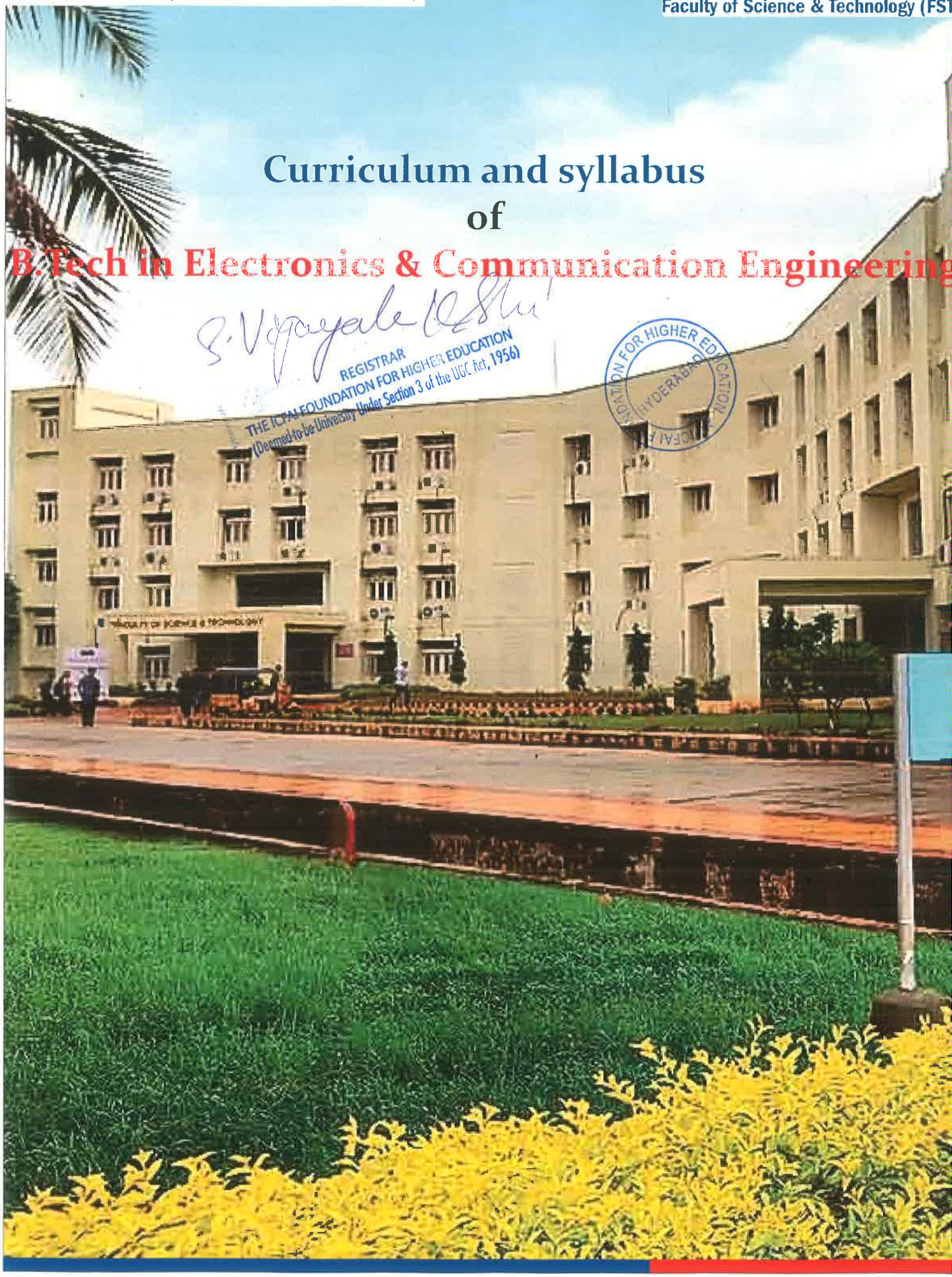
ICFAI Foundation for Higher Education
(Deemed-to-be University under Section 3 of the UGC Act, 1956)

IcfaiTech
Faculty of Science & Technology (FST

Curriculum and syllabus
of
B.Tech in Electronics & Communication Engineering



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.

