can recommend to the Director, IcfaiTech for condonation up to a maximum of 10% for those students who face genuine difficulty in maintaining 75% attendance.

Condoning process has the following steps:

• Instructor-in-Charge/instructors make a list of students with attendance between 65 and 75%.

• The data of these students on performance indicators like marks in tests, quizzes and assignments is examined.

• Assignments and tasks are designed for each student to make up for deficiency in academic performance and the shortage of attendance.

• who complete the task to the satisfaction of the Instructor are permitted to appear for the examination.

If a student does not write the end-semester examination or is not permitted to take the end-semester examination in any course, he/she will be given RRA report. He/she will be required to Register Again (RRA) for the course when it is next offered.

Periodic alerts given by the instructors regarding attendance must be taken seriously and every effort made to reach the required attendance.

Make-up Policy

If a student anticipates a genuine difficulty in meeting the date of component of evaluation, he/she should take the IC/Instructor into confidence prior to the event and request for a makeup. Whenever a student misses a component of evaluation for genuine and unanticipated reasons and has therefore not taken prior permission, the student must immediately after the test approach the IC/Instructor with a request for make-up.

If the IC is satisfied with the request, a make-up test/examination would be conducted one week after the date of the missed component of evaluation.

The students must note that there will be no makeup for laboratory experiments, lab exams, quizzes and presentations.

Unfair Practices in Examinations/Academics

Students must not resort to unfair means during any evaluation component. Any of the following events will be considered as unfair practice(s) during examinations/evaluation.

a) Possessing unauthorized materials like notes or slips in pockets, vanity bags and purses.

b) Having notes and formulas written on the body.

c) Using cell phones or programmable calculators.

d) Copying from other students.

e) Allowing/enabling other students to copy from one's paper/computer screen.

f) Taking or giving any kind of assistance from/to other students.

g) Communicating with the students in or outside the exam hall.

h) Going out of the examination hall other than to the rest room.

i) Plagiarism in project work/assignments.

In the judgement of the Invigilator, if a student has indulged in unfair means in the examination hall, the following steps are taken by the invigilator:

• The student is asked to surrender the answer book and any possible material evidence and leave the exam hall.

• A report is filed with the Director, IcfaiTech after handing over the answer book with material evidence. The examination committee conducts an enquiry where the student is given opportunity to defend himself.

Use of unfair means if established, would result in one of the two punishments:

a. Cancellation of registration (RC) for the course in which use of unfair means was established.

b. Cancellation of registration for the course along with suspension for a full semester. Suspension for a full semester implies that the student cannot register for any course offered in that semester.

7. GRADING

The IcfaiTech system emphasizes on continuous and regular evaluation, which includes numerical marking in grading the student. At the end of a semester, letter grades are awarded to the students based on their overall performance in the course. These grades are relative to the performance of all the students evaluated for that course.

Letter Grades

The list of letter grades, the grade points associated with them and their qualitative meanings are given below:

Letter	Qualitative Grade	Points attached
A	Excellent	10
B	Good	8
C	Fair	6
D	Poor	4
E	Exposed	2

In order to arrive at letter grades, the histogram based on the total marks in a particular course for all the students pursuing the course is made. The histogram normally shows clusters, gaps between clusters or dips between clusters. The grading in the course is guided with reference to the highest, lowest, average marks, and the gaps and dips between clusters of students. In courses where the registered number of students runs into hundreds, the range of C grade usually covers the average marks. This may however not be case when the histogram is skewed, and the average marks of the class is unusually high or low.

In case of absence of clear gap between clusters, the grade border may be drawn in a dip in the cluster. The decision on whether the students appearing on the borderline are pushed to the higher grade or to the lower grade is taken on a case by case basis. Some of the factors that guide the instructor in grading the borderline students are attendance, participation in the class and overall attitude.

In courses with a small number of registered students, the instructor opts for absolute grading. In such cases, the instructor announces to the students at the beginning of the semester, the anticipated mark ranges for various grades.

Reports

At the time of final grading, in certain cases, the Instructor-in-Charge can report certain events/facts in place of letter grades. These reports are not to be construed as grades. The various reports listed below are elaborated in the subsequent paragraphs.

