CURRICULUM
&
SYLLABUS
B.TECH - Computer Science & Engineering



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

IcfaiTech
Faculty of Science & Technology (FST)

ICFAI FOUNDATION FOR HIGHER EDUCATION HYDERABAD

S. Vijayalakshmi

REGISTRAR
ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deeemed-to-be-University establishes under section 3 of UGC Act 1956.)

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.

Contents

Item #	Description	Page#
1	Introduction	3
2	B.Tech Computer Science & Engineering Program Structure	16
3	Course Descriptions	18
4	Handouts	31
5	Registration	138
6	Teaching & Evaluation	140
7	Grading	144

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 emerge as an Institution of Excellence known for research, teaching and practice.

The Mission of IFHE is 'Learning for Leadership'. It aims at developing a cadre of professionals possessing specialized skills having a sense of social and moral responsibility and the ability to address problems from a broader perspective.

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	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	Attain the professional skill sets to understand, create and optimize algorithms, analyze, design and implement software and hardware-based solutions for industry and research problems.
PSO2	Gain vast knowledge in various areas of Computer Science and Engineering and implement the skills in higher studies, professional career and entrepreneurship
PSO3	Excellent adaptability to function in multi-disciplinary work environment, good interpersonal skills as a leader in a team in appreciation of professional ethics and societal responsibilities.

2. Computer Science and Engineering (CSE) - Semester-wise pattern

Year	Course Code	Semester-I	L	P	U	Course Code	Semester-II	L	P	U
I	CSCHEM111	Chemistry	3	0	3	CSES121	Thermodynamics	3	0	3
	CSEGL112	English Language Skills	3	0	3	CSAO122	Probability & Statistics	3	0	3
	CSMATH113	Linear Algebra	3	0	3	CSMATH123	Higher Calculus	3	0	3
	CSPHY114	Physics I	3	0	3	CSPHY124	Physics II	3	0	3
	CSTA115	Engineering Graphics	2	4	4	CSTA125	Scientific Measurements	0	4	2
	CSTA116	Computer Programming I	3	0	3	CSTA126	Workshop Practice	2	4	4
	CSEVS117	Environmental Science	2	0	2	CSTA127	Computer Programming II	3	0	3
	Total No of Credits				**21**	**Total No of Credits**				**21**
II	**Semester-III**					**Semester-IV**				
	CSES211	Electrical Sciences I	3	0	3	CSES221	Electrical Sciences II	3	0	3
	CSES212	Digital Electronics	2	2	3	CSTA222	Engineering Measurements	1	8	4
	CSES213	Engineering Mechanics	3	0	3	CSTA223	Professional Communication	3	0	3
	CSECON214	Principles of Economics	3	0	3	CSMGTS224	Principles of Management	3	0	3
	CSMATH215	Complex Variables	3	0	3	CSAO225	Optimization Techniques	3	0	3
	CSMATH216	Differential Equations & Fourier Series	3	0	3	CSES226	Structure & Properties of Materials	3	0	3
	CS211	Discrete Structures for Computer Science	3	0	3	CS221	Data Structures	2	2	3
	Total No of Credits				**21**	**Total No of Credits**				**22**
SUMMER TERM	**IP 221 INTERNSHIP PROGRAM I (for Internship option only)**									**5**
III	**Semester-V**					**Semester-VI**				
	CSAO311	Numerical Methods	3	0	3	—	Humanities Elective	3	0	3
	CSAO312	Control Systems	3	0	3	CS321	Programming Languages & Compiler Construction	3	0	3
	CS311	Microprocessor Programming & Interfacing	3	0	3	CS322	Computer Organization & Architecture	3	0	3
	CS312	Operating Systems	3	2	4	CS323	Computer Networks	3	0	3
	CS313	Theory of Computation	3	0	3	CS324	Design & Analysis of Algorithms	3	2	4
	CS314	Database Management Systems	2	2	3		Elective (1)	3	0	3
		Special Project / TIP	0	0	3		Special Project / TIP	0	0	3
	Total No of Credits				**22**	**Total No of Credits**				**22**
IV	**Semester-VII**					**Semester-VIII**				
	IP401/	Internship Program II			20	–	Electives (4)			18
	TS401	Thesis & Seminar				–	Humanities Elective (2)			
	–	Electives (4)			18	IP401/	Internship Program II			20
	–	Humanities Elective (2)				TS401	Thesis & Seminar			
	Total No of Credits				**20/18**	**Total No of Credits**				**18/20**
Total No of Credits										**172**

Table : Discipline Core Courses for the B.Tech. Programs

Computer Science &Engineering (CSE)				
Course Code	**Course Title**	**L**	**P**	**U**
CS211	Discrete Structures for Computer Science	3	0	3
CS221	Data Structures	2	2	3

Table : Compulsory Discipline Courses for the B.Tech Programs

Computer Science and Engineering (CSE)				
Course Code	**Course Title**	**L**	**P**	**U**
CS311	Microprocessor Programming & Interfacing	3	0	3
CS312	Operating Systems	3	2	4
CS313	Theory of Computation	3	0	3
CS314	Database Management Systems	2	2	3
CS321	Programming Languages & Compiler Construction	3	0	3
CS322	Computer Organization & Architecture	3	0	3
CS323	Computer Networks	3	0	3
CS324	Design &Analysis of Algorithms	3	2	4

Table : List of electives for B.Tech. (Computer Science & Engineering)

1) Database Specialization

Course Code	Course Title	L	P	U
CS401	Database Administration	3	0	3
CS402	SQL & DB Applications	3	0	3
CS403	Database Security & Privacy	3	0	3

2) Networks Specialization

Course Code	Course Title	L	P	U
CS404	Wireless Networks	3	0	3
CS405	Network Administration	3	0	3
CS406	Network Security	3	0	3
CS407	Cyber Security	3	0	3

3) Programming Languages & Applications Specialization

Course Code	Course Title	L	P	U
CS408	Advanced JAVA	3	0	3
CS409	Mobile Application Development	3	0	3
CS410	Scripting Languages	3	0	3
CS411	Web Enabled Technologies	3	0	3
CS412	Computer Graphics	3	0	3

4) Software Engineering Specialization

Course Code	Course Title	L	P	U
CS413	Software Engineering	3	0	3
CS414	Service Oriented Architecture	3	0	3
CS415	Object Oriented Analysis & Design	3	0	3
CS416	Software Testing Methodologies	3	0	3

5) Advanced Computing Specialization

Course Code	Course Title	L	P	U
CS417	High Performance Computing	3	0	3
CS418	Advanced Computer Architecture	3	0	3
CS419	Multicore Architecture	3	0	3
CS421	Parallel Computing	3	0	3

6) 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.Tech Program Course Description

Semester-wise Institute Courses

Course Code	Course Title	L	P	U	Course Description
CSCHEM111	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.
CSEGL112	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
CSMATH113	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.
CSPHY114	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.

CSTA115	Engineering Graphics	2	4	4	Angle of projections; free hand sketching; orthographic views; pictorial views; auxiliary views; lines and planes; intersection and development; AutoCAD command and simple drawings using AutoCAD.
CSTA116	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
CSEVS117	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
CSES121	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.
CSAO122	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.
CSMATH123	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, 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
CSPHY124	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.
CSTA125	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.
CSTA126	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.
CSTA127	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.
CSES211	Electrical Sciences I	3	0	3	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 of circuits; three phase circuits, transformers; basics of rotating machines; DC machines; induction machine

CSES212	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
CSES213	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.
CSECON214	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
CSMATH215	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.
CSMATH216	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.
CSES221	Electrical Sciences II	3	0	3	Semiconductor physics, doped semiconductors, junction diode, ideal diode, non-ideal diode models, Zener diode 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
CSTA222	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.
CSTA223	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.
CSMGTS 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.
CSAO225	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
CSES226	Structure & Properties of Materials	3	0	3	Study of the basic properties of materials in relation to their molecular structure; emphasis on the structure of metallic, polymeric and ceramic materials in relation to their mechanical, electrical, electronic and chemical properties, methods of imparting desirable properties to materials by inducing changes in molecular structure; property requirements and material selection, criteria for widely ranging service conditions.
CSAO311	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.
CSAO312	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 Social Change	3	0	3	Nature of Society, social institutions; concept and nature 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
HS312	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.
HS313	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.
HS314	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.
HS315	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.
HS316	Professional Ethics	3	0	3	Ethics, nature and purpose; ethical theories; ethics in business and management; ethics in engineering, global ethical issues.
DS491 CE491 CS491 EC491 EE491 ME491 MEC491	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.
IP 221	Internship Program I	0	0	5	This course is run during the summer term at various industries and is of about 8 week duration.

IP 401	Internship Program II	0	0	20	This course is run during one of the two semesters in the final year and is a part of adjoining summer vacation. The duration of this program is about five and half months. Students will be working at industries on the live projects under the supervision of the FST faculty.
TS 401	Thesis & seminar	--	--	--	TS 401 is a required course for all the students with thesis option.
TIP 491/TIP 491	**Technology Innovation Project**	0	0	3	A unique opportunity for the students in the form of a course that facilitate the combination of academics with the industry by involving an in-depth innovation, investigation under the supervision of mentor from Industry and a faculty member for performing the real-life projects with the support from various organizations. Students working in groups will be required to perform research, customer and problem discovery, ideation, concept creation and validation, and technical implementation for a real-world challenge. The specific time-bound based on the students registered for the course will be graded based on the performance feedback from both the industry and the Faculty supervisor. The student will be able to improve the skills and knowledge for improving written and oral communication with indicative content which includes innovation methodology, customer & problem discovery, problem validation, innovation experiments with innovative presentations.

B.Tech Computer Science Engineering Program (CSE)

Course Description

Course Code	Course Title	L	P	U	Description
CS211	Discrete Structures for Computer Science	3	0	3	Introduction to discrete mathematical structures; Formal logic and predicate calculus; Sets, relations and functions; Proof techniques; Graphs and trees; Primes, factorization, greatest common divisor, residues and application to cryptology; Boolean algebra; Permutations, combinations and partitions; Recurrence relations, and generating functions; Introduction to error-correcting codes; Formal languages and grammars, finite state machines.
CS221	Data Structures	2	2	3	Introduction to Software Design Principles- Modularity, Abstract Data Types. Data Structures And Algorithms. Analysis Of Algorithms. Linear Data Structures – Stacks, Arrays, Lists, Queues And Linked List. Representations- Pre-Fix, In-Fix and Post-Fix Expressions. Recursion. Set Operations. Hashing and Hash Functions. Binary and Other Trees. Traversal Algorithms. Huffman Codes. Search Trees. Priority Queues. Heaps and Balanced Trees. Sorting Techniques. Graphs and Digraphs. Algorithmic Design Techniques. Data Structures for External Storage. Multi-Way Search and B-Trees.
CS311	Microprocessor Programming & Interfacing	3	0	3	Elements of digital electronics; PC organization; 80X86 as CPU; Instruction set, register set, timing diagrams, modular assembly programming using procedures & macros, assembler, linker & loader concepts; concept of interrupts; hardware interrupts; software interrupts, BIOS and DOS interrupts; Memory interfacing and timing diagrams; I/O interfacing; programmable I/O devices such as 8255, 8253, 8259, etc.
CS312	Operating System	3	2	4	Introduction to Operating Systems. Various Approaches to Design of Operating Systems. Overview of Hardware Support for Operating Systems. Process Management. Process Synchronization and Mutual Exclusion. Inter-Process Communication. Process Scheduling. CPU Scheduling Approaches. Memory Management- Paging, Segmentation, Virtual Memory, Page Replacement Algorithms. File Systems- Design and Implementation of File Systems. Input/Output Systems. Device Controllers and Device Drivers. Security And Protection. Case Studies on Design and Implementation of Operating System Modules.
CS313	Theory of Computation	3	0	3	Finite Automata and Regular Languages – Equivalences, Closure Properties. Context Free Languages & Push-down automata – Equivalences, Closure Properties, Concepts in Parsing. Turing Machines. Computability & Decidability – Universal Turing Machine, Recursive Functions, Church-Turing Hypothesis. Complexity Classes – P, NP, Reducibility and NP-Completeness.
CS314	Database Management Systems	2	2	3	Introduction to Data Bases and Management. Data Files and Structures. Hierarchical, Relational, Network Models. Distributed Data Bases. Query Processing and Query Optimization, Query Languages. Concepts of Security and Protection. Case Study of a Data Base System

CS321	Programming Languages & Compiler Construction	3	0	3	Overview of Programming Languages Concepts and Constructs. Programming Paradigms. Introduction to Compiler Process, Phases and Passes. Bootstrapping of Compilers. Formal Languages, Grammars and Abstract Machines. Lexical Analysis, Regular Expressions and Finite Automata. Context-Free Grammar and Push-Down Automata. Recursive-Descent, LL and LR Parsers. Semantic Analysis, Attribute Grammar, Type Checking. Intermediate Representation. Run-Time Environments. Code Optimization and Code Generation.
CS322	Computer Organization & Architecture	3	0	3	Memories and memory module design; sample CPU design – instruction set, addressing modes, instruction formats, instruction fetching and execution; instruction and execution cycles, timing, realization and documentation; floating point arithmetic operations, FPAU design; I/O devices and interrupt processing; special topics such as microprogramming & bus structures, simple design example
CS323	Computer Networks	3	0	3	Evolution of Communication and Computer Networks, Protocol Layering, Network Reference Models, Multiple Access Protocols, Local Area Networks, Packet and Circuit Switching, Switching Fabrics. Network Performance Analysis and Simulation Techniques. Addressing, Routing, Flow and Congestion Control, IP Protocol. Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM) Reference Models. Network Interoperability, Traffic Management and Quality of Service in Integrated Network Protocol Design and Implementation Strategies.
CS324	Design & Analysis of Algorithms	3	2	4	Introduction to Algorithms, Elementary Data Structures, Set Operations, Divide and Conquer, Greedy method, Dynamic Programming, Searching and Traversal Techniques, Backtracking, Branch and Bound, NP-Hard and NP Complete problems
CS401	Database Administration	3	0	3	Introduction to DBA- ER Diagrams, Normalization, Database Design, Views. Database Security- Granting and Revoking Authority, Roles and Groups, Encryption SQL Injection. Backup- Importance, Approaches to Database Backup, Recovery, Determining Recovery Options, Steps for Recovery, Alternatives to Backup and Recovery. DBA Tools- Database Change Management, Performance Management, Data Warehousing, Analytics and Business Intelligence.
CS402	SQL & Database Applications	3	0	3	Introduction to Database Management Systems. Queries in SQL. Constraints and Triggers. SQL in a Programming Environment. Persistent Stored Modules (PSM). Virtual Tables. Java Database Connectivity. Transaction in SQL. Security and Authorization in SQL Application Development. SQL vs No NoSQL databases. Document store, Column store, Key Value pairs.
CS403		3	0	3	Security Fundamentals, Security Architecture & Operating

	Database Security & Privacy				system. Administration of Users & Profiles, Password Policies, Privileges and Roles. Database Application Security Models& Virtual Private Databases. Auditing Database Activities. Privacy Preserving Data Mining Techniques.
CS404	Wireless Networks	3	0	3	Introduction to Cellular Wireless networks. IEEE 802.11 standards. WiFi.WiMAX. Wireless Local Loop. Telecommunication Systems- GSM, SMS, GPRS, VOIP Service for Mobile Networks, PDP Context Procedure. Mobile IP-Configuration Protocols, Routing Protocols, TCP. WAP Model- Mobile Location based Services, WAP Gateway, WAP Protocols, WML, and WTA.
CS405	Network Administration	3	0	3	Introduction to Computer Networking- The TCP/IP and OSI Networking Models. A Brief History of Ethernet-Ethernet Data-Link Protocols, WAN, Fundamentals of IPv4 Addressing and Routing, Overview of Network Layer Functions, IP Addressing, IP Routing, IP Routing Protocols. LAN Switching Concepts- LAN Design Considerations. Operating Cisco LAN Switches, Ethernet Switch Configuration, Ethernet Switch Troubleshooting. Wireless LAN Concepts, Deploying WLANs, Wireless LAN Security. Introduction to Subnetting- Analyze Subnetting and Addressing Needs. Installing Cisco Routers, Cisco Router IOS CLI.Routing Protocol Concepts and Configuration. Configuring and Verifying RIP-2, Troubleshooting IP Routing.
CS406	Network Security	3	0	3	Security Services and Security Attacks. Classical Encryption techniques- Steganography. Symmetric Encryption- DES, AES. Asymmetric Encryption- RSA, Diffie-Hellman Key Exchange, ElGamal Cryptographic system. Message Authentication- MD5, SHA-1 Algorithms. Digital Signatures- DSS, Key Distribution Scenarios, X.509 Directory Service, Kerberos. Transport Layer- SSL, SET, Wireless LAN Security, IP Security, PGP, Firewalls
CS407	Cyber Security	3	0	3	Introduction to Cyber security- Security mind set, Vulnerability, Risk, Threat, CIA Concept, Policy and Procedures, Attacks. Software Security- Vulnerabilities and Protections, Malware, Program Analysis. Networks-Wired and Wireless Networks, Protocols, Attacks and Countermeasures. Practical Cryptography- Encryption, Authentication, Hashing, Symmetric and Asymmetric Cryptography. Mobile Security- Threats, Attacks, Countermeasures. Web Security- Threats, Attacks, Countermeasures. Web application security-Vulnerabilities, Attacks, Counter measures.
CS408	Advanced JAVA	3	0	3	Review on Java Fundamentals. Multi-threaded Programming- Threads, Programming, and Synchronization. SQL & JDBC-. Java EE- Servlets, Java Server Pages, Struts,

					Java Server Faces.
CS409	Mobile Application Development	3	0	3	Introduction to Android- Native Android Application, SDK Features, Introduction to Open Handset Alliance, Development Framework, Application Fundamentals, Device Compatibility, System permissions. User Interface and Application Components- Basic UI Design, Fragments, Widget Toolbox, Creating New View, Introduction to Intents, Intent Filters and broadcast Receivers; Activities, Services, Content Providers, Application Widgets, Processes and Threads. Files and Database Handling- Saving Application Data, Shared Preferences, Preference Framework and Activity, Static File as Resource, File System, Introduction to SQLite Database, Querying SQLite, Storage options, Data backup. User Experience Enhancement- Action Bar, Menus and Action Bar Items, Settings, Dialogs, Customizing Toast, Notifications, Search, Drag and Drop. Multimedia, Wireless Connectivity and Telephony: Audio and Video Handling, Manipulating Raw Audio, Sound Effects, Camera Programming, Video Recording, WiFi, Bluetooth, Near Field Communication, Hardware Support for Telephony, Telephony Management, SMS and MMS.
CS410	Scripting Languages	3	0	3	HTML- Common tags, Cascading Style Sheets, Java. XML- Defining XML tags, their attributes and values, Document Type Definition, XML Schemas, Document Object Model, DOM and SAX Parsers, XHTML. PHP-Basics and Essentials of PHP, Reading Data from Web Form Controls, Handling File Uploads Connecting to Database, Executing Simple Queries, Handling Results Handling Sessions and Cookies. Python- Python Object Types, Statements, Functions, OOP through Scripting, GUI, Data Structure, Algorithm Analysis. Introduction to Perl, Tcl and Tk-Basics and Essentials.
CS411	Web Enabled Technologies	3	0	3	Web Development Basics, Web Design Basics, Markup and Styling, JavaScript Programming Fundamentals, Responsive web design, Frameworks-Bootstrap, Drupal, Angular.JS, Node.Js, Web-Based and REST Style Services
CS412	Computer Graphics	3	0	3	Introduction to Computer Graphics, Color Models & Applications, Drawing Algorithms, Attributes of Output Primitives, Manipulation of Objects, Mapping of 2D from World to Screen, GUI and Interactive Methods, Mapping of 3D from World to Screen, 3D Object Representation, 3D Geometric and Modeling Transformation, 3D Viewing, Visible Surface Detection Methods, Illumination and Surface Rendering Methods, Animation.
CS413	Software Engineering	3	0	3	Introduction to Software Engineering. Process-Process Framework, The Capability Maturity Model Integration (CMMI), Process Patterns, Process Assessment, Personal and Team Process Models. Conventional Process models and Agile Process Models. Software Requirements. System Models. Design Engineering. Testing Strategies-Types of Testing. Product Metrics. Risk Management.