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ICFAI FOUNDATION FOR HIGHER EDUCATION HYDERABAD

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1. INTRODUCTION

1.1 The ICFAI Foundation for Higher Education

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

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

Vision and Mission of IFHE

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

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

1.2 Faculty of Science and Technology (IcfaiTech)

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

VISION

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

MISSION

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

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

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

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

1.3 Educational Philosophy

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

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

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

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

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

1.4 Objectives of IcfaiTech

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

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

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

1.5 Flexibilities

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

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

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

1.6 Admissios at IcfaiTech:

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

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

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

- Pass with 60% and above aggregate marks in Class XII ("or its equivalent") with Mathematics, Physics, Chemistry and English as subjects.

- Class XII (or icfaitech equivalent) students awaiting final examination results may also apply.

- Applicants should have completed 12 years of formal schooling in order to apply for the program.

- The applicant should fulfil the minimum age requirements as prescribed by the respective Board through which the applicant has appeared for the qualifying examination.

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1.7 Programs at IcfaiTech

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

First Degree Programs (First Tier)

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

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

Program Courses

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

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

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

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

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

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

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

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

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

The Higher Degree Programs (Second Tier)

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

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

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

Ph. D Program (Third Tier)

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

1.8 . The Academic Year

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

Structure of B.Tech Program

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

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

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

Discipline Courses

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

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

Credits calculation

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

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

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

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

Integrated First Degree (First tier)

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

Higher Degree (Second tier)

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

STATEMENTS OF PEOs, POs AND PSOs

PROGRAM EDUCATIONAL OBJECTIVES, PROGRAMOUTCOMES 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.

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 andsolve engineering problems with hands on experience in varioustechnologiesusing modern tools necessary for engineering practice to satisfy the needs ofsociety and the industry.

PEO3- TECHNICAL ACCOMPLISHMENTS

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

PEO4- PROFESSIONALISM

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

PEO5- LEARNING ENVIRONMENT

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

PROGRAM OUTCOMES (POs):

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

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1	To develop ability to analyze, design and implement solution to complex engineering problems in electronics and communications systems, through innovations and to collaborate in research and development.
PSO2	Develop ability to adapt fast to new developments in field of electronics, benefitting society and guided by principle of zero effect on the environment.
PSO3	To function in multi-disciplinary work environment, good interpersonal skills as a leader in a team in appreciation of professional ethics and societal responsibilities.

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Electronics & Communication Engineering (ECE) - Semester-wise pattern

Year	Course Code	Semester-I	L	P	U	Course Code	Semester-II	L	P	U
I	ECCHEM111	Chemistry	3	0	3	ECES121	Thermodynamics	3	0	3
	ECEGL112	English Language Skills	3	0	3	ECAO122	Probability & Statistics	3	0	3
	ECMATH113	Linear Algebra	3	0	3	ECMATH123	Higher Calculus	3	0	3
	ECPHY114	PhysicsI	3	0	3	ECPHY124	PhysicsII	3	0	3
	ECTA115	Engineering Graphics	2	4	4	ECTA125	Scientific Measurements	0	4	2
	ECTA116	Computer ProgrammingI	3	0	3	ECTA126	Workshop Practice	2	4	4
	ECEVS117	Environmental Science	2	0	2	ECTA127	Computer ProgrammingII	3	0	3
	Total No of Credits				**21**	**Total No of Credits**				**21**
II	**Semester-III**					**Semester-IV**				
	ECES211	Electrical Sciences I	3	0	3	ECES221	Electrical Sciences II	3	0	3
	ECES212	Digital Electronics	2	2	3	ECTA222	Engineering Measurements	1	8	4
	ECES213	Engineering Mechanics	3	0	3	ECTA223	Professional Communication	3	0	3
	ECECON214	Principles of Economics	3	0	3	ECMGTS224	Principles of Management	3	0	3
	ECMATH215	Complex Variables	3	0	3	ECAO225	Optimization Techniques	3	0	3
	ECMATH216	Differential Equations & Fourier Series	3	0	3	ECES226	Structure & Properties of Materials	3	0	3
	EC211	Signals & Systems	3	0	3	EC221	Data Structures	2	2	3
	Total No of Credits				**21**	**Total No of Credits**				**22**
SUMMER TERM	**ECIP 221 INTERNSHIP PROGRAM I (for Internship option only)**									**5**
III	**Semester-V**					**Semester-VI**				
	ECAO311	Numerical Methods	3	0	3	–	Humanities Elective	3	0	3
	ECAO312	Control Systems	3	0	3	EC321	Analog Electronics	2	2	3
	EC311	Microprocessor Programming & Interfacing	3	0	3	EC322	Analog & Digital VLSI Design	3	0	3
	EC312	Communication Systems	3	2	4	EC323	RF & Microwave Engineering	3	2	4
	EC313	Electromagnetic Fields & Waves	3	0	3	EC324	Digital Signal Processing	3	0	3
	EC314	Microelectronic Circuits	3	0	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**				
	ECIP401/	Internship Program II			20	–	Electives (4)			18
	ECTS401	Thesis & Seminar				–	Humanities Elective (2)			
	–	Electives (4)			18	ECIP401/	Internship Program II			20
	–	Humanities Elective (2)				ECTS401	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