1. Incomplete (I)

2. Grade Awaited (GA)

3. Withdrawn (W)

4. Registration Cancelled (RC), Required to Register Again (RRA) and Discontinued from the Program (DP)

5. Not Cleared (NC).

Incomplete (I)

An Instructor-in-Charge who finds that a student has not fulfilled some requirement of a course before the deadline for transmitting the grades, is satisfied that the student is able to transmit a grade or a report without this fulfillment; can use his/her discretion to give the student an opportunity.

The Instructor-in-Charge can within the deadline, send a report 'I' (Incomplete) for the student and also inform the student of the same. It shall be the responsibility of the student to contact the Instructor-in-Charge and fulfill the requirement for replacement of the 'I' report within two weeks after the end of the semester; failing which the Instructor-in-Charge will communicate whatever grade/report is possible for that situation.

Grade Awaited (GA)

'GA' is given in situations where operational and practical difficulties may cause a delay in transmitting of a grade or a report. Some instances when GA is given are as follows:

(i) pending case of unfair means

(ii) pending case of indiscipline

(iii) for IP courses where the student is at an off campus center and the dissemination of information between the Institute and the IP center is delayed

(iv) if due to genuine reasons a student is unable to appear for end-semester examination on the scheduled date and his/her request for make-up has been granted After the case has been decided, or the IP grade getting transmitted or the makeup taken and evaluated, the GA report is converted into a valid grade or report.

Whenever the report GA appears in the grade sheet, it must be converted into a letter grade or a report before the next semester registration.

Withdrawn (W)

A student may seek withdrawal from course(s) in a semester for any of the following reasons:
(i) The student is unable to attend classes for the course(s) for a genuine reason.

(ii) The student is unable to cope up with the normal load and withdraws from the course(s) to reduce his/her academic load for the semester.

Request for withdrawal should be made to Chairperson-Academics, within ten weeks of commencement of the semester. In case of withdrawal within the stipulated time, the grade sheet/transcript of the student will indicate 'W' (withdrawn) against the course(s) from which the student has withdrawn his/her registration. If the withdrawal is made after the due date, the event will be reported as 'RC'. In either of the situations, the student will have to register for the course(s) at the next offer and obtain a valid letter grade.

Registration Cancelled (RC), Required to Register Again (RRA), Discontinued from Program (DP)

If a student's registration for a course has been cancelled, it will be reported in the grade sheet as 'RC'. The following are the situations when an RC report is issued:

(i) Cancellation is recommended as a part of disciplinary action against the student for resorting to unfair means during examination or other unprofessional behavior

(ii) Cancellation is recommended due to less than the minimum required percentage of attendance.

(iii) Cancellation is recommended if a provisionally admitted student fails to submit the proof of necessary documents required for registration and/or does not satisfy the minimum eligibility requirements for the admission within the prescribed time limit.

(iv) Cancellation is recommended when a student persistently and/or deliberately does not pay his/her dues.

RC itself has many contextual meanings:

(i) When it is clearly known that the student is required to register again in the same course, the event will be reported as RRA (Required to Register Again).

(ii) If RC amounts to discontinuation from the program, it will be reported as DP (Discontinued from the Program).

(iii) If the cancellation of registration is not reported either as RRA or as DP but as RC, it does not necessarily mean that it is free from any constraint but that the meaning of the constraint must be construed from the context in which the RC is reported.

Not Cleared (NC)

If a student continued to remain registered in a course (with or without lab component) but gave the instructor inadequate opportunity to evaluate him by not attending the quizzes/ tests/examinations/lab sessions and other components of evaluation, or by appearing in the same for the sake of appearing, without applying himself to the task at hand, the student will be given NC (Not Cleared). It is to be noted that a NC cannot be ignored, except under the situations described in (ii) and (iii) below:

(i) Whenever a student gets a NC report in a course which is in the compulsory package of his/her program, he/she is required to register again in the same course and get a valid grade.