					Quality Management.
CS414	Service Oriented Architecture	3	0	3	Introduction to SOA. The Evolution of SOA. Web Services and Primitive SOA. Web Services and Contemporary SOA. Principles of Service-Orientation. Service Layers. SOA Delivery Strategies. Service Oriented Analysis. Service Oriented Design.
CS415	Object Oriented Analysis & Design	3	0	3	Overview of OOAD Methodology. Object Basics. Object-Oriented Methodologies. Unified Modeling Language (UML). Object-Oriented Analysis Process- Identifying Use Cases. Object Analysis-Classification. Identifying Object Relationships, Attributes and Methods. The Object-Oriented Design Process and Design Axioms. Designing Classes. Object Relational Systems.
CS416	Software Testing Methodologies	3	0	3	Software Testing Introduction. Flow Graphs and Path Testing. Transaction Flow Testing. Dataflow Testing. Domain Testing. Paths, Path Products And Regular Expressions. Logic Based Testing. State, State Graphs and Transition Testing. Graph Matrices and Application.
CS417	High Performance Computing	3	0	3	Basic of Parallel Computing, Pipelining, Performance of Memory, Thread Level Parallelism, Simultaneous Multi Threading, Concepts of Clusters, Grid and Mainframe, Constructs of an HPC cluster, Characterizing HPC Clusters, Building an unified performance suite to evaluate computing clusters, Introduction to Open MP, Vectorization, Introduction to the Advisor tool, Thread prototyping and optimizations with Advisor, Optimizing applications by analyzing machine balance and loop balance
CS418	Advanced Computer Architecture	3	0	3	RISC processors, Characteristics of RISC processors, RISC Vs CISC, Classification of Instruction Set Architectures, Review of performance measurements, Basic parallel processing techniques: instruction level, thread level and process level Classification of parallel architectures, Instruction Level Parallelism, Basic concepts of pipelining, Arithmetic pipelines, Instruction pipelines, Hazards, Dynamic instruction scheduling, Branch prediction techniques Instruction, Pentium Processor: IA 32 and P6 microarchitectures, ARM Processor, RAID, Interconnection topologies, Multiprocessor architecture,
CS419	Multicore Architecture	3	0	3	Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design, Performance – Scalability – Synchronization and data sharing – Data races, MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived

					datatypes – Performance evaluation.
CS421	Parallel Computing	3	0	3	Basic concepts in PCA, Design concepts, methodologies, and strategies, Message-passing and shared-memory programming paradigms, Parallel programming languages and tools, Fixed, reconfigurable, and hybrid device architectures and options, Parallel algorithmic complexity, Performance prediction and evaluation and tools, Shared-memory architectures, Distributed-memory architectures, Cache coherency and consistency, Interconnection networks, Research challenges and opportunities, Case studies

4. Institute Core Courses Handouts

Course No: CSCHEM111	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.

Skill Development / Employability / Entrepreneurship

List of Experiments in Chemistry

Sl. No	Name of the Experiment
1.	Estimation of iron (Fe^{+2}) by Dichrometry
2.	Estimation of copper by Iodometry
3.	pH curve of an acid base titration using Potentiometer
4.	Dissociation constant of a weak electrolyte by conductometry
5.	Colorimetric estimation of Iron
6.	Estimation of strength of oxalic acid using potassium permanganate as an intermediate solution
7.	Kinetics of iodination of acetone
8.	Synthesis of trans-dichlorobis (ethylenediamine) Cobalt (III) chloride
9.	Synthesis of Nickel(II)-Dimethylglyoxime complex
10.	Determination of rate constant and activation energy of the given ester catalysed by an acid
11.	Estimation of Copper by Complexometry

Course No: CSELS112	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.

Skill Development / Employability / Entrepreneurship

English communication Skills Lab

Cycle 1	Cycle 2
Why study spoken English	Debates
Phrases and Conversations	Group discussion
Letters and sounds	Presentation skills
Phonetics	Interview skills
Lab Exercises	e-Correspondence
Word accent and Stress shifts	Resume Writing
Telephone skills	Idioms
Intonation Body Language	Common errors in English
Grammar	
Vocabulary	

Course No: CSMATH113	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

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

Course No: **CSPHY114**	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.

Skill Development / Employability / Entrepreneurship

Physics

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: CSTA115	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.

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

Skill Development / Employability / Entrepreneurship

Name of the Laboratory: Engineering Graphics	
Sl. No.	**List of Topics for practice**
1	Methods of dimensioning
2	Geometric constructions
3	Construction of engineering curves, conics and scales
4	Orthographic Projections
5	Projections of Points and Lines
6	Auxiliary Views
7	Shortest Distance between graphical elements
8	Obtaining true shape of planes

9	Projections of Planes and Solids
10	Sections of solids
11	Development of Surfaces
12	Intersection of Surfaces
13	Isometric Views
14	Perspective projections

Course No: CSTA116	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 use indexing and slicing to access data in Python programs.
- To learn how to build and package Python modules for reusability.
- To learn how to read and write files in Python.
- 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: Multiprogramming, 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.

List of Computer Programming-I Laboratory Experiments:

No.s	Experiments	Duration
1.	Working on General purpose utilities in Unix	1:40 H
2	Working on file and directory manipulation commands	1:40 H
3.	Basic program on variables and datatypes in python	1:40 H
4.	Python programs to work on flow control	1:40 H
5.	Python programs to work on lists and dictionaries	1:40 H
6.	Python programs to work on tuples and sets	1:40 H
7.	Python programs to work on functions	1:40 H
8.	Python programs to work on packages	1:40 H
9.	Python programs to work on files	1:40 H
10.	Python programs to work on exception handling	1:40 H

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 an algorithmic approach.
- Write Python programs using conditional statements, loops and functions.
- Use Python data structures -- Strings ,lists, tuples, dictionaries,sets .
- Understand and summarize different File handling operations.
- Interpret Object oriented programming in Python
- Understand the Importance of cloud computing and its applications.

Course No: CSEVS117	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.

Skill development / employability / entrepreneurship

List of experiments in environmental science

sl. No	Name of the experiment
1	To determine total hardness of water sample by edta method
2	Determination of oxygen dissolved in water by winkler's method
3	Estimation of chloride content in water by argentometric method [mohr's method]
4	Estimation of carbonates and bicarbonates in water sample
5	Determination of hexavalent chromium in water samples by colorimetric method
6	Determination of acid value of lubricating oil
7	Determination of percentage of copper in brass
8	Determination of viscosity of lubricating oil by redwood viscometer

Course No: CSES121	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: CSAO122	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: CSMATH123	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.

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: CSPHY124	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: CSTA125	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

Course No: CSTA126	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.

Skill Development / Employability / Entrepreneurship

Name of the Laboratory: Workshop	
Sl. No.	**Name of the Experiment**
1	Metrology (To measure the Linear and angular measurements with various Measuring Instruments)
2	Fitting (To make a 'L' fit joint by using Mild steel plate)
3	Tin Smithy (To make a Square Box by using Galvonised Iron sheet)
4	Carpentry (To make the Dove tail lap joint by using wooden teak wood)

5	House wiring (To connect and performing the various connections)
6	Machine Shop (To make different operations by using Mild steel rod)
7	Welding (To make a different welding joints by using Arc welding machine)
8	Black Smithy (To make different shapes by using mild steel square rods in Black smithy)
9	Foundry (To make different moulded shapes by using different patterns)
10	Programming and performing on CNC Lathe Machine
11	Plumbing (Demonstration)
12	Demonstration on different machines

Course No: CSTA127	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.
- To give practical exposure with programming sessions

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

List of Computer Programming-II Laboratory Experiments:

No.s	Experiments	Duration
1.	Programs on variables and data types in java	1:40 H
2	Java programs on flow control	
3.	Basic Java programs using classes and objects	1:40 H
4.	Java programs on single and multidimensional arrays	1:40 H
5.	Java programs on inheritance	1:40 H

6.	Java programs on interfaces	1:40 H
7.	Java programs on exceptions	1:40 H
8.	Java programs to work with polymorphism (run time and compile time)	1:40 H
9.	Java programs on JDBC	1:40 H
10.	Java programs on JDBC	1:40 H

Course Outcomes

After successful completion of the course student will be able to

- Understand object-oriented programming concepts and basics of java programming
- Solve real world problems using OOP techniques
- Understand the use of abstract classes, packages and interfaces.
- Expand their knowledge of AWS cloud computing models, services and tools through narrative-based scenarios and short interactive tasks.
- Understand and apply problem solving and logical thinking skills to solve real life and engineering problems using OOP concepts.

Course No: CSES211	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.

Skill Development / Employability / Entrepreneurship

Electrical Science :

S No	Name of the Experiment
1	Study of measuring instruments
2	Verification of KCL and KVL
3	Super position theorem
4	Maximum power transfer theorem
5	Thevenin's and Norton's theorem
6	Sinusoidal response of RL circuit
7	Sinusoidal response of RLC circuit
8	OC and SC test on single phase transformer
9	Speed control of DC shunt motor
10	Load test on single phase transformer

Course No: CSES212	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.

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.

Skill Development / Employability / Entrepreneurship

Electronics:

S No	Name of Experiments / Exercises
1	Study of Electronic Components and Test Equipment's
2	Study of CRO
3	Characteristics of pn junction diode
4	Zener diode characteristics and its regulation
5	Non-linear wave shaping – clippers
6	Non-linear wave shaping – clamper
7	Transistor common-base configuration characteristics
8	Transistor common-Emitter configuration characteristics
9	Half-wave rectifier with and without filters
10	Full wave rectifier with and without filters

Course No: CSES213	Course Title: Engineering 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

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: CSECON214	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

Skill Development / Employability / Entrepreneurship

1.Field Visit - for studying organization structure and ethical practices

2. Business proposal writing

3. Case studies - for each function.

4. Report writing based on field visit.

Skill Development / Employability / Entrepreneurship

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Course No: CSMATHC215	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: CSMATH216	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: CSES221	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.

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: CSTA223	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.

Skill Development / Employability / Entrepreneurship

Lab component

As part of the Professional Communications course work students are expected to make a technical/academic presentation of 15 minutes

The topic for the presentation would be the topic which the students chose to write a technical report which is part of the course evaluation.

Students make a presentation for 15 minutes considering the following given criteria of assessment

1. Non-verbal communication

2. Verbal communication aspects – Use of appropriate grammar, use of accurate vocabulary and fluency of the language

3. Preparation of PowerPoint slides

4. Public speaking ability

A final score/ marks is provided based on the presentations and these would be added to the student's final marks for the course.

Course No: CSMGTS224	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

Skill Development / Employability / Entrepreneurship

1.Field Visit - for studying organization structure and ethical practices

2. Business proposal writing

3. Case studies - for each function.

4. Report writing based on field visit.

Course No: CSAO225	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: CSES226	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: CSTA 222	Course Title: Engineering Measurements	L	P	U
		1	6	4

Course Learning Objectives

- To give introduction to the experimental methods and measurement techniques.
- To train the students in the operation of various instruments and equipments and the measurement of various parameters in electronics and mechanical engineering.

UNIT -I:

Generalized Measurement System, Calibration, Standards, Dimensions and Units, Impedence Matching, Experiment Planning, Causes and Types of errors, Error Analysis, Uncertainty Analysis, Evaluation of uncertainties, Method of Least Squares, The Correlation Coefficient, Multiple regression, Standard deviation of mean, Graphical Analysis and Curve fitting, Choice of Graph Formats, General considerations in Data Analysis

UNIT-II:

Basic analog meters, Basic digital meters, Basic input circuits, The Electronic Voltmeter, Digital voltmeters, The Oscilloscope, Variable resistance, LVDT, Capacitive Transducers Photo electric effects, Hall effect Transducers, Digital Displacement Transducers, Comparison of analog &digital instruments

UNIT-III:

Area measurements, Graphical measurement , Planimeter, Graphical and Numerical Methods for Area measurement, Mechanical pressure-measurement devices, Dead weight tester, Bourdon tube, Diaphragm & Bellow Gages, Bridgman Gage, Low- Pressure Measurement, McLeod Gage, Ionization Gage,Alphatron.

UNIT-IV

Flow measurements, Positive-Displacement methods, Flow obstruction methods, Sonic nozzle, Drag effects, Hot-wire and Hot-film Anemometers, Magnetic flowmetersFlow – visualization methods, Laser Doppler Anemometer, Smoke methods, Pressure probes, Impact pressure in supersonic flow.

UNIT-V

Temperature measurements, Temperature scales, Ideal-gas thermometer, Temperature measurements by mechanical effects, by electrical effects, by radiation, heat transfer effect, transient response of thermal systems, thermocouple compensation, Temperature measurements in high flow speed flow. Concepts of Radiation, types, Detection of Radiation, GM counter, Ionization chambers, Photographic detection , Scintillation Counter, Neutron detection

Text Books

J.P.Holman,Experimental Methods for Engineers, TMH , 7th Edition, 2007

Reference Book

E.O. Doebelin ,Measurement Systems; Application & Design, 6th Edition, 2011

Course Outcomes

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

- Measure calibration errors in instruments
- Measure Area of a given curve
- Choose the graph format for any given curve: Can draw Semi-Log Graph.
- Operate and understanding the operation of pressure, flow, temperature, strain & stress measuring instruments

Skill Development / Employability / Entrepreneurship

Sl. No	Aim of the Experiment
1.	To determine the Young's modulus of a steel specimen by deflection test on a simply supported beam.
2.	To calculate shear stress generated in a shaft using strain gauge transducer (Torque Measurement)
3.	Determination of Grain Fineness Number using sand testing machine
4.	To Measure the temperature of a given knob using Thermistor
5.	Determination of Flash and Fire Point for a given Fuel using Pensky Marten's apparatus
6.	Determination of the coefficient of discharge through the Orifice meter.
7.	Determination of the Thermal Conductivity through metal rod.
8.	Study of the Micro Structure of pure metals like Mild Steel, Low Carbon Steel and High Carbon Steel.

-

Course No: CSAO312	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.

Course No: CSAO 311	Course Title: NUMERICAL METHODS	L	P	U
		1	6	4

Course Learning Objectives: Enables one to devise algorithms for the numerical solutions of mathematical problems. Applications to problems from Engineering are included for each method.

Course Content:

UNIT 1:

Computer Arithmetic and Errors, Interval halving /Bisection , Linear interpolation methods, Newton's method, Muller's method, Fixed point iteration: x = g(x) method, Multiple roots.

UNIT II:

The Gaussian Elimination and Gauss - Jordan methods, LU-decomposition approach, Norms, Condition numbers and errors in solutions, Iterative methods-Gauss-Seidel and Jacobi methods

Unit-III:

Interpolation; Newton and Lagrangian polynomials, divided differences, Derivatives from difference tables, Higher order derivatives, Newton - Cotes integration formulas, The trapezoidal rule - a composite.

UNIT IV:

Simpson's rules , Gaussian integration, The Taylor Series method, Euler and Modified Euler's method, Runge- Kutta methods, Multistep methods, Milne's method, The Adams-Moulton method, System of equations and higher order equations

UNIT V:

Solution through set of equations, Derivative boundary conditions, Eigen - value problems(Power Method)

Text Books

1. Steven Chapra, Raymond Canale., *Numerical Methods for Engineers*, Tata McGraw Hill, New Delhi, 5th Edition, 2007.

Reference Books

1. Francis Scheid , *Numerical Analysis*, Schaum's Outline, Tata McGraw Hill, New Delhi, 2009.

2. S.S.Sastry , *Numerical Methods* , PHI, New Delhi, 2010.

3. Erwin Kreyszig, *Advanced Engineering Mathematics*, 9th Edition, John Wiley & Sons, Inc, Singapore, 2006.

Learning Outcomes Upon successful completion of the course the student will be able to

- To solve nonlinear equations by standard methods.
- To solve Linear equations by Gauss-Seidel and other methods.
- To perform Matrix inversion by Gauss-Jordan method.
- To do Numerical differentiation and integration by standard methods.
- To solve ODEs numerically by standard methods.
- To apply software packages to solve above problems.

Course No	Course Title	L	P	U
HS 311	Dynamics of Social Change	3	0	3

Learning Objectives

The objective of this course is to enable students to have an insight into the social processes, sociological thought, methodology, sociological concepts and recent trends in modernization so as to empower the students to become active citizens. Sociological study aids in comprehending one's identity, thinking and action, it makes one more tolerant of human differences.

Course Contents:

Unit I

Sociology: its fundamentals, development of its methods and theories; Sociology and its relationship with other social sciences. Society: concepts and theories. Socialization and its theories, Social groups: Crowd Community, Association, Institutions.

Unit II

Family & Marriage: concepts, theories of origin; types, functions and changing patterns. Demographic transition.

Culture and its determinants: Social norms, Folkways, Mores, Taboos, Social roles, Social responsibility. Culture and personality.

Unit III

Social stratification: Caste, class, their functions and changing patterns.

Social Change: Concepts, Theories and Process and Dynamics of social change, Factors, Resistance to social change.

Unit IV

Modernization Concept: Industry and social change, Urbanization and rural sociology.

The role of education as a vital force for social change and to highlight the role of social institutions in educational and social developments.

Unit V

Sociology of Religion: Aspects, origin, Hinduism. Social disorganization and delinquency.

Text Book

Fundamentals of Sociology, Gisbert. P, Orient Longman, 3rd Edition, 1994.

Reference book(s)

1. Sociology - Systematic Introduction. Johnson.M.Harry. Allied Publishers, 2001
2. Sociology – A Guide to Problems and Literature. Bottomore T. T. Blackie & Sons, 1986.