Electronics and Communication Engineering (ECE)				
Course Code	Course Title	L	P	U
EC211	Signals & Systems	3	0	3
EC221	Data Structures	2	2	3

Table : Compulsory Discipline Courses for the B.Tech Programs

Electronics and Communication Engineering (ECE)				
Course Code	Course Title	L	P	U
EC311	Microprocessor Programming & Interfacing	3	0	3
EC312	Communication Systems	3	2	4
EC313	Electromagnetic Fields & Waves	3	0	3
EC314	Microelectronic Circuits	3	0	3
EC321	Analog Electronics	2	2	3
EC322	Analog & Digital VLSI Design	3	0	3
EC323	RF & Microwave Engineering	3	2	4
EC324	Digital Signal Processing	3	0	3

Table : List of electives for B.Tech. (Electronics and Communication Engineering)

1) Communication Electives

Course Code	Course Title	L	P	U
EC401	MIMO Wireless Communication	3	0	3
EC402	High Speed Communication Networks	3	0	3
EC403	Wireless Communication Networks	3	0	3
EC404	Optical Fiber Communications	3	0	3
EC405	Satellite Communications	3	0	3
EC406	Mobile Communication	3	0	3

2) Microwave Electives

Course Code	Course Title	L	P	U
EC407	Antenna and wave propagation	3	0	3
EC408	Radar Systems	3	0	3
EC409	RF and Microwave MEMs	3	0	3
EC410	Smart Antennas for Mobile Communication	3	0	3

3) VLSI Electives

Course Code	Course Title	L	P	U
EC411	Low power VLSI Design	3	0	3
EC412	Digital Design Using HDLS	3	0	3
EC413	CMOS Analog Integrated Circuit Design	3	0	3
EC414	VLSI Design for Testability	3	0	3
EC415	Digital Systems	3	0	3

4) Embedded Electives

Course Code	Course Title	L	P	U
EC416	Embedded Systems (H/W)	3	0	3
EC417	Hardware Software Co- Design	3	0	3
EC418	Embedded Real Time Operating System	3	0	3
EC419	DSP Processors and Architecture	3	0	3
EC421	Microcontrollers & Applications	3	0	3

5) Design Electives

Course Code	Course Title	L	P	U
EC422	Image Processing	3	0	3
EC423	Sensors & Actuators	3	0	3
EC424	Data Compression & Encryption	3	0	3

6) Controls

Course Code	Course Title	L	P	U
ECEE401	Stochastic Control Systems	3	0	3
ECEE402	Process Control	3	0	3
ECEE403	Digital Control Systems	3	0	3
ECEE404	Power system controls and stability	3	0	3
ECEE405	Vehicular Electric Power System	3	0	3

7) Power Electronics

Course Code	Course Title	L	P	U
ECEE406	Power Electronics Applications and Drives	3	0	3
ECEE407	Advanced Power Electronics	3	0	3
ECEE408	Flexible AC Transmission System	3	0	3
ECEE409	HVDC Transmission	3	0	3

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8) Power Systems

Course Code	Course Title	L	P	U
ECEE410	Power System Transients	3	0	3
ECEE411	High Voltage Engineering	3	0	3
ECEE412	Power Quality	3	0	3
ECECEE413	Power Generation Systems	3	0	3

9) Electrical Machines

Course Code	Course Title	L	P	U
ECEE414	Special Machines	3	0	3
ECEE415	Electrical Machine Design	3	0	3
ECEE416	Utilization of Electrical Energy	3	0	3
ECEE417	Machine Modeling And Analysis	3	0	3

10) List of Humanities Electives

Course Code	Course Title	L	P	U
ECHS311	Dynamics of Social Change	3	0	3
ECHS312	Introduction to Psychology	3	0	3
ECHS313	Heritage of India	3	0	3
ECHS314	Modern Political Science	3	0	3
ECHS315	Public Administration	3	0	3
HS316	Professional Ethics	3	0	3

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3. B.Tech Program Course Description

Semester-wise Institute Courses

Course Code	Course Title	L	P	U	Course Description
ECCHEM111	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.
ECEGL112	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
ECMATH113	Linear Algebra	3	0	3	Matrices,Elementary row operations, Row and columnequivalence, 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 byMatrices, Eigen values, Eigen vectors,Diagonalization,Quadratic forms, Canonical forms.
ECPHY114	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.