(ii) If a student has a NC report in an elective course, he/she can either repeat the course to get a valid grade or ignore it to choose another course. However, a student must get valid grades in at least the prescribed number of electives in his/ her program.

(iii) If a student record has a NC report in a course which remains unaccounted for, after a process of transfer has been completed, although it will not be possible for him/her to wipe out the NC report from his/her transcript, he/she can still graduate. (iv) If a student gets a NC in IP/Thesis, he/she will be required to register in the same for one more semester.

Cumulative Grade Point Average (CGPA)

The Cumulative Grade Point Average (CGPA) is used to describe the overall performance of a student in all courses in which he/she is awarded letter grades since his/her entry into the Institute. It is also used for the declaration of division when the program is completed.

CGPA is the weighted average of the grade points of all the letter grades received by the student from his/her entry into IcfaiTech and is computed as follows:

$$CGPA = \frac{\Sigma u_i g_i}{\Sigma u_i} = \frac{(u_1 g_1 + u_2 g_2 + u_3 g_3 + \ldots)}{(u_1 + u_2 + u_3 + \ldots)}$$

Where u1 , u2 , u3 , ... denote units associated with the courses taken by the student and g1 , g2 , g3 ..... denote grade points of the letter grades awarded in the respective courses. Reports will not alter the CGPA, since the same are not accounted for in the CGPA calculations.

When a student repeats a course in which he/she has already received a grade, as soon as a new grade is obtained, it will replace the earlier one in the calculation of CGPA. It is to be noted that only the latter grade in a course would be considered for the calculation of CGPA and not the better of the two grades.

Grade Sheet

A student's grades, reports, CGPA, etc., at the end of every semester/term will be recorded on a grade sheet, a copy of which will be issued to him/her. The grade sheet will be withheld when a student has not paid his/her dues or when there is a case of breach of discipline or unfair means pending against him/her.

While registration with approval of the appropriate authority is a token of permission to pursue studies, the grade sheet is a complete record of the outcome of what was intended in the registration. The various grades and reports discussed in the handbook will be appropriately used to tally the grade sheet with the registration data. It would be evident that this tally between what was registered for and what was obtained in terms of grades and reports will apply to all courses except for any course which was originally registered for, but subsequently replaced by another course through substitution.

The tally is made on a course by course basis at the end of the term to determine which of the courses have been cleared. A course is deemed to have been cleared if the student obtains a grade in the course. However, mere clearing of the prescribed courses does not tantamount to fulfilling the requirements of graduation.

While all grades secured, reports and other pertinent information for a semester are given in a grade sheet, the chronologically organized information from the grade sheets of a student with necessary explanation constitutes his/her transcript, which is issued at the time he/she leaves the institute or on request at an intermediate point.

Minimum Academic Requirements

The education philosophy of IcfaiTech interlinks and at the same time distinguishes between the performance of a student in a single course and his/her cumulative performance. Accordingly, the student of the first-degree program has to maintain the expected minimum academic requirement at the end of each semester.

They are as follows:

(i) A student should not have secured more than one 'E' grade in the semester.

(ii) A student should have CGPA of at least 4.50.

(iii) A student should have at least cleared with his/her latest performance, such courses (counted from the point of his/her entry into the Institute) as are prescribed for a period that corresponds to two-thirds of the number of semesters spent by him/ her since his/her entry into the Institute with reference to his/her current program. This means that at any stage of reckoning, the student should not have spent more than 50% extra time than what is prescribed for him/her up to that stage.

Academic Counseling Committee (ACC)

The minimum academic requirements that every first-degree student should meet at the end of every semester are mentioned above. Failure to meet even one of these requirements will automatically bring the student under the purview of the ACC or the designated authority.

The ACC will take immediate charge of the student and ask him/her to follow a specific path so that he/she can be rehabilitated at the earliest. The student under ACC will not undergo

normal registration process but will be guided by the ACC in selection of the courses for the semester registration.

Once a student has been placed under the purview of the ACC, he/she should continue to be under its direct guidance until,ACC after being satisfied with his/her overall progress and performance, declares him/her to be outside its purview. All decisions of the ACC shall be final.