Learning Outcomes:

After going through this course, the student will be able to:

- Define what social change is.
- Differentiate between social change and cultural change.
- Understand various characteristics of social change.
- Understand various sources of social change.
- Understand various factors of social change.
- Understand various theories of social change given by various sociologists.
- Understand the role of education for social change.

Course No: HS312	Course Title: Introduction to Psychology	L	P	U
		3	0	3

Learning Objectives

- To familiarize the students with type concepts of mind processes, motives, reactions, feelings, motivation
- To inculcate group thinking
- To develop skills like conflict resolution, crisis management

Course Content

UNIT I

Introduction: Definition of psychology; historical antecedents of psychology and trends in the 21st century; psychology and scientific methods; psychology in relation to other social sciences and natural sciences; application of psychology to societal problems.

Methods of psychology: Types of research, descriptive, evaluative, diagnostic and prognostic; methods of research: survey, observation, case-study and experiments; characteristics of experimental design and non-experimental design, quasi-experimental designs; focussed group discussions, brain storming, grounded theory approach.

UNIT II

Development of Human Behaviour: Growth and development; principles of development, role of genetic and environmental factors in determining human behaviour; influence of cultural factors in socialization; life span development, characteristics, development tasks, promoting psychological well-being across major stages of the life span.

Sensation, attention and perception: Sensation; concepts of threshold, absolute and difference thresholds, signal-detection and vigilance; factors influencing attention including set and characteristics of stimulus; definition and concept of perception, biological factors in perception; perceptual organization-influence of past experiences, perceptual defence-factors influencing space and depth perception, size estimation and perceptual readiness; the plasticity of perception; extrasensory perception; culture and perception, subliminal perception.

UNIT III

Learning: Concept and theories of learning (behaviourists, gestaltalist and information processing models); the processes of extinction, discrimination and generalization; programmed learning, probability learning, self-instructional learning, concepts; types and the schedules of reinforcement, escape, avoidance and punishment, modeling and social learning.

Memory: Encoding and remembering; short term memory, long term memory, sensory memory, iconic memory, echoic memory: the multistore model, levels of processing; organization and mnemonic techniques to improve memory; theories of forgetting: decay, interference and retrieval failure: metamemory; amnesia: anterograde and retrograde.

Motivation and emotion: Psychological and physiological basis of motivation and emotion; measurement of motivation and emotion; effects of motivation and emotion on behaviour; extrinsic and intrinsic motivation; factors influencing intrinsic motivation; emotional competence and the related issues.

UNIT IV

Thinking, problem solving: Piaget's theory of cognitive development; concept formation processes; information processing, reasoning and problem solving, facilitating and hindering factors in problem solving, methods of problem solving: creative thinking and fostering creativity; factors influencing decision making and judgment; recent trends.

Intelligence and aptitude: Concept of intelligence and aptitude, nature and theories of intelligence - Spearman, Thurstone, Gullford Vernon, Sternberg and J.P; Das; emotional intelligence, social intelligence, measurement of intelligence and aptitudes, concept of IQ, deviation IQ, constancy of IQ; measurement of multiple intelligence; fluid intelligence and crystallized intelligence.

UNIT V

Personality: Definition and concept of personality; theories of personality (psychoanalytical, sociocultural, interpersonal, developmental, humanistic, behaviouristic, trait and type approaches); Measurement of personality (projective tests, pencil-paper test); The Indian approach to personality; training for personality development; latest approaches like big 5 factor theory; the notion of self in different traditions.

Work Psychology and Organisational Behaviour: Personnel selection and training; use of psychological tests in the industry; training and human resource development; theories of work motivation, Herzberg, Maslow, Adam Equity theory, Porter and Lawler, Vroom; Leadership and participatory management; advertising and marketing; stress and its management; ergonomics; consumer psychology; managerial effectiveness; transformational leadership; sensitivity training; power and politics in organizations.

Text Books

1. Passer, M.W. and Smith, R.E. (2010). *Psychology: The science of mind and behavior*. 4th edn. Boston, MA, USA: McGraw-Hill Higher Education.
2. Pareek, U. and Khanna, S. (2012). *Understanding organizational behaviour*. 3rd edn. New Delhi, India: Oxford University Press.

Reference Books

1. Luthans, F. (2010). *Organizational behavior: An evidence-based approach*. 12th edn. New York, NY, USA: McGraw Hill Higher Education.
2. Morris, C.G. and Maisto, A.A. (2004). *Psychology: An introduction*. 12th edn. Harlow, United Kingdom: Prentice Hall.

Learning Outcomes

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

- Use critical thinking to evaluate and interpret evidence, and to apply psychological concepts, theories, and research findings to individual, social, and cultural issues
- Apply basic research methods in psychology, with sensitivity to ethical principles
- Demonstrate effective communication skills following professional conventions in psychology appropriate to purpose and context
- Understand the complexity of sociocultural diversity and societal inequality in the inquiry and analysis of psychological issues

Course No	Course Title	L	P	U
HS313	Heritage of India	3	0	3

Learning Objectives

Comprehending the heritage of the nation is a necessary pre condition for the making of conscientious citizenship. Knowledge of the nation's evolution and legacy enables to precisely define one's national self. Hence, this course is designed to serve the objective of enabling the students to take stock of the heritage and cultural evolution of their nation and its syncretic history.

Course Contents:

UNIT I: I

ndian Culture: An Introduction

Characteristics of Indian culture, Significance of Geography on Indian Culture. Society in India through ages- Ancient period- varna and jati, family and marriage in india, position of women in ancient india, Contemporary period; caste system and communalism. Religion and Philosophy in India: Ancient Period: Pre-Vedic and Vedic Religion, Buddhism and Jainism, Indian philosophy – Vedanta and Mimansa school of Philosophy.

UNIT II:

Indian Languages and Literature

Evolution of script and languages in India: Harappan Script and Brahmi Script. Short History of the Sanskrit literature: The Vedas, The Brahmanas and Upanishads & Sutras, Epics: Ramayana and Mahabharata & Puranas. History of Buddhist and Jain Literature in Pali, Prakrit and Sanskrit, Sangama literature & Odia literature.

UNIT III:

A Brief History of Indian Arts and Architecture

Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture. Indian Painting Tradition: ancient, medieval, modern indian painting and odishan painting tradition. Performing Arts: Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

UNIT IV:

Spread of Indian Culture Abroad

Causes, Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia, India, Central Asia and Western World through ages.

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UNIT V:

Understand and appreciate the heritage of India in various fields of applied sciences

Applied Sciences: Geography, Astronomy, Mathematics, Physics, Chemistry, Physiology, Medicine, Coinage, Weights and Measures, India's contribution to the world civilizations and the external influences on Indian Heritage

Text Books

Basham, A.L, The Wonder That was India, Picador, London, 2004.

Reference Books

1. Nehru, Jawaharlal, the Discovery of India, Jawaharlal Memorial Fund, New Delhi, 1999.
2. Thapar, Romila, The History of India, Vol. I, Penguin, New Delhi, 1966
3. Basham, A.L, ed., A Cultural History of India, Penguin, New Delhi, 1988.
4. Jha, D.N, Ancient Indian in Historical Outline, Manohar, New Delhi, 2004.
5. Wolpert, Stanley, an Introduction to India, Penguin, New Delhi, 1994.
6. Mazumdar, R.C, et.al, an Advanced History of India, MUP, Michigan, 1969.
7. Malekandathil, Pius: Maritime India: Trade, Religion and Polity in the Indian Ocean, Primus Books, Delhi, 2010.
8. McPherson, Kenneth: The early Maritime Trade of the Indian Ocean, in: ib.: The Indian Ocean: A History of People and The Sea, OUP, 1993, pp. 16-75.
9. Christie, J.W., 1995, State formation In early Maritime Southeast Asia, BTLV

Course No	Course Title	L	P	U
HS314	Modern Political Science	3	0	3

Objectives

- To familiarise the students with the basic ideas of political science.
- To make them thorough in the concepts of political theory.
- To help them understand and distinguish between basic concepts like political theory, political thought and political philosophy.
- To help the students understand and relate the concepts and facts with the political realities of the country and different parts of the world.
- To equip them with the basics of the discipline and help them learn the basic underpinnings of the subject of Political Science.

UNIT I

Political Theory

Nature, scope and significance of political theory, procedure of different theoretical ideas in political theory, the various traditional and modern theories of political science., theories of origin of the state.

UNIT II

Political Theory

Concept of Democracy, its types and theories (Elitist, Pluralist and Marxist) relating to it, concept of Development and various views and Perspective relating to it. i.e. Liberal, Marxist, Sustainable Development, Human Development and Gandhian Model of Development, Understanding basic concepts of Justice, distributive justice, multiculturalism and social justice.

UNIT III

Politics in India

Philosophy of Indian constitutions, introducing the Indian Constitution with a focus on the evolution of it and examining the essence of the Preamble, e Fundamental Rights and Duties of Indian citizens with a study of the significance and status of Directive Principles.

Analyzing the important institutions of the Indian Union: the Executive: President; Prime Minister, Council of Ministers; Governor, Chief Minister and Council of Ministers; The legislature: Rajya Sabha, Lok Sabha, Speaker, Committee System, State Legislature, The Judiciary: Supreme Court and the High Court: composition and functions- Judicial Activism

UNIT IV

Politics in India

Centre-State Relations with focus on the Legislative, Administrative and Financial Relations., evaluating the Indian Party system – its development and looking at the ideology of dominant national parties, the Electoral Process in India with focus on the Election Commission: Composition, Functions and Role, the challenges to National Integration: Terrorism, Regionalism and Casteism.

UNIT V

International Relations

Overview about the nature, evolution and scope of international relations, the basic ideas of international relations, the different approaches to the study of International Relations,historical background of the discipline which will help them understand international politics in a better way, basic concepts of International Relations and also develop a preliminary understanding of the global economy, formation, charter and objectives of United Nations and its working on Millennium Development Goals, the working of United Nations in resolving conflict and peacekeeping operations, the international security; Disarmament, Arms Control and Nuclear nonproliferation

Text Books:

1. J.C. Johari – "Principles of Modern Political Science", Sterling Publishers PVT. Ltd., New Delhi, 2007
2. Perter Harris, "Foundations of Political Science", Oxford University Press

References:

1. Amal Ray and Mohit Bhattacharya – "Political Theory: Institutions and Ideas" - The World Press Private Ltd., Calcutta, 1988
2. O.P. Gauba – "An Introduction to Political theory" Macmillan India Ltd., 2008.
3. Robert Dahl – "Modern political Analysis." OUP 2007
4. Prof. A.C Kapoor - "Principles of Political Science", Sterling Publishers PVT. Ltd., New Delhi, 2005

Course Outcomes:

- Understanding of government institutions, electoral processes, and policies in a variety of countries around the world and the ability to compare the effectiveness or impact of various political arrangements across countries.
- Knowledge of some of the philosophical underpinnings of modern politics and government and the legal principles by which political disputes are often settled.
- Understand the changes in patterns of political behaviour, ideas and structures.
- Assess how global, national and regional developments affect polity and society.
- Develop the ability to make logical inferences about social and political issues on the basis of comparative and historical knowledge.
- Knowledge of key theories and concepts, historical developments, organizations, and modern issues in international relations.

Course No	Course Title	L	P	U
HS315	Public Administration	3	0	3

Learning Objectives

The course on Public Administration/Management has following objectives:

1. Understand the concept of public administration/ management/organization
2. Understand the evolution of the concept of public administration and its importance
3. Understand the role of government
4. Understand the role and core functions of public manager
5. Understand the structure of government /organizations
6. Create understanding about the skills required by the public manager in imparting duties
7. Understand the changing role of government and role of public managers.

Course Contents:

UNIT I

Introduction:

Meaning, scope, and significance of Public Administration, Wilson's vision of Public Administration, Evolution of the discipline and its present status, New Public Administration, Public Choice approach, Challenges of liberalization, Privatisation, Globalisation, Good Governance: concept and application, New Public Management

UNIT II

Administrative Thought, Scientific Management and Scientific Management movement, Classical Theory, Weber's bureaucratic model – its critique and post-Weberian Developments, Dynamic Administration, Human Relations School, Functions of the Executive, Simon's decision-making theory, Participative Management.

UNIT III

Administrative Behaviour, Process and techniques of decision-making , Communication; Morale Motivation Theories – content, process and contemporary, Theories of Leadership: Traditional and Modern

Organisations - Theories – systems, contingency, Structure and forms:ministries & departments, corporations, companies, boards, commissions, ad hoc and advisory bodies, headquarters and field relationships, regulatory authorities, public-private partnerships.

UNIT IV

Accountability and control - Concepts of accountability and control; Citizen and Administration, Legislative, Executive and Judicial control over administration, Role of media, interest groups & voluntary organizations, Civil society, Citizen's Charters, Right to Information, Social audit.

UNIT V

Administrative Law - Meaning, scope, and significance, Dicey on Administrative law, Delegated legislation, Administrative Tribunals.

Comparative Public Administration - Historical and sociological factors affecting administrative systems, Administration and politics in different countries, Current status of Comparative Public Administration, Ecology and administration, Riggsian models and their critique,

Techniques of Administrative Improvement - Organisation and methods, Work-study and work management, Management aid tools like network analysis, MIS, PERT, CPM, e-governance and information technology.

Text Book:

1. Baker, R.J.S., 1972, Administrative Theory and Public Administration, Hutchinson University Library, London.
2. Bhattacharya, Mohit, 1998, New Horizons of Public Administration, Jawahar Publishers & Distributors, New Delhi.

References:

1. Bertram, M. Gross, 1964, The Managing of Organisations, The Administrative Struggle, The Free Press of Glencoe, CollierMacmillan., London.
2. Denhardt, Robert B. and Joseph W. Grubbs, 2003, Public Administration: An action Orientation, Fourth Edition, Thomson (Wadsworth), Canada.
3. Prasad, D. Ravindra, V.S. Prasad and P. Satyanarayan, 2004, Administrative Thinkers (Ed), Sterling Publishers, New Delhi.
4. Pugh, D.S., 1985, Organisation Theory: Selected Readings (Ed), Penguin Books, Middlesex, England.
5. Sharma, M.P. and B.L. Sardana, 1988, Public Administration in Theory and Practice, Kitab Mahal, New Delhi.
6. Srivastava, Om Prie, 1991, Public Administration and Management, The Broadening Horizons, Volume 1, Himalaya Publishing House, Delhi

COURSE OUTCOMES:

- To understand the nature and scope of Public Administration;
- To appreciate the methodological pluralism and synthesizing nature of knowledge in Public Administration;
- To comprehend the changing paradigms of Public Administration;
- To acquaint with the theories, approaches, concepts and principles of Public Administration;
- To understand the administrative theories and concepts to make sense of administrative practices.
- To Understand public administration theory and concepts from multiple perspectives

Course No: HS316	Course Title: Professional Ethics	L	P	U
		3	0	3

Learning Objectives

- To create an awareness on Ethics as applied in Engineering and Human Values
- Understand what morality is and how it connects to professional ethics
- Determine what characterizes a professional and distinguishes one from a nonprofessional

Course Content

UNIT I

Morals, values and ethics, integrity, work ethic, service learning, civic virtue, respect for others, living peacefully, caring, sharing, honesty, courage, valuing time, co-operation, commitment, empathy, self-confidence, character, spirituality.

UNIT II

Senses of 'Engineering Ethics', variety of moral issued, types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, consensus and controversy, models of professional roles, theories about right action, self-interest, customs and religion, uses of ethical theories.

UNIT III

Engineering as experimentation, engineers as responsible experimenters, codes of ethics, a balanced outlook on law, the challenger case study.

UNIT IV

Safety and risk, assessment of safety and risk, risk benefit analysis and reducing risk, the Three Mile Island and Chernobyl case studies. Collegiality and loyalty, respect for authority, collective bargaining, confidentiality, conflicts of interest, occupational crime, professional rights, employee rights, Intellectual Property Rights (IPR), discrimination.

UNIT V

Multinational corporations, environmental ethics, computer ethics, weapons development, engineers as managers, consulting engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE), India, etc.

Text Books

1. Martin, M.W. and Schinzinger, R. (2004). *Ethics in engineering*. 4th edn. Boston, MA, USA: McGraw Hill Higher Education.
2. Govindarajan, M., Natarajan, S. and Senthilkumar, V.S. (2004). *Engineering ethics*. New Delhi, India: Prentice-Hall of India Pvt.

Reference Books

1. Fleddermann, C.B. (2011). *Engineering ethics*. 4th edn. Boston, MA, USA: Prentice Hall.
2. Harris, J.C.E., Rabins, M.J., Pritchard, M.S., James, R. and Englehardt, E. (2013). *Engineering ethics: Concepts and cases*. 5th edn. Boston, MA, USA: Wadsworth Cengage Learning.
3. Boatright, J.R. (2011). *Ethics and the conduct of business*. Boston, MA, USA: Pearson College Div.
4. Seebauer, E.G. and Barry, R.L. (2010). *Fundamentals of ethics for scientists and engineers*. New York, NY, USA: Oxford University Press.

Learning Outcomes

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

- Choose their own personal, social, moral and spiritual values and be aware of practical methods for developing and deepening
- Assess their own ethical values and the social context of problems
- Identify an ethical issue and analyze that issue in relationship to the specific topic of study or discipline

Course No	Course Title	L	P	U
IP221	Internship Program I	0	0	5

Scope & Objective of the Course:

This course is run during the Summer Term only at various industries and is of about 8 weeks.
This course aims to provide an exposure of the world of professional work to the students.

Textbook(s): Not Applicable
Reference book(s): Not Applicable
Lecture-wise plan: Not Applicable

Evaluation Scheme:

Evaluation Component	Weightage (%)	Duration
Quiz-I	5	2nd week
Group Discussion-I	7	3rd week
Seminar-I	10	6th week
Project Report-I	10	7th week
Observation-I	6	7th week
Diary-I	2	Daily
Mid-Term Grading	40	16th week
Quiz-II	5	9th week
Group Discussion-II	8	12th week
Seminar-II	15	15th week
Project Report-II	20	16th week
Observation-II	9	16th week
Diary-II	3	Daily
Final Grading	100	

Course No	Course Title	L	P	U
IP401	Internship Program II	0	0	20

Scope & Objective of the Course:

The IP II Program is planned to bridge the gap between the professional world and the academic world and is implemented during the final year of graduation in either of the semesters. This Program constitutes working on real life situations, necessary for subsequent problem-solving efforts in the professional world.