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ECTA115	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.
ECTA116	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
ECEVS117	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
ECES121	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.
ECAO122	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.
ECMATH123	Higher Calculus	3	0	3	Polar coordinates: Definition, graphing and conics ,Cylindrical and spherical coordinates, Jacobian, Limits,

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					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
ECPHY124	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.
ECTA125	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.
ECTA126	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.
ECTA127	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.
ECES211	Electrical Science-I	3	0	3	Introduction; basic circuit elements; sources (dependent and independent); Kirchoff's current and voltage law, source

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					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
ECES212	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
ECES213	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.
ECECON214	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
ECMATH215	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.
ECMATH216	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.

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ECES221	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
ECTA222	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.
ECTA223	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.
ECMGTS 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.
ECAO225	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
ECES226	Structure & Properties of Materials	3	0	3	Study of the basic properties of materials in relation to their molecularstructure; emphasis on the structure of metallic, polymeric and ceramicmaterials in relation to their mechanical, electrical, electronic and chemicalproperties, methods of imparting desirable properties to materials by inducingchanges in molecular structure; property requirements and material selection criteria for widely ranging service conditions.

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ECAO311	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.
ECAO312	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
ECHS311	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
ECHS312	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.
ECHS313	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.
ECHS314	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.
ECHS315	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.
ECHS316	Professional Ethics	3	0	3	Ethics, nature and purpose; ethical theories; ethics in business and management; ethics in engineering, global ethical issues.
ECDS491 ECCE491		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

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ECCS491 ECEC491 ECEE491 ECME491 ECMECEC491	Special Projects				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.
ECIP 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.
ECIP 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.
ECTS 401	Thesis& seminar	--	--	--	ECTS 401 is a required course for all the students with thesis option.
ECTIP 491/ECTIP 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.

REGISTRAR
THE ICFAI FOUNDATION FOR HIGHER EDUCATION
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ICFAI FOUNDATION FOR HIGHER EDUCATION HYDERABAD

B.Tech Electronics & Communication Engineering Program (ECE)

Course Descriptions

Course Code	Course Title	L	P	U	Description
ECEC211	Signals & Systems	3	0	3	Mathematical description of signals & Systems, convolution, correlation, Fourier series ,Fourier Transforms, Laplace Transforms, Analysis of signals & systems using Laplace & Fourier Transforms, sampling, Discrete time signals & systems, Fourier transform of sequences ,Z-Transforms, Analysis of discrete time systems using Z-Transforms, DFT, FFT
EC221	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.
ECEC311	Microprocessor Programming & Interfacing	3	0	3	Elements of digital electronics; PC organization; 80X86 as CPU;I nstruction 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
EC312	Communication Systems	3	2	4	Principles of modern analog and digital communication with more emphasis on digital communication. Amplitude and angle modulation, sampling, PCM, DM, ADPCM, pulse shaping, digital modulation: FSK, PSK, DPSK, QPSK, etc.; information theory, source coding & channel coding, Shannon capacity theorems; emerging trends in communication systems. Experiments in analog and digital communication.
EC313	Electromagnetic Fields & Waves	3	0	3	Maxwell's equations; application of circuit theory and field theory; Maxwell's equations in free space and time varying fields; plane waves in dielectric and conducting media; solution of wave equations; the poynting vector; the poynting theorem; poynting vectorin conducting