Students under the purview of ACC are cautioned from time to time if they fail to improve in the following stages.

Warning: A student, who comes under the purview of the ACC for the first time due to a CGPA between 4.2 and 4.5 is warned to take studies seriously and improve the performance in order come out of ACC list by the next semester.

Severe Warning and Reduction in Course Load: If a student has CGPA between 3.0 and 4.2 or continues to remain under the purview of the ACC in the subsequent semester, he/ she would be severely warned. The ACC, based on its evaluation of the student, decides that the student would not be able to cope up with the normal load of courses for the semester. The ACC will work out a package of courses with reduced load for the ensuing semester, so that the student gets a chance to improve and come out of the purview of the ACC.

The implication of a reduced load is that the period of study gets extended.

Probation: If the advice and guidance of the ACC is not taken seriously by the student,and he/she continues to give deteriorating performance, he/she might be given a last chance and kept on probation during the next semester. During this semester his/her progress will be closely monitored.

Discontinued from Program: If a student on probation during a semester fails to improve his/her performance to the satisfaction of the ACC and his/her CGPA falls to below 3.0, he/ she would be Discontinued from the Program (DP) and would be asked to leave IcfaiTech.

It must be noted that any student under the purview of the ACC found to be involved in any act of indiscipline or unfair means in examination at any time would be immediately asked to discontinue from the program. It should therefore be the single-minded objective of the student to fulfill the minimum academic requirements stipulated,thus enabling himself/herself to be declared outside the purview of the ACC at the earliest.

Graduation Requirements

A student is deemed to have fulfilled the requirement of graduation for the first-degree program when he/she satisfies the following conditions-

(i) Has cleared all the courses prescribed for him/her in his/her program.

(ii) Has obtained a minimum CGPA of 4.5.

(iii) Has remained outside the purview of the ACC or has been declared outside its purview.

(iv) Has overcome all the consequential stipulations of an NC report; except where there is NC report in an elective course over and above the prescribed number of elective courses or in a course which has ceased to be a part of his/her current program because of transfer of program.

A student is deemed to have become eligible for the Bachelors degree if, in addition to the above requirements he/she has no case of indiscipline or unfair means pending against him/ her. If a student has outstanding dues against him/her to be paid to IcfaiTech, the student hostel or any other recognized affiliate/ associate organization of IFHE, his/her degree will be withheld until the said dues are cleared.

Certification

The following classification based on CGPA will be made and mentioned in the graduation certificate of the first Degree program student.

Distinction	CGPA 9.00 or above
I Division	CGPA 7.00 or more but less than 9.00
II Division	CGPA 4.50 or more but less than 7.00

Every student is expected to familiarize himself with the following documents associated with academic progress and program completion: Grade Sheet: Grade sheet is a complete record of courses done, grades obtained by the student, showing GPA and CGPA and other information for a semester. Students can obtain duplicate copies of grade sheet on payment of nominal fee.

Transcript: Transcript is chronologically organized information of courses, grades,GPA, CGPA obtained in various semesters during the Program which is issued on successful

completion of the Program. Students can obtain additional transcript on payment of ` nominal fee. Provisional Certificate: Students who fulfill the graduation criteria will be given a provisional certificate before the convocation.

Degree Certificate:

Students who fulfill the graduation criteria will be awarded the Degree certificate at the formal convocation.

Awards

All students who successfully complete the prescribed course work and examinations will receive their degree from IFHE.

Gold and Silver medals will be awarded to the students scoring the first rank and second rank respectively on completion of the program. A student against whom disciplinary action has been taken or has any backlog of course(s) will not be eligible to get merit scholarship/medals.

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University Under Section 3 of the UGC Act, 1956)

ICFAI FOUNDATION FOR HIGHER EDUCATION HYDERABAD

ICFAI Foundation for Higher Education
(Deemed-to-be University under Section 3 of the UGC Act, 1956)

IcfaiTech
Faculty of Science & Technology (FST

Contact
ICFAI Tech Hyderabad, IFHE Campus,
Donthanapally, Shankarapalli Road, Hyderabad - 501203, Telangana, India.