Textbook(s): Not Applicable
Reference book(s): Not Applicable
Lecture-wise plan: Not Applicable

Evaluation Scheme:

Evaluation Component	Weightage (%)	Duration
Quiz-I	4	2nd week
Group Discussion-I	5	3rd week
Seminar-I	6	6th week
Project Report-I	5	7th week
Observation-I	3	7th week
Diary-I	3	Daily
Quiz-II	4	9th week
Group Discussion-II	5	12th week
Seminar-II	6	15th week
Project Report-II	5	16th week
Observation-II	3	16th week
Diary-II	3	Daily
Mid-Term Grading	52	16th week
Quiz-III	4	17th week
Group Discussion-III	5	20th week
Seminar-III	12	Last week of IP II
Project Report-III	20	22nd week
Observation-III	4	End of IP II
Diary-III	3	Daily
Final Grading	100	

Course No	Course Title	L	P	U
TS401	Thesis & Seminar	0	0	20

Objective of the course:

This course TS 401 is a must for all students with Thesis option for the eligibility of degree. This course involves research work in an active area to satisfy the creative urge in a student and may involve advanced study learning and experimentation. This work may form the basis for dissertation of a higher degree. Also this requires fulltime work from the student for a complete semester and must co-terminate with thesis report.

Textbook(s) No prescribed text book. Literature Survey to be done with peer reviewed journals.

Reference book(s) - do -

Mid -Semester Grading and Final Grading

TS 401 courses are only awarded non-letter grades Excellent/Good/Fair/ Poor based on the performance of the student as per the evaluation scheme Mid term Grading is to be done announced to the student. All grades are to be submitted to the IC in the format provided to the Supervisors.

Operation Procedure

1. Student has to devote full semester for TS 401 course.
2. Student has to report to Supervisor regularly.
3. Particular of Thesis is to be submitted to IC within two weeks of registration
4. Seminars and Thesis evaluation has to carried out in the presence of two member Committee comprising of experts in the relevant area constituted by the Supervisor.
5. Final Thesis to be submitted has to be in formal hard bound cover bearing the Institute emblem.

Course No	Course Title	L	P	U
CE 491/CS 491	Special Project	0	0	3
EC 491/EE 491				
ME 491				

- **Scope & objective of the course:**

This is an unstructured open ended where under the overall supervision of a faculty-in-charge, batches of students will be attached to different faculty members. 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. Faculty-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 faculty member and faculty-in-charge. The faculty-in-charge may assign specific hours of formal brain storming sessions.

4. Evaluation Scheme:

Component	Duration (hr/min)	Weightage (%)	Remarks
Literature Survey	2nd week	7	
Project outline	3rd week	5	**To be submitted to I/C by the faculty**
Diary -I	**Continuous**	4	
Observation-I	**Continuous**	4	
MidTerm Project	7th week	15	
Report	7th week		
Mid-Semester	8th week	10	
Seminar/Viva	8th week		
Mid-Term Grading	8th week	45	**To be submitted to I/C by the faculty**
Diary-II	**Continuous**	5	
Observation-II	**Continuous**	5	**A copy to be submitted to I/C by the faculty**
Final Project Report	14th week	25	
Final Seminar	15th week	20	
Final Grading	15th week	100	**To be submitted to I/C by the faculty**

Textbook(s) & Reference book(s)

Based on literature survey to be done with peer reviewed journals.

General guidelines:

a) This being a three unit course, a student is expected to work for at least 9 hours per week including the formal contact hours with the instructor.

b) Each student should meet the faculty at least once a week in addition to the formal contact hours at mutually agreed time to apprise the faculty of the progress in the project.

c) Student is supposed to maintain a diary and record the daily progress of the work done. The diary would be periodically checked by the faculty.

d) All the evaluation components are compulsory. If a student misses any component of evaluation, he is likely to get 'NC'.

e) The Mid-term evaluation is to be strict to avoid any laxity on the part of the student.

f) Student should make two copies of the final report in the prescribed format, one his personal copy and the other for submission to the Institute. The faculty may ask for an additional copy if so desired.

g) The final seminar is to be planned only after the submission of the project report.

h) The final seminar is open to all the students and the faculty. The faculty member should involve the local experts in the evaluation of final seminar.

i) If the progress in the project work is not satisfactory, the faculty may advise the student to withdraw from the course in time and the same may be communicated to the instructor-in-charge.

j) The student should submit the withdrawal request to the Convener, Academic Registration Committee. The last day for withdrawal is the same as that for all other courses.

k) If more than one student is working on the same project, the distribution of work among the students is to be made clear to the students and the Instructor-in-charge. The evaluation should be based on individual performances only.

l) The details of components of evaluation should be submitted in the prescribed format only.

m) The student is expected to attend a **conference** on the area of project opted or present a **technical paper** in any of the journal.

Course No	Course Title	L	P	U
TIP 491	Technology Innovation Project	0	0	3

Scope & Objective of the course:

A unique opportunity for the students in the form of a course that facilitate the combination of academics with the industry by involving an in-depth innovation, investigation under the supervision of mentor from Industry and a faculty member for performing the real-life projects with the support from various organizations. Students working in groups will be required to perform research, customer and problem discovery, ideation, concept creation and validation, and technical implementation for a real-world challenge. The specific time-bound based on the students registered for the course will be graded based on the performance feedback from both the industry and the Faculty supervisor. The student will be able to improve the skills and knowledge for improving written and oral communication with indicative content which includes innovation methodology, customer & problem discovery, problem validation, innovation experiments with innovative presentations.

Evaluation:
Student evaluation is based on Literature survey, seminar series conducted, and observations of the supervisor and Thesis report.

Component	Weightage (%)	Date	Remarks
Literature Survey and Project outline	20	3rd week	Supervisor to submit copy to IC
Mid-term Project Report	10	7th week	Supervisor to submit to IC after evaluation
Mid-term Seminar	20	8th Week	Mid-semester grading to be submitted to IC by Supervisor
End-Sem Project Report	25	14th week	Supervisor to submit to IC after evaluation
End-Sem Seminar	25	15th Week	

Textbook T1	There are no specifically prescribed or recommended texts for this subject as student must do literature survey from journals of his field of research.
Reference book(s) R1	Related to Project work

General Guidelines:

a) This being a three-unit course, a student is expected to work for at least 12- 14 hours per week including the formal contact hours with the instructor.

b) Each student should meet the faculty and mentor from Industry at least twice a week in addition to the formal contact hours at mutually agreed time to apprise the faculty of the progress in the project.

c) Student is supposed to maintain a diary and record the daily progress of the work done. The diary would be periodically checked by the faculty.

d) All the evaluation components are compulsory. If a student misses any component of evaluation, he is likely to get "NC".

e) The Mid-term evaluation is to be strict to avoid any laxity on the part of the student.

f) Student should make two copies of the final report in the prescribed format, one his personal copy and the other for submission to eh Institute. The faculty may ask for an additional copy if so desired.

g) The final seminar is to be planned only after the submission of the project report.

h) The final seminar is open to all the student and the faculty. The faculty member should involve the local experts in the evaluation of final seminar.

i) If the progress in the project work is not satisfactory, the faculty may advise the student to withdraw from the course in time and the same may be communicated to the instructor-in-charge.

j) The student should submit the withdrawal request to the Convener, Academic Registration Committee. The last day for withdrawal is the same as that for all other courses.

k) If more than one student is working on the same project, the distribution of work among the students is to be made clear to the students and the Instructor-in-charge. The evaluation should be based on individual performances only.

l) The details of components of evaluation should be submitted in the prescribed format only.

m) The student is expected to attend a conference on the area of project opted or present a **technical paper** in any of the journal.

Learning Outcomes:

After successful completion of the course student will be able to

1. Work independently as part of an interdisciplinary team to complete a technical innovation project
2. Collect and critically analyse a range of data about the project allotted by creating innovation hypotheses from the data
3. Validate innovation hypotheses
4. Conceptualize, design, and implement an innovative and technology-based solution to the identified problem Present technical solutions to various stakeholders in both written and oral forms

4. B.Tech Computer Science Engineering Program (CSE)
Course Handouts

Course No: **CS211**	Course Title: **Discrete Structures for Computer Science**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To write an argument using logical notation and determine if the argument is or is not valid
- To write and evaluate a proof or outline the basic structure of and give examples of each proof technique
- To understand the basic principles of sets and operations in sets
- To understand the basics of Boolean algebra and Lattices
- To design and analysealgorithms
- To study finite state machines
- To understand phrase structure grammars
- To introduce error-correcting codes
- To applyNumber Theory in cryptography.

Course Contents

UNIT-I

Statement of Addition Principle, Sequences, Strings, Characteristic Function, Matrices, Boolean matrix operations Mathematical Structures,Logic, Logical Operations, Quantifiers, Conditional Statements,

UNIT-II

Methods of proof, Mathematical Induction, permutation, combinations. Pigeonhole Principle, Recurrence relations, Generating functions, Relations and Directed Graphs, Paths in relations anddirected, Equivalence relation and partitions,

UNIT-III

Graphs, Euler paths and Circuits, Hamiltonian paths and Circuits, Colouring Graphs, Chromatic polynomial, Closure and transitive closure, Warshall's Algorithm

UNIT-IV

Partially Ordered sets, Lattices, Hasse diagram, Boolean algebra and Boolean Expressions, Trees and their representations, labeled trees, Undirected trees, spanning trees, Minimal Spanning Trees, Prim's and Kruskal's algorithms for minimal spanning tree in a connected graph

UNIT- V

Definition of group and semi group, Languages and finite state machines, Coding of Binary information and Error detection, Error Correction,Factorization of integers, Greatest common divisor, residues, Fermat's theorem and RSA

Text Books:

1. Kolman Bernard, Robert Busby, Sharon Ross andNadeemurRehman, Discrete Mathematical Structures, PHI, 5th Edition, 2006.

Reference Books:

1. Liu.C.L, and D.P.Mohapatra, Elements of Discrete Mathematics,a Computer Oriented Approach, Tata McGraw Hill, 4th edition, 2013.
2. Gary Haggard and John Schlipf, Discrete Mathematics for Computer Science, Thomson 2006.
3. Mott.J.L, Kandel.A, Baker.T.P, Discrete Mathematics for Computer Scientists and Mathematicians, PHI 2006.
4. Rosen.K.H, Discrete Mathematics and its Applications, TMH,2011

Course Outcomes:

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

- use logical notation to determine if an argument is valid
- write and evaluate a proof
- Use graph theory in optimal circuit design
- understand the basics of Boolean Algebra and Lattices
- design and analyse algorithms
- analyse phrase structure grammars for languages
- develop error-correcting codes
- apply Number Theory in cryptography for computer security

Course No: **CS221**	Course Title: **Data Structures**	L	P	U
		2	2	3

Course Learning Objectives

- To understand the basics of all data structures.
- To choose the appropriate data structure for specific application.
- To understand and analyze various searching and sorting algorithms.
- To solve the complex problem using hashing, trees and graphs.
- To implement various algorithms and data structures using C and to improve the programming skills.

Course Contents

UNIT-I

Introduction to Data Structures, need and advantages of data structure. Array, Pointers: basics, pointer with function, array of pointers, pointer to array, applications, advantages and disadvantages of pointer. Linear data structures: Stack, Queue, Linked list. Stack: Fundamentals, stack implementation using array and linked list, infix to postfix conversion and vice versa, postfix expression evaluation, recursion, stack operations: Traversing, insertion, deletion, searching (linear search and binary search), sorting (insertion sort, selection sort, bubble sort, quick sort, merge sort).

UNIT-II

Queue: Fundamentals, queue implementation using array and linked list. Queue operations: traversing, insertion and deletion. Double ended queue: Basics, implementation, operations. Circular queue: Basics, implementation, operations. Application of queue.

UNIT-III

Linked list: Fundamentals, difference between array and linked list. Single linked list: basics, representation, operations: insertion, deletion, traversing. Double linked list: basics, representation, operations: insertion, deletion, traversing. Circular linked list: basics, representation, operations: insertion, deletion, traversing.

UNIT-IV

Tree: Fundamentals, representation. Binary tree: Basics, representation, complete binary tree, tree, traversal: Inorder, preorder, postorder traversal, searching, sorting (heap sort, radix sort). Binary search tree: Basic, Inorder, preorder, postorder traversal, searching, sorting (heap sort, radix sort). B+ tree: Basic, traversing, searching, sorting. Red-black tree: Basic, traversing, searching, sorting. AVL tree: traversing, searching, sorting. Threaded binary tree: Basic, traversing, searching, sorting.

UNIT- V

Graph: Basics, Representation: adjacency matrix. Cyclic graph: basics, Acyclic graph: Basics, Traversal: Depth first search, Breadth first search. Minimum spanning tree, shortest path (Dijkstra algorithm), Prim's algorithm. Hashing.

Text Books:

1. Fundamentals of Data structures in C, E. Horowitz, S. Sahni and Susan Anderson-Freed, Universities Press. , 2nd Edition, 2007.
2. Data Structures, S. Lipscutz, Schaum's Outlines, TMH.McGraw Hill Education; 1st edition, July 2017.

Reference Books:

1. Data structures: A Pseudo code Approach with C, R. F. Gilberg and B. A. Forouzan, Cengage Learning, 2nd edition, November 2007.
2. Data structures A Programming Approach with C, D. S. Kushwaha and A.K. Misra, PHI.Phi Learning pvt Ltd, 1st edition, February 10, 2011.

List of Data Structures Laboratory Experiments

S.No	Experiment / Program Name	Duration
1.	Implementing Stack using Array	1:40 H
2.	Implementing Queue using Array	1:40 H
3.	Solving an Arithmetic Expression using Stack	1:40 H
4.	Implementing Various Sorting Techniques - Bubble / index / radix / quick sort	1:40 H
5.	Implementing Single Linked List - Insertion / Deletion / Searching	1:40 H
6.	Implementing Doubly linked List - Insertion / Deletion / Searching	1:40 H
7.	Implementing Binary Tree Traversals - Inorder / Preorder / Postorder	1:40 H
8.	Implementing Binary Search Tree - Insertion / Deletion / Searching	1:40 H
9.	Implementing Depth First Search	1:40 H
10.	Implementing Breadth First Search	1:40 H
11.	Implementing Kruskal's Algorithm - Minimum Cost Spanning Tree	1:40 H
12.	Implementing Prim"s Algorithm - Minimum Cost Spanning Tree	1:40 H

Course Outcomes

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

- Understand how to use data structure concepts for realistic problems.
- Ability to identify appropriate data structures for solving computing problems in respective languages.
- Ability to solve problems independently and think critically.
- Utilize the acquired skill sets and solve problems using the appropriate data structures.

Course No: CS311	Course Title: Microprocessor Programming & Interfacing	L	P	U
		3	0	3

Course Learning Objectives

- This subject deals about the basics of 8-bit and 16-bit Microprocessor, their architectures, internal organization and their functions, peripherals and interfacing.
- The objective of the course is to enable the students to acquire Assembly language programming skill which is the real essence of Microprocessor.
- The student can learn how a microprocessor is interfaced with wide variety of low-level I/O devices.

Course Content

UNIT-I

Introduction to 8085 Microprocessor, 8086 Architecture-Functional diagram. Register Organization, Memory Segmentation. Programming Mode. Memory addresses. Physical memory organization. Architecture of 8086, signal descriptions of 8086- common function signals. Minimum and Maximum mode signals. Timing diagrams. Interrupts of 8086.

UNIT-II

Instruction formats, addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.

UNIT-III

8255 PPI various modes of operation and interfacing to 8086.Memory interfacing(RAM/ROM) to 8086, Interrupt structure of 8086, Vector interrupt table, Interrupt service routine , Interfacing Interrupt Controller 8259

UNIT-IV

Introduction to DMA, Interfacing DMA Controller 8237/8257 to 8086.Interfacing Key board display controller 8279: Architecture, Modes of Operation, interfacing and programming, Stepper motor interfacing D/A and A/D converter Interfacing with 8086.

UNIT-V

Serial communication standards, Serial data transfer schemes. 8251 USART architecture and interfacing.Introduction to 80286, 80386 processors

Text Books

Douglas V. Hall, SSS P Rao. "Micro processors and Interfacing", TMH. 3rd edition 2015.

Reference Books

1 *A. K. Ray and K.M. Bhurchandani, "Advanced Microprocessors and Peripherals," TMH, 2nd edition 2006.*

2. *Liu, Gibson, "Micro computer systems: 8086/8088 family" PHI, 2 nd edition 2003.*

Course Outcomes

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

- Recall and apply the basic concept of digital fundamentals to Microprocessorbased personal computer system.
- Identify the detailed s/w & h/w structure of the Microprocessor.
- Illustrate how the different peripherals are interfaced with Microprocessor.
- Train their practical knowledge through laboratory experiments.
- Analyze the data transfer information through serial & parallel ports.

Course No: CS312	Course Title: Operating Systems	L	P	U
		3	2	4

Course Learning Objectives

- To provide a clear understanding of the concepts that underlie operating systems.
- To discuss Process Management and Concurrency control.
- To discuss memory management and virtual memory techniques.
- To introduce the practical aspects that pertain to the most popular operating systems such as Unix/Linux and Windows.
- To improve the programming skills of the students by implementing various operating system principles using C/C++/Java/Python.

Course Content

UNIT- I

Introduction to Operating System: Operating Systems Objectives and functions, Computer System Architecture, OS operations, Different types of O.S: batch, multi-programmed, time-sharing, real-time, distributed, parallel. Operating System services, System Calls and Types of System Calls, Operating System Structure, Virtual Machines.

UNIT-II

Process Management :The Process ,Process States, Process Control Block(PCB), Process Scheduling, Operations on process ,Inter Process Communication(IPC), Examples of IPC on Unix Operating System Thread Management: Overview of Thread, Advantages of Multithreaded Programming ,Thread libraries on Unix Operating System CPU scheduling: Basic Concepts, Scheduling criteria ,Scheduling Algorithms and Thread Scheduling.

UNIT- III

Concurrency: Principles of Concurrency ,Mutual Exclusion ,Critical Section Problems, Peterson's Solution, Semaphores, Classic Problems of Synchronization ,Monitors Deadlocks: Deadlock, Deadlock Characterization ,Methods to Handle deadlocks, Deadlock prevention, Detection and Recovery Techniques Memory Management: Background, Swapping ,Memory Management Algorithms ,paging ,Structure of Page Table , Segmentation.

UNIT- IV

Virtual Memory Management: Introduction to Virtual Memory , Demand paging ,Page Replacement Algorithms ,Allocation of Frames and Thrashing , Case studies on Unix and Windows File System: File Concept, Access Methods ,Directory and Disk Structure ,File System Mounting ,File Sharing and File Protection Implementing File System: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free Space Management and Efficiency and Performance .

UNIT- V

Secondary Storage Structure: Mass-Storage Structure, Disk structure, Disk Scheduling ,Swap Space management , RAID Structures System Protection: Goals of Protection, Principles of Protection ,Domain of Protection, Access Matrix, Operation of Access Matrix, Revocation of Access rights ,Capability Based Protection System Security: The Security Problem, Program Threads , System and Network Threads, Cryptography, Firewalls to Protect Systems and Networks case study: The Linux System.