Course Code	Course Title	L	P	U	Description
					media and circuit application; wave polarization; linear' elliptical and circular polarization; wave reflection, refraction and diffraction; transmission lines and resonators; Smith chart, and its applications in stub matching and impedance matching; discontinuities; antennas and radiation; half wave dipole antenna; loop antenna; helical antenna; directive arrays; frequency independent antennas, antenna arrays; Friis formula; antenna practices and antenna measurements.
EC314	Microelectronic Circuits	3	0	3	Basic single and two transistor amplifier configurations; current mirrors & current sources; active loads; basing in discrete and integrated circuit amplifiers; voltage sources and voltage references; differential and multistage amplifiers; frequency response of amplifiers; frequency compensation; output stages and power amplifiers; filters and tuned amplifiers; signal sources and communication etc, illustrative example of analog integrated circuits. The course will emphasize MOS/CMOS and bipolar transistors circuits. Computer simulation exercise using SPICE and other software packages will be prescribed.
EC321	Analog Electronics	2	2	3	Introduction and applications of various analog and mixed signal ICs;Discrete and IC amplifier basics; low and high frequency amplifiers; linear and non-linear Op-amp circuits: Active RC filters; Non-linear ICs; precision circuits; comparators; Schmitt Triggers; non-sinusoidal and sinusoidal waveform generators; phase-locked-loops; analog switches; IC power amplifiers; RF/IF amplifiers; switched capacitor circuits; data converters; IC sensors and systems.Laboratory and computer simulation experiments in analysis, design and characterization of electronic circuits also form part of the course.
EC322	Analog & Digital VLSI Design	3	0	3	Review of the Physics of semiconductor devices; models of MOS transistors; basic IC building block; MOS operational amplifiers; Analog system design applications, Digital circuits – MOS & CMOS inverters, logic gates, PLA and storage circuits,etc., Introduction to analog and digital VLSI design; CAD for IC design and CAD applications in circuit simulation and layout generation.
EC323	RF & Microwave Engineering	3	2	4	Introduction to radio frequency engineering; advantages, various frequency bands; propagation; transmission lines; microwave waveguides and components; their characterizations; s-parameters and their use; microwave transistors; FETs, Gunn diode, IMPATT diodes, microwave tubes; Klystron, two cavity Klystron amplifier analysis; reflex Klystron; TWTs; high power tubes; cross field tubes; microstriplines; MMICs, microwave antennas and microwave communication system; microwave

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Course Code	Course Title	L	P	U	Description
					applications; ISM applications; introduction to EMI and EMC; microwave hazards.
EC324	Digital Signal Processing	3	0	3	Introduction to Modern Filter Theory, Design of Analog filters, Design of Digital filters (IIR and FIR),Structures for realization of digital filters: direct form I & II, cascade form, parallel form, Signal flow graphs;Multi-rate Signal Processing and Poly-phase filters; Adaptive filters; Programming & Architectural features of Digital Signal Processors.
EC401	MIMO Wireless Communication	3	0	3	Introduction to Introduction to wireless communication systems and wireless channels, SISO channels, MIMO channels.MIMO channel capacity, MIMO channel Matrix, Single-user MIMO, Multi-user MIMO.Precoding design, Channel estimation on the transmitter side, A transmitter structure.Multi user receiver design, Multiple-access MIMO systems, Iterative space–time multi-user detection.Multi user MIMO, Mathematical model for Multi user MIMO system, channel capacity of Multi user MIMO system, transmission methods for broadcast channel.
EC402	High Speed Communication Networks	3	0	3	The TCP/IP protocol architecture, Internetworking, Packet switching networks, Frame relay networks, Asynchronous Transfer mode (ATM) protocol architecture, High speed LANs. Multistage networks. Overview of probability and stochastic process, Queuing analysis, single server and multi-server queues, queues with priorities, networks of queues, Self similar Data traffic Congestion control in data networks and internets, Link level flow and error control, TCP traffic control, Traffic and congestion control in ATM networks. Overview of Graph theory and least cost paths, Interior routing protocols, Exterior routing protocols and multicast. Quality of service in IP networks, Integrated and differentiated services, Protocols for QOS support-Resource reservation protocol, Multiprotocol label switching, Real time transport protocol.
EC403	Wireless Communication Networks	3	0	3	Multiple Access Techniques for Wireless Communication ,Difference between wireless and fixed telephone networks, Development of wireless networks, Traffic routing in wireless networks, Wireless Data Services : CDPD, ARDIS, RMD, Common channel signaling, ISDN, BISDN and ATM, SS7, SS7 user part, signaling traffic in SS7,Mobile IP And Wireless Access Protocol : Mobile IP Operation of mobile IP, Co-located address, Registration, Tunneling, WAP Architecture, overview, WML scripts, WAP service, WAP session protocol, wireless transaction, Wireless datagram protocol. Wireless LAN Technology : Infrared LANs, Spread spectrum LANs, Narrow bank microwave LANs, IEEE 802 protocol Architecture, IEEE802 architecture and services, 802.11 medium access control, 802.11 physical layer.