Text Books

1. Abraham Silberschatz, Peter B.Glavin, Greg Gagne, "*Operating System Concepts*", Wiley Publication, 8Th Edition,2011

Reference Books

1. D.M.Dhamdhere,"*Operating System A concept based approach*", Tata Mcgraw-Hill, 2nd Edition.
2. Andrew S Tanenbaum,"*Operating System Design and Implementation",* 3/E, Prentice Hall.
3. Achyut S Godbole,"*Operating System"*, Tata Mcgraw Hill, 2nd Edition.
4. Maurice J. Bach, "*The design of Unix Operating System"*, Prentice Hall.1986,1st edition
5. W .Richard Stevens "Advanced *Programming in the Unix Environment*", 3rd edition, 2015.

List of Operating Systems Laboratory Experiments

No.s	Name of the Experiment	Duration
1	**Shell Scripting in Linux / Unix Environment**	**1: 40H**
2	**Implementing a Simple Client and Server using socket programming in C/C++**	**1: 40H**
3	**Implementing a Server and Client to transfer the requested file from the server to the client using socket programming in C/C++**	**1: 40H**
4	**Implementing a micro shell using C/C++, which implements the linux/unix commands – ls, mkdir, exit and clear**	**1: 40H**
5	**Implementing a micro shell using C/C++, which implements the linux/unix commands – ls -l, cd, rmdir, history.**	**1: 40H**

6	**Given the list of processes, their CPU burst times and arrival times. Compute and print the average waiting time and average turnaround time for FCFS and SJF**	**1: 40H**
7	**Given the list of processes, their CPU burst times and arrival times. Compute and print the average waiting time and average turnaround time for Priority and Round Robin Scheduling**	**1: 40H**
8	**Developing Application using Inter Process communication (using shared memory, pipes or message queues).**	**1: 40H**
9	**Implement the Producer – Consumer problem using semaphores (using UNIX system calls).**	**1: 40H**

Course Outcomes

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

- Gain extensive knowledge on principles and difference between different types of modern operating systems, virtual machines and their structure of implementation.
- Understand process management, concurrent processes and threads
- Compare performance of processor scheduling algorithms.
- Able to understand the concepts of deadlock in operating systems and how they can be managed / avoided and implement them in a multiprogramming system.
- Produce algorithmic solutions to process synchronization problems.
- understand the types of I/O management; disk scheduling, protection and security problems faced by operating systems and how to minimize these problems
- Improve their programming skills by implementing various Operating System concepts.

Course No: CS313	Course Title: Theory of Computation	L	P	U
		3	0	3

Course Learning Objectives

- Able to understand different types of abstract devices.
- Able to compute the types of problems to be solved by the machine.
- Convert one abstract machine into another machine.

Course Content

UNIT-I

Symbols, Alphabets, Strings, Languages, Sets, Relations, Functions.Chomsky Hierarchy of languages, Definition of an Automaton , Finite Automaton Model, Non- deterministic Finite Automaton, Equivalence of DFA and NFA, Mealy Machine , Moore machine, Minimization of Finite Automata.

UNIT-II

Identity rules, Equivalence of Regular Expressions and Finite Automata, Regular Sets, Pumping Lemma for regular sets, Closure Properties of Regular Sets, Regular Grammars: right linear and left linear grammars.

UNIT-III

Context Free Grammars (CFG), Derivation Trees, Ambiguity in Context-Free Grammars, Chomsky Normal Form, GreibachNorma Form.PDA Definition, Acceptance by PDA, Push down automata and context free languages, Deterministic push down automata, Equivalence of PDA and DPDA. Pumping Lemma for Context Free languages (CFL), Closure Properties of CFL.

UNIT-IV

Definition of Turing Machines, Design of Turing Machines, Computable Language and Functions. Techniques for TM Construction, Modification of TM, Universal Turing machine, Properties of recursive and recursively enumerable languages.

UNIT-V

Post's Correspondence Problem, Definition of P and NP problems, NP Complete and NP Hard Problems.Advance topics: relations of deterministic and non-deterministic finite automata, structural characterizations of classes of regular languages, descriptional complexity of regular languages and their relationship to grammatical inference.

Text Books

1. *"Introduction to Automata Theory, Languages, and Computation"* - John E. Hopcraft, Jeffery D. Ullman, Rajeev Motwani, Pearson 3rd edition, 2013.
2. D. I. A. Cohen, *"Introduction to Computer Theory"*, John Wiley & Sons, 2nd edition, 1997.

Reference Books

1. K.L.P. Mishra & N.Chandrasekaran*"Theory of Computer Science (Automata, Languages and Computation)"*PHI, 3rd edition, 2008.
2. J. C. Martin, *"Introduction to Languages and the Theory of Computation"*, 3rd Ed, Tata McGraw-Hill, 2002.
3. H. R. Lewis and C. H. Papadimitriou, *"Elements of the Theory of Computation"*, Prentice Hall, 2nd edition, 1997.

Course Outcomes

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

- Understand the computational capabilities of any machine modal.
- Able to decide what are the problems can be solved by machine and what are not possible.
- Understand the working of Turing machine.
- Understand the different classes of problem.

Course No: CS314	Course Title: Database Management Systems	L	P	U
		2	2	3

Course Learning Objectives

- To provide a general introduction to relational model
- To learn about data modelling through ER diagrams
- To learn about Normalization
- To learn about SQL commands
- To learn about Query Processing and Transaction Management

Course Content

UNIT-I

Overview of Database Systems- Overview of a Database Management System-Database design and ER diagrams: Elements of the E/R Model-Design Principles-The Modeling of Constraints-Weak Entity Sets

UNIT- II

Basics of the Relational Model-From E/R Diagrams to Relational Designs - Design of Relational Database Schemas - Multi valued Dependencies. Relational Algebra: Relational Operations-Extended Operators of Relational Algebra- Constraints on Relations - Normalization - Normal Forms

UNIT-III

Simple Queries in SQL-Sub queries-Full-Relation Operations-Database Modifications-Defining a Relation Schema-View Definitions- Constraints and Triggers: Keys and Foreign Keys-Constraints on Attributes and TuplesModification of Constraints-Schema-Level Constraints and Triggers -Java Database Connectivity- Stored Procedures

UNIT-IV

The memory hierarchy -RAID-Index Structures: Indexes on Sequential Files-Secondary Indexes-B-Trees-Hash Tables-. QUERY EVALUATION: Operator Evaluation, Query Optimization Estimating the Cost of Operations-Cost-Based Plan Selection -Order for Joins-Physical-Query Plan

UNIT-V

ACID- Transactions and Schedules, CONCURRENCY CONTROL: Serial and Serializable Schedules-ConflictSerializability-Enforcing Serializability by Locks-Locking Systems with Several Lock Modes-Concurrency Control by Timestamps, validation. TRANSACTION MANAGEMENT: Serializability and Recoverability-View Serializability-Resolving Deadlocks-Distributed Databases: Commit and Lock

Text Book(s)

1. Ramakrishna R &Gehrke J, "*Database Management Systems*", Mc-Grawhill, Singapore, 3rd Ed, 2002

Reference Books

1. RamezElmasri and SB Navathe,*"Fundamentals of Database Systems"*, Pearson Education,India, 5th Ed, 2008
2. Hector G Molina, Jeffrey D Ullman and Jennifer Widom, *"Database Systems – The Complete Book"*, Pearson Education,India, 2nd Ed, 2008
3. Silberschatz, Korth,Sudarshan,"*Database System Concepts*", Mc-Grawhill,India, 4th Ed,2002

List of Database Management Systems Laboratory Experiments:

S.No	Name of the Experiment	Duration
1	Data Modelling : ER Diagrams	1: 40 H
2	Basic DDL,DML, TCL commands	1: 40 H
3	Joins	1: 40 H
4	Joins and Subqueries	1: 40 H
5	Aggregate Functions	1: 40 H
6	Group By , Having clause	1:40 H
7	Views	1:40 H
8	Indexes	1:40 H

Course Outcomes

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

- Understand database concepts and structures.
- Understand data modeling and database development processes using SQL.
- Construct and normalize conceptual data models.

- Become proficient in using database query language, i.e., SQL. using MySQL
- Understand the issues related to database performance,transaction Management and crash recovery.

Course No: CS321	Course Title: Programming Languages and Compiler Construction	L	P	U
		3	0	3

Course Learning Objectives

- Aim is to learn how to design and implement a compiler
- Able to design small compiler using varies tools discussed.
- Able to understand how the language is processed by the computer.
- What are the different phases of compilation process?

Course Content

UNIT- I

Evolution of programming languages, language processors, structure of a compiler, phases of the compiler, compiler construction tools. Lexical analysis:
Role of lexical analyzer, specification and recognition of tokens, automatic generation of lexical analyzer. Lex tool.

UNIT-II

CFG ambiguity, associativity, precedence, Top down parsing methods, elimination of left recursion, recursive descent and predictive parsers;
Bottom up parsing, shift-reduce parsing, precedence parsing, LR parsers, SLR (1) table construction, limitations of SLR parsing, non -SLR (1) grammars; Introduction to canonical and LALR parsing, YACC.

UNIT-III

Syntax directed definitions: Inherited and synthesized attributes, dependency graph, bottom up and top down evaluation of attributes, L- and S- attribute definition.
Type checking, type systems, type expressions, type conversion and overloading. Run time environments, storage organization and allocation strategies, parameter passing, symbol tables.

UNIT-IV

Intermediate code generation, interpreters, intermediate languages, syntax trees, postfix code, triples and indirect triples, syntax directed translation of simple statements. Issues in code generation, basic blocks and flow graphs, next use information, register allocation and assignment, simple code generation. Sources of optimization, optimization of basic blocks, data flow analysis, code generation from DAG, peep hole optimization.

UNIT-V

Advanced topics: Type systems, data abstraction, compilation of object-oriented features and non-imperative programming languages.

Text Books

1. Aho, A .V., Lam, M ., Sethi, R and U llman, J D., " *Compilers: Principles, Techniques and Tools*", 2nd 2007 Ed., Pearson Education.
2. Tremblay, J.P. and Sorenson, P G., "Theory *and Practice of Compiler Writing*", SR Publications, 1st edition, 1985.

Reference Books

1. "*Principle of compiler design",* V. Raghavan, Tata McGrawHill, 4th edition 2012.
2. "*Compiler Principles and Practice*", Parag H. Dave, Himanshu B. Dave, Pearson, 1st edition, 2012.
3. Holub, A.I.,"*Compiler Design in C"*, Prentice-Hall of India, 1st edition, 1993.
4. Tremblay, A.S., and Sorenson, P.G.," *The Theory and Practice of Compiler Writing",* McGraw-Hill Int. 1st Edition, 1985.

Course Outcomes

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

- Understand the complexity in designing the compiler.
- Working of compiler.
- Develop small compiler using the tools.
- Understand the intermediate code generated by compiler.

Course No: CS322	Course Title: Computer Organization and Architecture	L	P	U
		3	0	3

Course Learning Objectives

- To have a thorough understanding of the basic structure and operation of a digital computer.
- To study the different ways of communicating with I/O devices and standard I/O interfaces.
- To impart an understanding of the internal organization and operations of a computer.
- To introduce the concepts of processor logic design and control logic design.

Course Contents

UNIT- I

Basic Structure of computers–functional units – basic operational concepts –bus structures – software. Memory locations and addresses – memory operations – instructions and instruction sequencing – addressing modes –Basic I/O operations – stacks subroutine calls. Basic processing unit – fundamental concepts – instruction cycle - execution of a complete instruction –multiple- bus organization – sequencing of control signals.

UNIT- II

Arithmetic algorithms: Algorithms for multiplication and division of binary and BCD numbers — array multiplier —Booth's multiplication algorithm — restoring and non-restoring division — algorithms for floating point, multiplication and division. Introduction to CPU design, Instruction interpretation and execution, Micro-operation and their RTL specification, Hardwired control CPU design, Micro-programmed control CPU design.

UNIT- III

Memory Concepts, Memory Hierarchy, Physical memory design, Cache memory and related mapping and replacement policies, Virtual memory.

UNIT- IV

Introduction to input/output processing, working with video display unit and keyboard and routine to control them, Programmed controlled I/O transfer, Interrupt controlled I/O transfer, DMA controller, Secondary storage and type of storage devices, Introduction to buses and connecting I/O devices to CPU and memory.

UNIT- V

Introduction to pipelining and pipeline hazards, design issues of pipeline architecture, Instruction level parallelism and advanced issues.

Text Books:

1. Hamacher C., Z. Vranesic and S. Zaky, Computer Organization, 5/e, McGraw Hill, 2011, 5th Edition.

Reference Books:

1. Mano M. M., Digital Logic & Computer Design, 4/e, Pearson Education, 2013. 6th Edition.

2. Patterson D.A. and J. L. Hennessey, Computer Organization and Design, 5/e, Morgan Kauffmann Publishers, 2013. 6th Edition.

Course Outcomes

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

- Identify the basic structure and functional units of a digital computer.
- Analyze the effect of addressing modes on the execution time of a program.
- Design processing unit using the concepts of ALU and control logic design.
- Identify the pros and cons of different types of control logic design in processors.
- Select appropriate interfacing standards for I/O devices.
- Identify the roles of various functional units of a computer in instruction execution

Course No: CS323	Course Title: Computer Networks	L	P	U
		3	0	3

Course Learning Objectives

- Build an understanding of the fundamental concepts of data communication and computer networking
- To study the foundational principles, architectures, and techniques employed in computer networks.
- To study the concepts of communication networks, protocols and their performance
- Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks
- To study TCP & UDP socket and RIP, OSPF routing protocols

Course Content

UNIT-I

Uses of Computer Networks, Network Hardware , Network Software , Network protocol (syntax, semantics, and timing); Protocol suites (OSI and TCP/IP); Layered protocol software (stacks): Physical layer networking concepts; data link layer concepts; network layer concepts; transport and application layer concepts; Network Standards and standardization bodies.

UNIT-II

Bandwidth and Data Rate, Encoding and Modulation Techniques, Transmission modes, Multiplexing (FDM &TDM), Transmission media.

UNIT-III

LAN topologies (bus, ring, star), LAN technologies (Ethernet, token Ring, Gigabit Ethernet), Error detection and correction, Carrier sense multiple access networks (CSMA), Large networks and wide areas, Protocols (addressing, congestion control, virtual circuits, quality of service). Internet - addressing, routing, end point control; Internet protocols - IP, TCP, UDP, ICMP, HTTP, CIDR

UNIT-IV

Flooding; Minimal spanning trees; Bellman Ford, Dijkstra's, OSPF, BGP shortest path algorithms; The leaky bucket, floyd warshall and Random Early Detection congestion methods; Data security and integrity: Fundamentals of secure networks; cryptography; Encryption and privacy: Public key, private key, symmetric key; Authentication protocols; Packet filtering; Firewalls; Virtual private networks; Transport layer security

UNIT-V

Overview of the issues of network management; Domain names and name services; Issues for Internet service providers (ISPs); Quality of service issues: performance, failure recovery.

Text Books

1. W. Stallings, "*Data & Computer Communications*", Prentice-Hall, 10th Edition, 2005.
2. A. S. Tanenbaum, "*Computer networks*", Prentice-Hall, 5th Edition, 2005

Reference Books

1. Behrouz A Forouzan, "*Data Communications and Networking*", Tata Mc-grawhill, 2nd Edition, 2007.
2. J.F.Kurose and K.W.Ross, "*Computer Networking: A Top-Down Approach Featuring the Internet*", Pearson Education, 6th Edition, 2001.

List of Computer Networks Laboratory Experiments:

S.No	Experiments	Duration
1	Write a program to implement Connection oriented Client & Server (TCP Client & TCP Server)	1.40H
2	Write a program to implement Connection less Client & Server (UDP Client & UDP Server)	1.40H
3	Time of the day server and client using TCP	1.40H
4	Concurrent echo server & client using UDP	1.40H
5	How to configure Ethernet , Telnet and Console interface on CISCO router using Netsimk and CISCO Packet Tracer	1.40H
6	How to configure LAN & WAN interfaces on CISCO router	1.40H
7	How to configure static routing	1.40H
8	How to configure RIP , OSPF ,EIGRP protocols on CISCO router	1.40H
9	How to configure L2 & L3 switches	1.40H

Course Outcomes

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

- understand basic computer network technology
- Understand and explain Data Communications System and its components
- Identify the different types of network topologies and protocols
- Understand about working of Intranet, LAN, WAN, MAN setups, different topologies
- Gain familiarity with common networking protocols and algorithms
- Configure network protocols and analyze its performance
- Understand , configure, troubleshoot routing protocols using simulators like netsimk and CISCO packet tracer

Course No: **CS324**	Course Title: **Design and Analysis of Algorithms**	L	P	U
		3	2	4

Course Learning Objectives:

- To analyze performance of algorithms.
- To choose the appropriate data structure and algorithm design method for a specified application.
- To understand how the choice of data structures and algorithm design methods impacts the performance of programs.
- To solve problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking and branch and bound.
- To understand the differences between tractable and intractable problems.
- To introduce P and NP classes.
- To implement the algorithm/Logic of a problem in a computer program such as C/C++ etc.

Course Content

UNIT-I

Introduction-Algorithm definition, Algorithm Specification, Performance Analysis Space complexity, Time complexity, Asymptotic Notation. Divide and conquer- General method, applications – Binary search, Merge sort, Quick sort, Selection sort, Strassen's Matrix Multiplication.

UNIT-II

Elementary Data Structures: Introduction, Trees –Tree Terminology, Binary Trees, Dictionaries, Graphs, Graph Terminology and representations. Set Operations: Set Disjoint Set operations-Union and Find. Searching and Traversal Techniques: Binary Tree Techniques, Connected Components, Bi - connected components. Spanning trees, Graph traversals - Breadth first search and Depth first search

UNIT-III

Greedy method- Introduction - Job sequencing with deadlines, knapsack problem, Minimum cost spanning trees-Prim's algorithm, kruskal's algorithm, Single source shortest path problem, Disjkstra's Algorithm.

UNIT-IV

Dynamic Programming- General Method, applications, Introduction-Matrix chain multiplication, Longest common subsequence, All pairs shortest path problem – BellMan Ford, Floyd Warshall, Travelling salesperson problem. Backtracking: Introduction, n-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles.

UNIT-V

Branch and Bound- Introduction, Travelling salesperson problem, LC Branch and Bound solution, FIFO Branch and Bound solution. NP-Hard and NP-Complete problems- Basic

concepts, non deterministic algorithms, NP - Hard and NP Complete classes, clique vertex coloring, SAT Theorem, Cook's theorem.

TEXT BOOKS:

1. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekharam, Galgotia publications pvt. Ltd. 2nd Edition, 2013.

REFERENCE BOOKS:

1. Introduction to Design and Analysis of Algorithms by Anant Levitin Third Edition, Pearson Publications, 2012
2. Design and Analysis of Algorithms by M. T. Goodrich and R. Tomassia, John Wiley and sons 2nd Edition 2011
3. The Algorithm Design Manual, 2nd Edition – 2009, Steven Skiena, Springer.
4. Design and Analysis of Algorithms by Aho, Ullman and Hopcroft, Pearson Education, 1st Edition, 2004.

List of Design and Analysis of Algorithms Laboratory Experiments:

S.No	Experiments	Duration
1	**Write a C program to implement Quick sort algorithm for sorting a list of integers in ascending order**	**1:40 H**
2	**Write a C program to implement a Merge sort algorithm for sorting a list of integers in ascending order.**	**1:40 H**
3	**Write a C program to implement the dfs algorithm for a graph.**	**1:40 H**
4	**Write a C program to implement the bfs algorithm for a graph.**	**1:40 H**
5	**Write a C program to implement a backtracking algorithm for the N-queens problem.**	**1:40 H**
6	**Write a C program to implement the backtracking algorithm for the sum of subsets problem.**	**1:40 H**
7	**Write a C program to implement the backtracking algorithm for the Hamiltonian Circuits problem.**	**1:40 H**

8	**Write a C program to implement a greedy algorithm for job sequencing with deadlines.**	**1:40 H**
9	**Write a C program to implement Dijkstra's algorithm for the Single source shortest path problem.**	**1:40 H**
10	**Write a C program that implements Prim's algorithm to generate a minimum cost spanning tree.**	**1:40 H**
11	**Write a C program that implements Kruskal's algorithm to generate minimum cost spanning tree**	**1:40 H**
12	**Write a C program to implement Floyd's algorithm for the all pairs shortest path problem.**	**1:40 H**
13	**Write a C program to implement a Dynamic Programming algorithm for the 0/1 Knapsack problem.**	**1:40 H**
14	**Write a C program to implement a Dynamic Programming algorithm for the Optimal Binary Search Tree Problem.**	**1:40 H**

Course Outcomes

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

- Ability to analyze the performance of algorithms.
- Ability to choose appropriate algorithm design techniques for solving problems.
- Ability to understand how the choice of data structures and the algorithm design methods impact the performance of programs.
- Ability to implement algorithms in a programming environment.

Course No: CS401	Course Title: Database Administration	L	P	U
		3	0	3

Course Learning Objectives:

- To understand the role of a database management system in an organization.
- To understand the role of the database administrator.
- To gain a conceptual understanding of the Oracle database architecture and how its components work and interact with one another.
- To understand performance monitoring, database security, user management, and backup/recovery techniques.
- Understand the Industry oriented DBA projects through Case Study

Course Content

UNIT-I

Database, Data, and System Administration DBA-DBA Tasks - Types of DBA - Creating a Database Environment - Choosing DBMS - Installing DBMS

Case study: Database Installation and Migration Solutions

UNIT-II

ER Diagrams - Normalization - Normal Forms- Database Design - From Logical Model to Physical Database- Database Performance design--Views

UNIT-III

Database Security basics- Granting and Revoking Authority - Roles and Groups-Encryption-SQL Injection, Other Database Security Mechanisms-Using Views for Security,Using Stored Procedures for Security,Encryption,DBMS Fix-packs and Maintenance.

Case Study: Access control requirements for a Health Information System

UNIT-IV

Backup: -Importance-Approaches to Database Backup- Recovery-Determining Recovery Options-Steps for recovery -types-Alternatives to backup and recovery.

Disaster Planning: General Disaster Recovery Guidelines, Backing Up the Database for Disaster Recovery, Disaster Prevention.

Case Study: Database Replication and Partitioning Solutions.

UNIT- V

Types-Benefits of DBA tools- Database change management-performance management-Data Warehousing, Analytics and Business Intelligence

Case study: Building ETL Transformations in Pentaho Data Integration (Kettle)

Text Book(s)

1. Craig S.Mullins, "*Database Administration ,The complete guide to DBA practices and procedures*",2nd Edition, Addison- Wesley,2015

Reference Books

1. Hector G Molina, Jeffrey D Ullman and Jennifer Widom ,"*Database Systems – The Complete Book*", , 2nd Edition, Pearson Education, India, 2008
2. C J Date,"*An Introduction to Database Systems*",8th Edition, Pearson Education India,2009

Course Outcomes:

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

- properly install, configure and tune a database administer servers and server groups
- properly manage and optimize schemas, tables, indexes, and views
- properly create logins, configure permissions, assign roles, and perform other essential security tasks
- properly monitor server activity and resolve performance issues
- take charge of automation and maintenance
- plan and implement a comprehensive backup and recovery strategy
- Develop Various Case Studies in the Industry

Course No: CS402	Course Title: SQL & Database Applications	L	P	U
		3	0	3

Course Learning Objectives

- To familiarize and provide the skills for developing applications using SQL, PL/SQL and NoSQL databases.

Course Content

UNIT-I
Overview of DBMS, ER models.

UNIT-II
Simple Queries, Keys and Constraints - Aggregate Functions, Sorting, Grouping - Joins - Subqueries

UNIT-III
Defining a Relation Schema-View Definitions- Constraints and Triggers: Keys and Foreign Keys-Constraints on Attributes and Tuples Modification of Constraints-Schema-Level Constraints and Triggers -Assertions

UNIT-IV
SQL in programming environment - SQL, Host Language Interface, Cursors, Dynamic SQL - Procedures stored in the schema - Stored Routines - Functions and stored procedure - Java Database Connectivity. No SQL database- Features, Types, Query Mechanism, Advantages, SQL vs NoSQL, MongoDB, Cassandra, HBASE, Neo4j , NoSQL Datastores, CRUD operations,Column oriented Databases, Hbase Distributed storage architecture, document store, key value stores. Case study: Google's Bigtable - a table with a billion rows and a million columns.

UNIT-V
Column Oriented database-Apache HBase, Cassandra-Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Document and Key Value database- MongoDB-Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases. Case study: Amazon's Dynamo - accept an order 24 hours a day, 7 days a week, Case study: Google's MapReduce - use commodity hardware to create search indexes.

Text Book(s)

1. Hector Gracia-Molina, Ullman & Widom, "*Database Systems, The Complete book*" Pearson Education,2nd Edition, Delhi, 2008

Reference Books:

1. Shashank Tiwari, Professional NoSQL, Wrox Press, Wiley, 2011, ISBN: 978-0-470-94224-6
2. Ramakrishna R &Gehrke J, "*Database Management Systems*", Mc-Grawhill, Singapore, 3rd Ed, 2002
3. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Author: Sadalage, P. & Fowler, Publication: Pearson Education

Course Outcomes

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

- Become proficient in using database query language, i.e., SQL. using My SQL and MongoDB.
- Able to develop real world applications using SQL and NoSQL.
- To have knowledge of Modern databases.

Course No: CS403	Course Title: Database Security & Privacy	L	P	U
		3	0	3

Course Learning Objectives:

- Open availability of robust, strong cryptography, A Secure Name Infrastructure
- A Secure Forwarding Infrastructure, Encryption by default.
- A Useful Privacy and Security Public Policy Framework.

Course Content

UNIT I

Data Security: Database systems- architectures- storage structures- storage issues in in Database Management Systems- Security of data at various levels of Database Management Systems

UNIT II

Distributed Databases: Distributed Data Processing- Distributed Database system- Distributed Database Management System Architecture: Architectural models for Distributed Database Management System – Global directory issues – Distributed database design - distributed design issues – fragmentation – Allocation

UNIT III

Semantic Data Control: View Management – Data centralized Authorization control – Distributed Authorization control – centralized Semantic Integrity Control - Centralized Semantic Integrity Control - Database interoperability - issues related to security in database interoperability, Knowledge base systems - Knowledge base system design – storage of knowledge – various formats – Levels of security issues in Knowledge base system design – conceptual level – implementation level

UNIT IV

Expert Systems – Design of Expert systems – Knowledge representation techniques in Expert system – structured, semi structured and unstructured data – Knowledge Management and security issues.

UNIT- V

Data Privacy: Introduction to Data Privacy, K-annonymity, l-diversity, differential-privacy, privacy-preserving distributed data mining, Policy, legal ethics and compliance, Economics of data security and privacy.

Text Books:

1. Michael Gertz and Sushil Jajodia (Editors), Handbook of Database Security: Applications and Trends, ISBN-10: 0387485325. First Edition,Springer, 2007
2. Security in Computing, Charles P. Pfleeger and Shari Lawrence Pfleeger, Third Edition, Pearson Education, 2003.

Reference Books:

1. Principles of Distributed Database Systems, M.Tamer OZSU and Patrick Valdureiz, Second Edition, Pearson Education, 2001.
2. Artificial Intelligence: A Modern approach, Stuart Russel and Peter Norwig, Third Edition, Pearson Education, 2003. Knowledge Management, Ganesh Natarajan and Sandhya Shekhar, Tata McGrawHill, 2000.

Course Outcomes

At the end of the course, the students will be able to:

- Understand the basic concepts of data security such as Confidentiality, Integrity, Authentication, Key management, and their relevance in various Contexts of Network Communication.
- Understand the security mechanisms applied to the Distributed Database Management System in Real time communication.
- Understand the various security aspects in Expert System along with their protocols and architecture.
- Understand the data privacy policies applied to distribute data mining along with various protocols used for encryption and key management.

Course No: CS404	Course Title: Wireless Networks	L	P	U
		3	0	3

Course Learning Objectives

- To study the specifications and functionalities of various protocols/standards of wireless networks.
- To study the current trends in Wireless Networks.

Course Content

UNIT-I

Introduction – Applications - Frequency Management and Channel Assignment, Signal, Antenna, Signal Propagation, Multiplexing, Modulation, Spread Spectrum - Cellular Wireless Networks- Cellular systems.

UNIT-II

Motivation for Specialized MAC, SDMA, FDMA, TDMA - Fixed TDM, Classical Aloha, Slotted Aloha, CSMA, DAMA, PRMA, Reservation TDMA, MACA, Polling and ISMA and CDMA

UNIT-III

GSM-architecture-Location tracking and call setup- Mobility management- Handover-Security-GSM SMS –International roaming for GSM- call recording functions-subscriber and service data mgt –-Mobile Number portability–GPRS –Architecture.

Infra red vs radio transmission, Infrastructure and ad-hoc network, IEEE 802.11 Standards – Architecture – Services – Mobile Ad hoc Networks- WiFi and WiMAX - Wireless Local Loop.

UNIT-IV

Mobile IP – Dynamic Host Configuration Protocol-Mobile Ad Hoc Routing Protocols– Multicast routing-TCP over Wireless Networks – Indirect TCP – Snooping TCP – Mobile TCP – Fast Retransmit / Fast Recovery – Transmission/Timeout Freezing-Selective Retransmission – Transaction Oriented TCP- TCP over 2.5 / 3G wireless Networks.

UNIT-V

WAP Model- Mobile Location based services -WAP Gateway –WAP protocols – WAP user agent profile- caching model-wireless bearers for WAP - WML – WMLScripts - WTA - iMode- SyncML

Text Books

1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education, Second Edition, 2003.
2. William Stallings, "Wireless Communications and Networks", Pearson Education, Second Edition, 2002.

Reference Books

1. P. Nicopolitidis, M.S. Obaidat, G. I. Papadimitrious, A. S. Pomportsis, " *Wireless Network*", First Published, 2002.
2. Theodore S. Rappaport, "*Wireless Communications Principles and Practice*" Second edition, 2010.

Course Outcomes

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

- Describe the need for the study of wireless and mobile networks.
- Describe the main characteristics of mobile IP and how it differs from IP.
- Illustrate traffic routing with mobile IP.
- Develop applications that rely on wireless data communications including applications for the mobile phone
- Describe current and emerging interests in wireless and mobile computing and current capabilities, limitations and potential of each.

Course No: CS405	Course Title: Network Administration	L	P	U
		3	0	3

Course Learning Objectives

- Able to understand different types of abstract devices.
- Able to compute the types of problems to be solved by the machine.
- Convert one abstract machine into another machine.
  Able to understand various routing and routed protocols

Course Content

UNIT-I

Introduction to Computer Networking, The TCP/IP and OSI Networking Models, TCP/IP Networking Model, History Leading to TCP/IP , Overview of the TCP/IP Networking Model , TCP/IP Application Layer , HTTP Overview , TCP/IP Transport Layer , TCP Error Recovery Basics , Same Layer and Adjacent Layer Interactions , TCP/IP Internet Layer , Internet Protocol and the Postal Service , Internet Protocol Addressing Basics , IP Routing Basics , TCP/IP Network Access Layer , TCP/IP Model and Terminology , Comparing the Two TCP/IP Models , Data Encapsulation Terminology, Names of TCP/IP Messages, OSI Networking Model , Comparing OSI and TCP/IP , Describing Protocols by Referencing the OSI Layers , OSI Layers and Their Functions , OSI Layering Concepts and Benefits , OSI Encapsulation Terminology.

UNIT- II

A Brief History of Ethernet, Ethernet UTP Cabling, Improving Performance by Using Switches Instead of Hubs, Ethernet Data-Link Protocols.
Fundamentals of WANs: OSI Layer 1 for Point-to-Point WANs, OSI Layer 2 for Point-to-Point WANs, Frame Relay and Packet-Switching Services.
Fundamentals of IPv4 Addressing and Routing: Overview of Network Layer Functions, IP Addressing, IP Routing, IP Routing Protocols, Network Layer Utilities.
Fundamentals of TCP/IP Transport, Applications, and Security: TCP/IP Layer 4 Protocols: TCP and UDP, TCP/IP Applications, Network Security

UNIT-III

LAN Switching: LAN Switching Concepts, LAN Design Considerations.
Operating Cisco LAN Switches, Ethernet Switch Configuration, Ethernet Switch Troubleshooting,
Wireless LANs: Wireless LAN Concepts, Deploying WLANs, Wireless LAN Security,

.

UNIT- IV

Introduction to Subnetting, Analyze Subnetting and Addressing Needs, Make Design Choices, Analyzing Classful IPv4 Networks: Classful Network Concepts, Practice with Classful Networks,

Converting Subnet Masks: Subnet Mask Conversion, Practice Converting Subnet Masks, Analyzing Existing Subnet Masks:

UNIT-V

Installing Cisco Routers, Cisco Router IOS CLI, Upgrading Cisco IOS Software and the Cisco IOS Software Boot Process, Routing Protocol Concepts and Configuration: Connected and Static Routes, Routing Protocol Overview, Configuring and Verifying RIP-2,
Troubleshooting IP Routing: IP Troubleshooting Tips and Tools, A Routing Troubleshooting Scenario

List of Network Administration Laboratory Experiments:

S.No	Experiments	Duration
1	Understand and Practice how to configure LAN interfaces	1.40H
2	Understand and Practice ping , tcpdump , net view, netstat , nslookup , arp , ipconfig & tracert commands	1.40H
3	How to configure firewalls	1.40H
4	How to configure & manage L2 switches	1.40H
5	How to configure & manage L3 switches	1.40H
6	How to configure LAN & WAN interfaces on routers	1.40H
7	How to configure Static routing on routers	1.40H
8	How to configure routing protocols on routers	1.40H

Text Books

1. Odom, W. & Knott, T. (2006). Networking Basics: CCNA 1 Companion Guide, 1st Edition, Cisco Press.
2. Lammle, T. (2008). CCENT: Cisco Certified Entry Networking Technician. Sybex, 1st Edition, Study Guide Edition.

Reference Books

1. Odom, W. (2011). CCENT/CCNA ICND1 Official Exam Certification Guide (3rd Ed.). Cisco, 1st edition Press Pearson Education India.

Course Outcomes

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

- Perform simple PC (hardware, software, network settings) and NIC troubleshooting.
- Describe the devices required to buil, d a LAN.
- Build and troubleshoot a simple LAN.
- Able to understand and configure network management commands, RIP , OSPF routing protocols

Course No: CS406	Course Title: Network Security	L	P	U
		3	0	3

Course Learning Objectives

- The key objective of this course is to understand the technologies , methodologies and protocols to secure computer networks
- This Course focus towards the introduction of network security using various cryptographic algorithms.
- To know the methods of conventional encryption.
- To understand the concepts of public key encryption and number theory.
- To understand authentication, Hash functions and Digital signatures.
- To know the network security tools and applications.
- To understand the System security, Transport layer security, IP security, Wireless LAN security and Application level security

Course Content

UNIT- I

OSI Security Architecture Security Attacks, Security Services, Security Mechanisms and A model for Network Security. Classical Encryption Techniques Symmetric Cipher Model, Substitution Techniques, Transposition techniques and Steganography

UNIT- II

Data Encryption Standards Block Cipher principles, DES algorithm and Examples, Strength of DES, Block Cipher design Principles .Block Cipher Operations Modes of operations, ECB,CBC,CF,OF and Counter Mode, Multiple Encryption and Triple DES. Advanced Encryption Standards AES Structure (Encryption and Decryption), AES Transformation Functions Introduction to number Theory .Prime Numbers, Fermat's and Euler's Theorem

UNIT- III

Public-Key Cryptography Principles of Public-Key Cryptosystems, RSA Algorithm. Other Public-Key Cryptosystems Diffie-Hellman Key Exchange, ElGamal Cryptographic system, Elliptic Curve Cryptography, ElGamal Cryptographic Hash Functions Authentication, Message Authentication Functions, Message Authentication Requirements, Applications of Cryptographic Hash Functions, Two Simple Hash Functions, MD5 and SHA-1 algorithms, MACs based on Hash functions(HMAC).

UNIT- IV

Digital Signatures Properties, Attacks and Forgeries, Digital Signature requirements, Direct Digital Signature, DSA algorithm. Key Management and Distribution Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution ofPublic keys, X.509 Certificate format, Forward Certificate and reverse Certificate. User Authentication Remote user Authentication Principles, Remote user-Authentication using Symmetric and AsymmetricEncryption, Kerberos Authentication protocol

UNIT- V

Transport Level Security, Web Security, SSL Architecture, Secure Shell (SSH), SET. Wireless LAN Security and E-mail Security IEEE 802.11i Wireless LAN Security, Wireless Transport layer Security, PGP, S/MIME. IP Security IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations. System Security Intruders, IDS, Password Management, Malicious Software, Firewalls, Firewall characteristics, Types of firewalls, Firewall Basing

Text Books

1. William Stallings, "*Cryptography and Network Security - Principles and Practices*", Pearson, Fifth Edition, 2011

Reference Books

1. William Stallings, "*Network Security Essentials- Applications and standards*", Pearson, Fourth Edition, 2011.
2. Atul Kahate, "*Cryptography and Network Security*", Tata McGraw-Hill, Second Edition, 2008.
3. W. Mao, "*Modern Cryptography – Theory and Practice*", Pearson Education, Second Edition, 2007

Course Outcomes

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

- identify Vulnerabilities ,different types of threats and Risk
- Write code for relevant cryptographic algorithms and Digest algorithms.
- understand security tools like Crypt , Wireshark ,Cain and abel
- understand SET,SSL & S/MIME protocols
- Determine firewall requirements, and configure a firewall.