Course Code	Course Title	L	P	U	Description
EC404	Optical Fiber Communications	3	0	3	Optical Fibers: Transmission Mechanisms, Structure, Wave Guiding. Step-index and graded index optical fibers. Modal analysis. Classification of modes. Single Mode Fibers. Pulse Dispersion, Material and waveguide dispersion, Absorption, scattering and bending losses. Dispersion Shifted Fibers, Optical Power Launching and Coupling: Fiber to fiber joints. Splicing techniques. Optical fiber connectors, Optical sources and detectors: Laser fundamentals. Semiconductor Laser basics. LEDs.PIN and Avalanche photodiodes, Optical Tx/Rx Circuits, Design considerations of fiber optic systems, Noise in detection process. Bit error rate. Optical receiver operation. Power Budget and Rise time Budget. WDM.
EC405	Satellite Communication	3	0	3	Review of microwave communications and LOS systems; the various satellite orbits like GEO, MEO, LEO; the satellite link analysis and design; the communication transponder system like INSAT, INELSAT etc; theearth segment and earth station engineering; the transmission of analog and digital signals through satellite and various modulation techniques employed; the multiple access techniques like FDMA, TDMA,CDMA,etc; the INSAT program; salient features of INSAT – systems and services offered;satellite services offered by INTELSAT, INMARSAT and future satellites like IRIDIUM etc; future trends in a satellite communications.
EC406	Mobile Communication	3	0	3	Operations and applications of second/third generation and future cellular mobile and personal. Communication technology. Introduction to the technology and underlying principles of wirelesscommunications including radio signal propagation, radio channel modeling, anti-fadingtechniques like transmit and receiver antenna diversity, equalization etc., essential functions ofall cellular telephone systems like frequency re-use, cellular hierarchy, sectorization, handoff,power control and Multiple Access techniques. In addition data transmission via mobile stations,WLAN, Bluetooth etc.
EC407	Antenna and wave propagation	3	0	3	Antennas Basics, Antenna Parameters, Patterns, Beam Area (or Beam Solid Angle), Radiation Intensity, Beam Efficiency, Directivity D and Gain G, Directivity and Resolution, Antenna Apertures, Effective Height, The radio Communication link, Fields from Oscillating Dipole, Single-to-Noise Ratio(SNR), Antenna Temperature, Antenna Impedance, Point Sources and Their Arrays, Electric Dipoles, Thin Liner Antennas and Arrays of Dipoles and Apertures, The Loop Antenna, Reflector Antennas, Ground Wave Propagation: Plane Earth Reflection, Space Wave and Surface Wave, Space

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					Wave Propagation.
EC408	Radar Systems	3	0	3	Introduction Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Related Problems. Radar Equation : Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment). Related Problems, CW and Frequency Modulated Radar, MTI and Pulse Doppler RADAR, Tracking Radars, Detection of Radar Signals in Noise.
EC409	RF and Microwave EMs	3	0	3	Review of Transmission line Theory, terminated transmission lines, smith chart, impedance matching, Micro strip and Coplanar waveguide implementations, microwave network analysis, ABCD parameters, S parameters, Networks, Basics of high frequency amplifier design, device technologies, biasing techniques, simultaneous tuning of 2 port circuits, noise and distortion, Feedback systems, phase locked loops, LNA design, impedance match noise performance, linearity, noise and large signal performance, Power amplifier design, Various classes of power, MEMS technologies and components for RF applications.
EC410	Smart Antennas for Mobile Communication	3	0	3	Applications of Antenna Arrays to Mobile Communications, Introduction to Smart Antennas, Spatial Processing for Wireless Systems, Key Benefits of Smart Antennas , Smart antenna introduction ,smart antenna configuration, SDMA, architecture of smart antenna systems, Smart Antennas Techniques for CDMA,CDMA System Range and Capacity Improvement Using Spatial Filtering
EC411	Low power VLSI Design	3	0	3	Physics of Power Dissipation in CMOS FET Devices, Power Estimation, Modeling in signals, Signal Probability calculation, Probabilistic Techniques for signal activity estimation, Statistical Techniques, Estimation of Glitching power, Sensitivity Analysis. Power estimation using the input vector compaction, power dissipation in domino CMOS, high level power estimation, Information theory based approaches, Estimation of maximum power, Synthesis for Low Power, Low Power Static RAM Architectures, Low Energy Computing using Energy Recovery Techniques.
EC412	Digital Design Using HDLS	3	0	3	Introduction to HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Function Verification, System Tasks, Programming Language Interface, Module, Simulation and Synthesis Tools.