Course No: CS407	Course Title: Cyber Security	L	P	U
		3	0	3

Course Learning Objectives:

- Safeguard national critical information infrastructure.
- To respond to resolve and recover from cyber incidents and attacks through timely information sharing, collaboration, and action.
- To establish a legal and regulatory framework to enable a safe and vibrant cyberspace, Foster a culture of cyber security that promotes safe and appropriate use of cyberspace.
- To develop and cultivate national cyber security capabilities.
- Security breaches , vulnerabilities and threats

Course Content

UNIT- I

Introduction:

Cyber Security – Cyber Security policy – Domain of Cyber Security Policy – Laws and Regulations – Enterprise Policy – Technology Operations – Technology Configuration - Strategy versus Policy – Cyber Security Evolution – Productivity – Internet – E commerce – Counter Measures Challenges. Botnets.

Case study 1: To understand the need of security , Vulnerability , threats and security breaches using IFHE Campus network

UNIT- II

Cyber security objectives and guidance

Cyber Security Metrics – Security Management Goals – Counting Vulnerabilities – Security Frameworks – E Commerce Systems – Industrial Control Systems – Personal Mobile Devices – Security Policy Objectives – Guidance for Decision Makers – Tone at the Top – Policy as a Project – Cyber Security Management – Arriving at Goals – Cyber Security Documentation – The Catalog Approach – Catalog Format – Cyber Security Policy Taxonomy.

Case study 2 : To understand the basic cryptography , elements required to implement cryptography and keys used in cryptography using WattsApp messenger End-to-End encryption

UNIT- III

Cyber governance issues

Cyber Governance Issues – Net Neutrality – Internet Names and Numbers – Copyright and Trademarks – Email and Messaging - Cyber User Issues - Malvertising - Impersonation – Appropriate Use – Cyber Crime – Geo location – Privacy - Cyber Conflict Issues – Intellectual property Theft – Cyber Espionage – Cyber Sabotage – Cyber Welfare.

UNIT- IV

Cyber infrastructure issues

Cyber Infrastructure Issue – Economics, finance and banking – Health care – Industrial Control systems. Cyber insurance, cyber security in international relations.

UNIT- V

Introduction about the cyber space, Regulation of cyber space – introducing cyber law, Scope of Cyber laws – e-commerce; online contracts; IPRs (copyright, trademarks and software patenting); e-taxation; e- governance and cyber crimes Cyber law in India with special reference to Information Technology (Amendment) Act, 2008

Text Book

1. Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs, Jeffrey Schmidt, Joseph Weiss "Cyber Security Policy Guidebook" John Wiley & Sons , 1 st Edition,2012.
2. Duggal Pavan, "Cyber Law "Unversal Law Publishing, Second Edtion, 2013.

Reference Book

1. James Graham "Cyber Security Essentials" Auerbach Publications, 1 st Edition, 2011.
2. B.G Raggad, "Information Security Management", CRC Press, 1 st Edition Taylor Francis, 2015

Course Outcomes:

At the end of the course, the students will be able to:

- Understand the concept of cyber security.
- Identify different types of cyber attacks.
- Know various cyber security issues and policies in different sectors like financing, banking, healthcare etc.
- Understand and analyze various security threats and vulnerabilities.

Course No: CS408	Course Title: Advanced Java	L	P	U
		3	0	3

Course Learning Objectives

- To learn to build applications using advanced Java APIs. To be able to design and implement stand alone applications and web applications.
- To be able to use intermediate level features of Java programming language, like IO, thread control, network API and database access
- To understand construction of web applications using the servlet API, JSP technology, and other server Java technology
- To understand the role of frameworks in application development.
- To understand the concepts with hands on experience and development

Course Content

UNIT-I

Review of IO and multithreading in Java. Networking – socket programming, concurrent server programs, client-server application examples.

UNIT-II

Database access in a Java program. The JDBC API. JDBC drivers and connections. Statements, Prepared Statements, Result Set, Query execution and updates. Stored procedures and scrollable result sets. Programs and small applications using MySQL databases.

UNIT-III

Brief introduction to RMI and its architecture. The abstraction of lower layers, to offer services at a higher level. The use of stubs and skeletons as proxies, the registry for remote objects. Introduction to web servers as containers for web components. Servlets as components. Thread model for servlets. The Servlet API. Review of HTML protocol, HTML methods

UNIT-IV

Using the HTTPServlet API to build web applications. The Servlet Context, the XML configuration, the ServletRequest and ServletResponse interfaces. The session object. Interaction among servlets using forward and include. The use of Cookies and HTML mechanisms like hidden fields to maintain the state data of a client. Design and implementation of an online shopping application using servlets, HTML forms, HTTPSession and database access using JDBC. Any other application using the same features.The use of JSP technology to build web application. Introduction to JSP elements and JSP tags. Creating cutom JSP tags. Appreciating the use of the JSP technology in building easy to maintain web applications.

UNIT-V

Introduction to the Apache Struts, MVC Architecture, Struts Architecture, the Struts Controller, the Struts Action Class, Using Struts Action Form Class, Using Struts HTML Tags,
Design and implementation of an example application (library management system, for example).
ORM – the use of a suitable framework (like Hibernate) that uses ORM. Introduction to Hibernate 3.0, Hibernate Architecture. Building an application using an ORM framework.

Text Books

1. Java Server Programming Java EE 7 (J2EE 1.7), Black Book Paperback – 2014 by Kogent Learning Solutions Inc.DreamTech
2. *"The Complete Reference Java"* – Eight Edition – Herbert Schildt – TATA McGRAW-HILL.-2011

Reference Books

1. *"Programming with Java A Primer"* – Third Edition – E.Balagurusamy – TATA-McGRAW-HILL.
2. *"Thinking in Java* "– Fourth Edition – Bruce Eckel – Pearson Education.
3. *"Professional EJB*"– Third Indian Reprint –Rahim Adatia and Faiz Arni – Apress L.P. Ltd.
4. *"J2EE 1.4 Bible"* – MCGOVERN and others – WILEY Publishing, Inc.
5. *"Web Programming – Building Internet Applications* "– Second Edition – Chris Bates – WILEY Publishing, Inc.

List of Advanced Java Laboratory Experiments:

S.No	Experiments	Duration
1.	**Java programs on multithreading**	**1:40 H**
2	**Java programs on JDBC**	**1:40 H**
3.	**Java programs using socket API to create a client and server application**	**1:40 H**
4.	**Java programs using socket API to create a client and server application**	**1:40 H**
5.	**Java programs on creating files and accessing the data from the**	**1:40 H**

	files	
6.	**Java programs on creating files and accessing the data from the files**	**1:40 H**
7.	**Programs on Java sevrlets**	**1:40 H**
8.	**Programs on Java sevrlets**	**1:40 H**
9.	**Programs using MVC architecture**	**1:40 H**
10.	**Programs using MVC architecture**	**1:40 H**

Course Outcomes

After successful completion of the course student will

1. Appreciate the use of Java technologies –some of the advanced APIs from the Enterprise Edition of Java, and features like containers - in building enterprise web applications
2. Starting with the low level socket API, understand progressively more sophisticated platforms for building distributed applications
3. Become familiar with the use of Servlets, JSP, accessing data from databases using JDBC, the process of deployment of web application, and the role of XML
4. Be introduced to the MVC pattern through a framework, like Struts.
5. Become familiar with problem solving techniques of advanced java technologies

Course No: CS409	Course Title: Mobile Application Development	L	P	U
		3	0	3

Course Learning Objectives:

- Add multiple activities & associated layouts to an Android project.
- Switch between screens display a dialog window.
- Display and add functionality to a custom menu.

UNIT-I

Introduction to Android: Native Android Application; SDK Features; Introduction to Open Handset Alliance; Development Framework; Application Fundamentals; Device Compatibility; System permissions.

UNIT –II

User Interface and Application Components: Basic UI Design; Fragments; Widget Toolbox; Creating New View; Introduction to Intents; Intent Filters and broadcast Receivers; Activities; Services; Content Providers; Application Widgets; Processes and Threads.

UNIT –III

Files and Database Handling: Saving Application Data; Shared Preferences; Preference Framework and Activity; Static File as Resource; File System; Introduction to SQLite Database; Querying SQLite; Storage options; Data backup

UNIT – IV

User Experience Enhancement: Action Bar; Menus and Action Bar Items; Settings; Dialogs; Customizing Toast; Notifications; Search; Drag and Drop

UNIT-V

Multimedia, Wireless Connectivity and Telephony: Audio and Video Handling; Manipulating Raw Audio; Sound Effects; Camera Programming; Video Recording; Managing Wireless Connectivity : WiFi, Bluetooth, Near Field Communication; Hardware Support for Telephony; Telephony Management; SMS and MMS

Text Books

1. Reto Meier, "*Professional Android 4 Application Development*", Wrox, 2012
2. Matt Gifford, *"PhoneGap Mobile Application Development Cookbook"*, PACKT, 2012

References

1. Adrian Kosmaczewski, *"Mobile JavaScript Application Development"*, O'RELLY, 2012

Course Outcomes

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

- Explain mobile devices, including their capabilities and limitations.
- Describe the components and structure of a mobile development framework.
- Use current mobile platforms and their architectures.
- Describe and compare different mobile application models/architectures and patterns.
- Identify the challenges that mobile programming has in providing an effective user interface
- Write mobile application for small devices

Course No: CS410	Course Title: Scripting Languages	L	P	U
		3	0	3

Course Learning Objectives

- This course is an introduction to different scripting languages.
- Scripting languages have been around almost since the invention of computers, certainly since the invention of the operating systems.
- In describing the world of scripting languages many traditional and modern Scripting have been identified, web scripting form is one of the important one in modern scripting
- To understand scripting few unstructured lab experiments and case studies using python and Javascript will be discussed
- By end of this course, a student can implement scripts by his/her own and also able to understand scripts written in different scripting languages (like Python, Perl, etc.)

Course Content

UNIT-I

Scripts and programs, Uses for scripting languages, Characteristics of scripting languages, Uses for scripting languages, Introduction to python object Types, Numeric Types, Strings, Lists, Dictionaries, Tuples Files, Case Study on Extracting web data (Email and contact details) using Python

UNIT-II

Python Statements, Assignment, Expressions, Print Control, Function basics, Scopes, Arguments, Recursive, Non-recursive, Case Study on automating day to day activities using Python

UNIT-III

Classes, Operator overloading, Exceptions Advanced Classes, GUI, Data Structure, Algorithm Analysis, Case Study on analysing file contents using Python

UNIT-IV

Basic Scripting in PERL, Variables, Control Structures, Regular Expressions, Subroutines, Operators, References, Objects

UNIT-V

An overview of Tcl and Tk, Variables, Expressions, Control flow Procedures

Text Books

1. The World of Scripting Languages, David Barron, Wiley Publications, 1st Edition, 2000.
2. Learning Python, Fifth Edition, Mark Lutz, Oreilly Publications, 2013.
3. Programming Perl, Fourth Edition, Tom Christiansen, Brian d foy & Larry Wall with Jon Orwant, Oreilly Publications, 2012.
4. Tcl and the Tk Toolkit, John K. Ouster hout, A technical report, 2nd Edition, 1996.

Reference Books

1. Fundamentals of Python: First programs, Kenneth A. Lambert, Martin Osborne, Cengage, 2nd Edition, 2011.
2. Python Programming for the Absolute Beginner, Third Edition, Michael Dawson, Premier Press, 3rd Edition, 2003.
3. Python Cookbook, Third Edition, David Beazley and Brian K. Jones, Oreilly Publications, 3rd Edition, 2013.
4. Programming Perl, Larry Wall, Tom Christiansen, & Randal Schwartz, Oreilly Publications, 2nd Edtion, 1996.

List of Scripting Languages Laboratory Experiments:

No.s	Experiments	Duration
1.	Basic scripts on Data types in PYTHON interactive environment	1:40 H
2	Basic scripts on Operators in PYTHON interactive environment	1:40 H
3.	Basic scripts on Control Statements in PYTHON interactive environment	1:40 H
4.	Basic scripts on Functions in PYTHON using SPYDER	1:40 H
5.	Basic scripts on Objects and Classes in PYTHON using SPYDER	1:40 H
6.	Basic scripts on Exception handling in PYTHON using SPYDER	1:40 H
7.	Basic scripts on File handling in PYTHON using SPYDER	1:40 H
8.	Basic scripts on GUI in PYTHON using SPYDER	1:40 H
9.	Basic scripts on Web development in PYTHON using SPYDER	1:40 H
10.	Basic scripts on Automation in PYTHON using SPYDER	1:40 H

Course Outcomes

After going through this course the students will be capable of

- Understanding the scripts written in different scripting languages.
- Writing the scripts using python and perl.
- Writing scripts to automate day to day activities which enhances the programming skills and employability
- Focus on particular areas of scripting: pattern matching, processing structured text, GUI, Data Analysis, high performance computing, machine learning and structured graphics (Tcl and Tk).
- Focused on writing scripts to implement computational methods and algorithms.

Course No: CS411	Course Title: Web Enabled Technologies	L	P	U
		3	0	3

Course Learning Objectives

- Students gain practical experience required for entry into web design and development careers.
- Able to use a variety of latest technologies to create responsive websites.
- To understand web programming unstructured lab experiments and few case studies using Javascript will be discussed
- Understand different frameworks.

Course Content

UNIT-I

Web Development and Design Basics: Standard HTML, basic tags, working with Text, List, Tables and Frames - Linking document, Image and Multimedia – Forms and Controls. Markup and Styling: Creating Style Sheet – Properties and Styling, CSS Advanced- Properties and Styling, case study on designing application form using HTML

UNIT-II

JavaScript Programming Fundamentals: Introduction to Java script – Fundamentals of JavaScript, Event Handling, case study on login page design and authentication using CSS

UNIT-III

Responsive web design: Introduction, Viewing, Media, Frameworks and Templates.

UNIT-IV

Frameworks: Bootstrap, Drupal, Angular.JS, Node.Js, case study on designing dynamic web page

UNIT-V

Web-Based and REST Style Services: Restful Web Services, Java RESTful Web Services API

Text Books

1. Programming the World Wide Web, R.W.Sebesta, Pearson, 7th Ed., 2014
2. Responsive Web Design with Html5 and Css3, Frain Ben, Packt publishing house, 2nd edition, 2015

Reference Books

1. Learning AngularJS: A Guide to AngularJS Development, Ken Williamson, O'Reilly, 1st Ed., 2015
2. HTML and CSS: The Complete Reference, Thomas A. Powell, McGraw- Hill Osborne Media, 5th Ed., 2010.
3. Learning AngularJS: A Guide to AngularJS Development, Ken Williamson, O'Reilly, 1st Ed., 2015
4. Bootstrap: Responsive Web Development, Jake Spurlock, O'Reilly Media; 1 edition, 2013.
5. Drupal For Dummies Lynn Beighley, 2 edition, 2011
6. RESTful Web Services Cookbook: Solutions for Improving Scalability and Simplicity, Subbu Allamaraju, Yahoo Pres 1st Edition, Kindle Edition, 2010

List of Scripting Languages Laboratory Experiments:

No.s	Experiments	Duration
1.	Basic web page design using HTML tags	1:40 H
2	Basic web page design using HTML tags (Including Text)	1:40 H
3.	Basic web page design using HTML tags (Including Images and table)	1:40 H
4.	Basic web page design using CSS for styling and coloring	1:40 H
5.	Basic web page creation for application form using HTML and CSS	1:40 H
6.	Creating dynamic web page using HTML and CSS	1:40 H
7.	Basic programs using javascript fundamentals	1:40 H
8.	Basic programs using javascript functions	1:40 H
9.	Basic programs using javascript objects and classes	1:40 H
10.	Creating dynamic web page using javascript	1:40 H

Course Outcomes

After successful completion of the course student will be able to

- Ability to produce dynamic, flexible and responsive websites which enhances the programming skills and employability
- Possess a good working knowledge of different frameworks and technologies

Course No: CS412	Course Title: Computer Graphics	L	P	U
		3	0	3

Course Learning Objectives

- This basic course makes the student aimed with topics including anti-aliasing, fractal objects representations methods, ray tracing, spline curves and surface, 2D, 3D modeling and Rendering methods.
- The standard software like Graphical Kernel System (GKS), OpenGL, Simple Raster Scan Graphics Package (SRGP), and other Post Scripts interpreters for page descriptions and a variety of painting, drawing and designs, has impacted the human nature blended with splendid colors.

Course Contents

UNIT- I

Presentation graphics, art and visualization, Image processing, GUI. Display devices, Raster Scan, Random Scan, CRT Monitors, storage devices and 3-dimansion viewing. I/O devices, Graphics functions and software standards.

UNIT- II

Properties of light, standard primitives, Chromaticity diagrams RGB, YIQ, CMY and HSV color models selections and applications. Color and Gray Scale levels.Output Primitives for drawing objects -drawing 2D objects, homogenous coordinates: Line, Circle & Ellipse, Brensenham Line drawing, Area-fill attributes, antialiasing

UNIT- III

Basic transformations, matrix representations, computational efficiency, reflection, shear and affine transformation. Point and line clipping, Cohen-Sutherland and other algorithms.

UNIT- IV

Parallel, perspective and other projections, Depth cuing, surface rendering. Polygon surface and tables , quadratic surfaces, sphere, ellipsoid, torus and other 3D objects, spline representation , continuity, Beizer curves and surfaces.

UNIT-V

Viewing coordinates, perspective-projection transformations, clipping in homogenous coordinates.Back-face detection, scan 0line, BSP-line and Ray-casting, wireframe methods Light sources, diffuse reflection, transparency and shadows, Half tone and Dithering techniques.

Text Books

1. Hearn Donald and Baker M. Pauline, Computer Graphics C version 2nd Ed.

   Pearson Edu 2009

2. Foley James. et. al, Computer Graphics Principles and Applications, 2nd Ed.

   Pearson Edu. 2008

Reference Books

1. Foley James. et. al, Computer Graphics Principles and Applications, 2nd Ed. Pearson Edu. 2008

2. Sinha A.N and Udai A.D, Computer Graphics, 1st Ed., TMH, 2012

List of Computer Graphics Laboratory Experiments:

S.No	Experiments	Duration
1	Drawing 2D objects & Implementing Scaling, Translating and Rotation operations	1:40 H
2	Drawing 2D objects & Implementing Scaling, Translating and Rotation operations	1:40 H
3	Geometric transformation and animation	1:40 H
4	Geometric transformation and animation	1:40 H
5	Geometric transformation and animation	1:40 H
6	Drawing 3D objects & implementing Orthographic and Perspective Projections(Cube)	1:40 H

7	Drawing 3D objects & implementing Orthographic and Perspective Projections(Cube)	1:40 H
8	Drawing 3D objects & implementing Orthographic and Perspective Projections(Cube)	1:40 H
9	Drawing 3D Objects and Animation	1:40 H
10	Drawing 3D Objects and Animation	1:40 H

Course Outcomes

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

- Drawing the basic primitives
- Manipulating and mapping the 2D,3D objects
- Drawing the smooth curves and surfaces
- Viewing and representing the 3D objects
- Knowing the illumination and surface rendering methods
- Showing the graphics in motion

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Course No: CS413	Course Title: Software Engineering	L	P	U
		3	0	3

Course Learning Objectives

- To understand the software process models such as waterfall and evolutionary models.

- To learn how to implement the agile process models in real projects.
- To understand the software requirements and SRS document.
- To learn different software architectural styles.
- To understand various software testing approaches such as unit, integration,validation and system testing.
- To understand the quality control and learn how to ensure good quality software.
- To understand software engineering principles and practices by working on real time case studies.

UNIT- I

Introduction to Software Engineering: The evolving role of software, Changing Nature of Software, Software myths. A Generic view of process: Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models. Process models: The waterfall model, Incremental process models, Evolutionary process models, The Unified process.

Agile Process models:What is Agility? ,Agile Process-Human factors,Agile Process Models-Extreme Programming, ASD, Scrum, Crystal and Feature Driven Development.

Case Study:**iLearn: A digital learning environment**

UNIT-II

Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. System models: Context Models, Behavioural models, Data models, Object models, structured methods.

Case Study:**Mentcare: A mental health support system :This case study illustrates how requirements documents may be organized and can be used as a basis for discussing the issues and problems in developing requirements documents.**

UNIT - III

Design Engineering: Design process and Design quality, Design concepts, the design model. Creating an architectural design: Software architecture, Data design, Architectural styles and patterns, Architectural Design. Object-Oriented Design: Objects and object classes, An Object-Oriented design process, Design evolution. Performing User interface design: Golden rules, User interface analysis and design, interface analysis, interface design steps, Design evaluation.

Case Study:**Airbus 340 flight control system:This case study describes the architecture of the Airbus 340 flight control system, a safety critical system that implements the fly-by-wire flight system on the Airbus**

UNIT- IV

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging. Product metrics: Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance. Metrics for Process and Products: Software Measurement, Metrics for software quality. Risk management: Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.

CaseStudy:Testing of Social Media Marketing Tool

UNIT-V

Quality Management: Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards.

Casestudy:Waste Management Inspection Tracking System

Text Books

1. *"Software Engineering: A practitioner's Approach"*, Roger S Pressman, 6th edition. McGrawHill International Edition.
2. *"Software Engineer*ing", Ian Sommerville, 7th edition, Pearson education.

Reference Books

1. "*Software Engineering, A Precise Approach*", Pankaj Jalote, Wiley India, 2010.
2. "*Software Engineering: A Primer*", Waman S Jawadekar, Tata McGraw-Hill, 2008
3. "*Fundamentals of Software Engineering*", Rajib Mall, PHI, 2005

Course Outcomes:

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

- Identify minimum requirements for developing a software application.
- Choose an appropriate process model based on the user requirements.
- Identify and apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices.
- Write test cases and can develop a simple test report
- Understand the concepts of quality control and can ensure the quality of software.

Course No: CS414	Course Title: Service Oriented Architecture	L	P	U
		3	0	3

Prerequisites: Web Technology, Java, Databases and Computer Networks

Course Learning Objectives

- Offers an overview and critical SOA and service design principles such as loose coupling, interoperability, extensibility, reuse and discoverability.
- The integration of XML and SOAP architecture and XML schemas, WSDL web services are explored - capable of being extended to accommodate changing business needs and promote integration simplicity.

Course contents

UNIT- I

Fundamentals of SOA, Services and primitives, Common Characteristics and Misconceptions of Contemporary SOA, Tangible benefits of using SOA.

Evolution of SOA: XML technology, Client Server architecture, Distributed and hybrid and object oriented SOA architecture.

Understanding SOA, Service Orientation and XML and Web Services, Services primitives, quality, Common characteristics of cotemporary SOA, misconceptions of SOA, and tangible benefits of SOA.

UNIT- II

Services Roles and descriptions, Messaging and WS* extensions, Service activity and coordination, atomic transactions, business activities Orchestration, Choreography.

UNIT-III

Addressing, Reliable Messaging, Correlation, Policies, Metadata exchange, Security, Notifications and Eventing, SOA–orientation, anatomy, common principles of service-orientation and inter-relate.

UNIT- IV

Application, business and other layers. Agnostic services, hybrid utilities and services, Web Services

UNIT- V

SOA life cycle and phases, testing, delivery strategies, Agile Strategies.

Textbooks

1. Thomas Erl , "*Service – Oriented Architecture : Concepts, Technology and Design* ", 1st Edition ,Pearson Education 2008

Ref. Book(s)

1. James Bean , "*SOA and Web Services Interface Design – Principles , techniques and standards*" 1st ed. Morgan Kaufmann(Elsevier), 2010
2. Len Bass et. all – "*Software Architecture in Practice*" , 2nd Ed. Pearson 2010
3. Charles F. Goldfarb's "*XML Handbook*", 5th Edition, Elsevier /Pearson Education 2010

Course Outcomes

- Know the basic concepts of SOA.
- Analyze the service and deployment models
- Integration of XML and services

Course No: CS415	Course Title: Object Oriented Analysis and Design	L	P	U
		3	0	3

Prerequisites: Object Oriented Programming, Software Engineering

Course Learning Objectives

This basic course makes the student aimed with topics including Object Oriented System Development and Unified Modeling Language. To understand UML diagrams few unstructured lab experiments will be discussed

Course Contents

UNIT- I

Introduction: An overview of Object Oriented System Development, Object Basics, Object-Oriented systems, Development of Life Cycle.

Object-Oriented Methodologies: Rumbaugh methodology, Booch methodology, Jackobson methodology, Object Oriented Programming, Object Oriented Design, Object Oriented Analysis, Elements of Object Model.

UNIT- II

UML: Unified Modeling Language, Conceptual Model of the UML, Iterative development, Unified Approach, Unified modeling language, static and dynamic models, Use-case diagram, class diagram, UML dynamic models, package and model organization, UML meta-model.

UNIT- III

Object-Oriented Analysis: Understanding requirements, Identifying use cases, Use-case driven Object Oriented Analysis, Case studies, Classification, Identifying Object relationships, Attributes and Methods.

Object Oriented Design:Object Oriented Design, Design models: GRASP, Design Patterns, Framework, Object Oriented Testing, Process and Design Axioms and corollaries, Designing classes, Access Layer, Object Storage, Object Interoperability; Designing Interface Objects.

UNIT- IV

Object Oriented Data Model: Quarry Languages, OODBMS, Object Rational Database system, designing access layer.

UNIT- V

View Layer: Designing interface objects, designing view layer classes, macro and micro level process, purpose of a view layer, case studies, Quality assurance test, Testing strategies, Test cases and test plan, continuous testing.

Text Book

1. Object Oriented Systems Development, Ali Bahrami, Tata McGraw-Hill, 1999, 1st Edition.

Reference Book

1. Applying UML and Patterns, CriagLarman, Pearson Education, 1997, 3rd Edition.

2. Introduction to Object Oriented Analysis and Design, Stephen R Schach, Tata McGraw-Hill, 2003, 1st Edition.

3. Unified Modeling Language Reference Manual, James Rumbaugh, Grady Booch, Addison Wesley, 1999, 2nd Edition.

4. Practical Object-Oriented Design with UML, Mark Priestley, Tata McGraw-Hill, 2003, 2nd Edition.

5. Object-Oriented Design with UML and JAVA, Kbrclay, Elsevier, 2008, 2nd Edition.

List of Object Oriented Analysis and Design Laboratory Experiments:

S.No	Experiments	Duration
1	To develop a problem statement.	1:40 H
2	Develop an IEEE standard SRS document. Also develop risk management and project plan (Gantt chart).	1:40 H
3	Identify Use Cases and develop the Use Case model.	1:40 H
4	Identify the business activities and develop an UML Activity diagram.	1:40 H
5	Identity the conceptual classes and develop a domain model with UML Class diagram.	1:40 H
6	Using the identified scenarios find the interaction between objects	1:40 H

	and represent them using UML Interaction diagrams.	
7	**Draw the State Chart diagram.**	**1:40 H**
8	**Identify the User Interface, Domain objects, and Technical services. Draw the partial layered, logical architecture diagram with UML package diagram notation.**	**1:40 H**
9	**Implement the Technical services layer.**	**1:40 H**
10	**Draw Component and Deployment diagrams.**	**1:40 H**

Course Outcomes:

At the end of the course, the students will be able to:

- To Gather and specify requirements of the software projects and to analyze software requirements with existing UML tools
- To Design and test software using UML tools
- To Estimate the project with respect to effort and development time
- Take up a software development project and to work in a team as well as independently on software projects.

Course No: CS416	Course Title: Software Testing Methodologies	L	P	U
		3	0	3

Course Learning Objectives

- Understand the software testing methodologies such as flow graphs and path testing, transaction flows testing, data flow testing, domain testing and logic base testing.

Course Contents

UNIT – I:

Introduction:-Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs. Flow graphs and Path testing: - Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT – II:

Transaction Flow Testing:-transaction flows, transaction flow testing techniques. Dataflow testing:- Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.

UNIT – III:

Domain Testing:-domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT-IV:

Paths, Path products and Regular expressions:-path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection. Logic Based Testing:- overview, decision tables, path expressions, kv charts, specifications.

UNIT – V:

State, State Graphs and Transition testing:– state graphs, good & bad state graphs, state testing, Testability tips. Graph Matrices and Application:-Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like JMeter or Win-runner).

TEXT BOOKS:

1. Software Testing techniques – Boris Beizer, DreamtechPress, Second edition, 2002.
2. Effective methods of Software Testing, Perry, John Wiley, 3rd Edition, 2006.

REFERENCE BOOKS:

- Software Testing Tools – Dr.K.V.K.K.Prasad, Dreamtech Press, 1st Edition 2007.
- Software Testing Concepts and Tools, P.Nageswara Rao, Dreamtech Press.,2006
- Foundations of Software Testing, A.P.Mathur, Pearson,1st Edition 2008

Course Outcomes:

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

- Ability to apply the process of testing and various methodologies in testing for developed software.
- Ability to write test cases for given software to test it before delivery to the customer.

Course No: CS417	Course Title: High Performance Computing	L	P	U
		3	0	3

Course Learning Objectives

- The overall goal is to acquaint students who anticipate doing independent work that may benefit from large-scale simulation with current hardware, software tools, practices, and trends in parallel scientific computing.
- To provide an opportunity to build and execute sample parallel codes to enhance performance of the general purpose computing systems.
- The software employed in course examples is freely available. The course is also designed to make students intelligent consumers and critics of parallel scientific computing literature and conferences.
- The focus is on algorithms that can scale to the frontier of current and likely future high performance architectures.
- Significant reference is made to applications that drive the push towards high performance.

Course Contents

UNIT- I

Basic of Parallel Computing, Pipelining, Performance of Memory, Thread Level Parallelism, Simultaneous Multi Threading.

UNIT- II

Concepts of Clusters, Grid and Mainframe, Constructs of an HPC cluster, Characterizing HPC Clusters, Building and unified performance suite to evaluate computing clusters, Case Study on performance estimation of a specific core/processor using OPENMP.

UNIT- III

Introduction to OpenMP, Performance analysis for serial and threaded application with VTune Amplifier, including system-level profiling, Case Study on vector addition using OPENMP

UNIT- IV

Vectorization, Introduction to the Advisor tool, Thread prototyping and optimizations with Advisor, Optimizing applications by analyzing machine balance and loop balance, Introduction to Roofline Analysis, Case Study on matrix multiplication using OPENMP

UNIT- V

Introduction to the Legion programming model, Regions and Tasks, Mapping of Regions and Tasks, Partitioning of Regions,

Text Books:

1. K.R. Wadleigh and I.L. Crawford, "Software Optimization for High Performance Computing: Creating Faster Applications" Hewlett-Packard professional books, Prentice Hall. 2000, 1st Edition.

Reference Books:

1. B. Wilkinson and M. Allen, "Parallel Programming: Techniques and Applications using Networked Workstations and Parallel Computers" Prentice Hall. 2004, 2nd Edition.
2. L.R. Scott, T. Clark, and B. Bagheri, "Scientific Parallel Computing" Princeton University Press. 2005, 2nd Edition.

Course Outcomes

This course will provide students with an in-depth analysis of these current issues in HPC systems including:

- Parallel Computing knowledge on OPENMP
- New Processor Architectures.
- Power-Aware Computing and Communication.
- Advanced Topics on Peta-scale Computing and Optical Systems.

Course No: **CS418**	Course Title: **Advanced Computer Architecture**	L	P	U
		3	0	3

Course Learning Objectives

- To understand pipelining, instruction set architectures and memory addressing.
- To understand symmetric shared-memory architectures and their performance.
- To understand multiprocessor cache coherence using the directory based and snooping class of protocols.
- To understand the various models to achieve memory consistency.
- To understand the architectural aspects practically few case studies are included.

Prerequisites: Basic Electronics, Digital electronics, Computer Organization and Architecture.

Course Contents

UNIT- I

Introduction ,basic RISC instruction set ,Simple implementation of RISC instruction set, Classic five stage pipe line for RISC processor, Basic performance issues in pipelining , Pipeline hazards, Reducing pipeline branch penalties. Memory Hierarchy Design: Introduction, review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.

UNIT- II

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT- III

Instruction-Level parallelism, dynamic scheduling, dynamic scheduling using Tomasulo's approach, Branch prediction, high performance instruction delivery- hardware based speculation.ILP Software Approach: Basic compiler level techniques, static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues -Hardware verses Software, Case Study on achieving parallelism on general purpose computers using MPI

UNIT- IV

Multi Processors and Thread level Parallelism Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – memory architecture, Synchronization, Case Study on assigning tasks to specific core/processor using MPI

UNIT- V

Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters. Intel Architecture: Intel IA- 64 ILP in embedded and mobile markets Fallacies and pit falls, RAID, Case Study on performance analysing a specific core/processor using MPI

Text Books:

1. John L. Hennessy, David A. Patterson, "Computer Architecture: A Quantitative Approach", an Imprint of Elsevier, 2017, 6th Edition.

Reference Books:

1. John P. Shen and Miikko H. Lipasti, "Modern Processor Design: Fundamentals of Super Scalar Processors", McGrawHill, 2002, Beta Edition.
2. Kai Hwang, Faye A.Brigs. "Computer Architecture, and Parallel Processing", McGraw Hill., 2017, 1st Edition.

Course Outcomes

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

- Design basic and intermediate RISC pipelines, including the instruction set, data paths, and ways of dealing with pipeline hazards.
- Consider various techniques of instruction-level parallelism, including superscalar execution, branch prediction, and speculation, in design of high-performance processors.
- State and understand memory hierarchy design, memory access time formula, performance improvement techniques, and trade-offs.
- State and compare properties of shared memory and distributed multiprocessor systems and cache coherency protocols.
- Learn from additional topics in computer architecture, such as multi-core processors, thread-level parallelism, and warehouse computing.
- Design, implement, and assign parallel tasks to a specific processors using MPI (Message Passing Interface)

Course No: **CS419**	Course Title: **Multi-core Architecture**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multi-threaded programming. Few case studies included
- To learn about the various parallel programming paradigms.
- To develop multi-core programs and design parallel solutions using POSIX threads programming.

Course Contents

UNIT- I

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design.

UNIT- II

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes), case study on thread management using POSIX threads programming

UNIT- III

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations. Case Study on Mutex using POSIX threads programming

UNIT- IV

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation, performance analysis using POSIX threads programming

UNIT- V

Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

Text Books:

1. Peter S. Pacheco, —An Introduction to Parallel Programming, Morgan-

Kauffman/Elsevier, 2011. 1st Edition.

Reference Books:

1. Michael J Quinn, —Parallel programming in C with MPI and OpenMP, Tata McGraw Hill, 2003. 1st Edition.
2. Victor Alessandrini, Shared Memory Application Programming, Concepts and Strategies in Multi-core Application Programming, Morgan Kaufmann, 2015. 1st Edition.
3. Yan Solihin, Fundamentals of Parallel Multi-core Architecture, CRC Press, 2015. 1st Edition.

Course Outcomes

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

- Describe multi-core architectures and identify their characteristics and challenges.
- Identify the issues in programming Parallel Processors.
- Write programs using OpenMP and MPI, and POSIX threads programming.
- Design parallel programming solutions to common problems.
- Compare and contrast programming for serial processors and programming for parallel processors.

Course No: CS421	Course Title: Parallel Computing	L	P	U
		3	0	3

Course Learning Objectives

- Parallel computing is pervasive. From embedded devices, laptops.
- To high-end supercomputer, and large-scale data centers, parallel computing is widely employed to achieve performance and efficiency targets.
- This course introduces the foundations of parallel computing, including parallel architectures, parallel programming methods and techniques, parallel algorithm designs, and parallel performance analysis and some case studies on parallel computing using NVIDIA CUDA programming

Course Contents

UNIT- I

Principles of parallel algorithm design, decomposition techniques, mapping & scheduling computation, templates, Programming shared-address space systems, Cilk Plus, OpenMP, Pthreads.

UNIT- II

Parallel computer architectures, shared memory systems and cache coherence, distributed-memory systems, interconnection networks and routing, Programming scalable systems, message passing: MPI, global address space languages.

UNIT- III

Analytical modeling of program performance, speedup, efficiency, scalability, cost optimality, isoefficiency, Collective communication, Case Study on performance estimation of a specific core/processor using NVIDIA CUDA.

UNIT- IV

Synchronization, Non-numerical algorithms, sorting, graphs, Numerical algorithms, dense matrix algorithms, sparse matrix algorithms, Case Study on Vector addition using NVIDIA CUDA

UNIT- V

Performance measurement and analysis of parallel programs, GPU Programming, Problem solving on clusters using MapReduce, Warehouse-scale computing, Case Study on matrix multiplication using NVIDIA CUDA

Text Books:

1. Introduction to Parallel Computing, Second Edition, Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, Addison-Wesley, 2003, 1st Edition.

Reference Books:

1. John P. Shen and Miikko H. Lipasti, "Modern Processor Design: Fundamentals of Super Scalar Processors", McGrawHill, 2002, Beta Edition.
2. Kai Hwang, Faye A.Brigs. "Computer Architecture, and Parallel Processing", McGraw Hill., 2017, 1st Edition.

Course Outcomes

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

- Apply knowledge of computing and mathematics appropriate to the discipline.
- Analyze a problem and identify the computing requirements appropriate for its solution; an ability to design, implement and evaluate a parallel computer based system, process, component or program to meet desired needs.
- Apply mathematical foundations, algorithmic principles and computer science theory to the modeling and design of computer based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- Apply design and development principles in the construction of software systems of varying complexity.

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.

ICFAI FOUNDATION FOR HIGHER EDUCATION HYDERABAD

REGISTRAR
ICFAI FOUNDATION FOR HIGHER EDUCATION
(Deemed-to-be-University establishes under section 3 of UGC Act 1956.)