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					Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators, Gate Level Modeling, Behavioral Modeling, Switch Level Modeling, Sequential Models - Feedback Model, Capacitive Model, Implicit Model, Basic Memory Components, Functional Register, Static Machine Coding, Sequential Synthesis. Components Test and Verification: Test Bench - Combinational Circuits Testing, Sequential Circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification.
EC413	CMOS Analog Integrated Circuit Design	3	0	3	The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model. Analog CMOS Sub-Circuits. CMOS Amplifiers, CMOS Operational Amplifiers and comparators.
EC414	VLSI Design for Testability	3	0	3	Fundamentals of Test and Design for Testability (DFT), Fault Modeling, Testing For Single Stuck Faults (SSF), Testability Trade-Offs, Techniques. Scan Architectures and Testing, Controllability and Absorbability, Generic Boundary Scan, Full Integrated Scan, Storage Cells for Scan Design. Board Level and System Level DFT Approaches, Boundary Scans Standards. Compression Techniques, Syndrome Test and Signature Analysis, Built-In Self-Test (BIST), Memory BIST (MBIST), Introduction to Automatic in Circuit Testing (ICT), JTAG Testing Features.
EC415	Digital Systems	3	0	3	Introduction to digital design, PLD, ASIC and their design levels. Introduction to logic families and their interfacing. Timing specification and hazards of combinational & sequential logic circuits. Static machine analysis and design using different latches & flip-flops. Impediments to synchronous and asynchronous design with debugging circuits. Introduction & implementation of logic circuits on FPGA & CPLD.
EC416	Embedded Systems (H/W)	3	0	3	Introduction to Embedded systems, Processors embedded into a system, embedded hardware units and Devices in system, embedded software in a system, Embedded System on chip, Classification of embedded systems, skills required for embedded designers, Examples of embedded systems. Real Time system – Hard RTS, Soft RTS, Introduction to sensors and Actuators, Mixed Signal Microcontroller, MSP430 Interfacing Serial data transfer - UART, SPI, and I2C. Interrupts. I/O ports and port expansion. ADC, PWM, DC motor, Stepper motor and

Course Code	Course Title	L	P	U	Description
					LCD interfacing, ARM 7 Block diagram, ARM 7 Interfacing Serial data transfer.
EC417	Hardware Software Co- Design	3	0	3	Hardware Software Co- Design Issues, Synthesis Algorithms, Prototyping and Emulation, Target Architectures, Compilation Techniques and Tools for Embedded Processor Architectures, Design Specification And Verification, Languages for System – Level Specification and Design
EC418	Embedded Real Time Operating System	3	0	3	Introduction to Unix, Typical Real Time Application, Hard Vs Soft Real Time Systems, a Reference Model of Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency Functional Parameters, Resource Parameters of Jobs and Parameters of Resources, Approaches to Real Time Scheduling, Operating Systems, Fault Tolerance Techniques, Case Studies-VX Works, RT Linux
EC419	DSP Processors and Architecture	3	0	3	Review of Digital signal processing, Architectures for Programmable DSP Devices, basic architectural features, DSP computational building blocks. Bus architecture and memory, data addressing capabilities, address generation unit, programmability and program execution, speed issues, features for external interfacing. Programmable Digital Signal Processors, Commercial Digital Signal Processing Devices, implementation of Basic DSP Algorithms, Interfacing Memory and Parallel IO Peripherals to Programmable DSP Devices, Interfacing Serial Converters to a Programmable DSP Device
EC421	Microcontrollers & Applications	2	2	3	Architectural features and programming of 8-bit/16-bit Micro controllers, RISC/ CISC and Harvard/ Princeton architectures; timers/ counters; Types of memories, Interfacing memory devices; Interfacing with UART, SPI, PWM, WDT, input capture, output compare modes, I2C, CAN; Interfacing LED, switches, ADC, DAC, LCD, RTC; Interfacing analog circuits, FPAA and FPGA; Control Applications (Temperature, PID, DC motor/Stepper motor etc) hardware-software co-design issues, emerging bus standards (USB, Compact PCI etc), types of memories
EC422	Image Processing	3	0	3	Introduction to Image Processing and Imaging systems, Image sampling, Transforms, Enhancement and Restoration, Coding and Compression, Image Compression, Image analysis and understanding; Pattern Recognition; Introduction to tomography.

Course Code	Course Title	L	P	U	Description
EC423	Sensors & Actuators	3	0	3	Sensor characteristics, R, L and C sensors, Hall effect sensors, Piezoelectric sensors, Micro-sensors. Sensors for displacement, pressure, temperature, flow etc. Optical sensors; chemical and bio-sensors. Sensor applications in non-destructive testing. Interfacing sensors with microprocessors and micro controllers. General concepts and terminology of measurement systems, transducer classification, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data. Standards and Calibration.
EC424	Data Compression & Encryption	3	0	3	Data Compression Techniques, Audio, Image and Video Compression, Data Security: Security goals, cryptography, stenography, cryptographic attacks, services and mechanics. Integer arithmetic, modular arithmetic, and linear congruence, Substitution cipher, transposition cipher, stream and block cipher, and arithmetic modes for block ciphers Data encryption standard, double DES, triple DES,attacks on DES, AES, key distribution center, Asymmetric Key Cryptography, Malware, Intruders, Intrusion detection system, firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking, Secure Electronic Payment system.
ECEE401	Stochastic Control Systems	3	0	3	Discrete time stochastic control theory, and depending on time, continuous-time stochastic control. Discrete-time control include state space models, linear stochastic systems, controlled Markov chains, stochastic dynamic programming, estimation and control for linear systems, infinite-horizon dynamic programming, systems identification and adaptive control: multi-armed bandit models, approximate dynamic programming methods reinforcement learning, actor-critic methods Model-Predictive Control and related methods, Operations Research and Finance.
ECEE402	Process Control	3	0	3	Need for process control , Mathematical model of Flow, Level, Pressure and Thermal processes, Interacting and non-interacting systems, Continuous and batch processes – Self regulation ,Characteristic of on-off, proportional, integral and derivative controllers, Pneumatic and electric actuators, Modeling of pneumatic control valve – Valve body:-Commercial valve bodies, Selection criteria. Evaluation criteria - Tuning:- Process reaction curve method, Auto tuning. Feed-forward control – Ratio control Inferential control – Split-range and introduction to multivariable control, Adaptive control
ECEE403	Digital Control Systems	3	0	3	Comparison between analog and digital control, Difference equations- Z transform, Frequency response of discrete time systems, Transfer function of zero order hold, Analog Subsystem, stable z-domain pole placement locations, stability conditions, root locus design, Finite

Course Code	Course Title	L	P	U	Description
					time response settling time; time systems- solving discrete time state space equations- Pulse transfer function matrix, Discretization of continuous state space equations-Liapunov stability analysis(discrete time) Controllability observability-design via pole placement-state observers.
ECEE404	Power system controls and stability	3	0	3	Stability stability–rotorangle stability–frequency stability voltage stability, Reference frame theory, Clarks and Parks Transformation, Synchronous machine modeling, Transmission line modeling and load Modeling. Small Signal Stability Analysis, Transient Stability Analysis, Methods of Improving Stability
ECEE405	Vehicular Electric Power System	3	0	3	History of hybrid and electric vehicles, Basics of vehicle performance, vehicle power source characterization, Capabilities, Automation system computer facilities; Configuration and control of DC Motor drives Induction Motor drives, Permanent Magnet Motor drives, and Switched Reluctance Motor drives; classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy strategies. Changes in Distribution Operations; Planning Electrical power system in air craft, sea and undersea vehicles, space vehicles-hybrid vehicle control strategies
ECEE406	Power Electronics Applications and Drives	3	0	3	Various components-power converters, motors, loads, coupling mechanisms, Stability of drive; Modeling of d.c. motor drives. Transfer function and state-space models; Speed control using ac to dc converters, Input performance parameters, Speed reversal schemes. Four quadrant operation. Input filters design; Harmonic behavior of induction motors harmonic currents and harmonic torques using per phase equivalent circuit. Stator voltage control schemes. Speed control of wound type motors; Voltage source-Inverter fed operation. Field oriented control schemes.
ECEE407	Advanced Power Electronics	3	0	3	Single-phase converters, effect of load and source impedances; Three-phase converters, effect of load and source impedances; Dual converter, twelve-step converter; Multi-pulse converters using delta/ zigzag/ Polygon transformers, analysis; Controlled freewheeling, sequence control of converters; PWM converter – Single pulse modulation, multiple pulse modulation, sinusoidal pulse width modulation, commutation technique; design of commutating elements; DC-DC converters- buck converter, boost converter, Cuk converter; Three-phase ac regulators, operation with resistive load; Introduction to Matrix converters; three-phase voltage source inverters, voltage and frequency control; Harmonic reduction techniques, PWM inverters, Space Vector Modulation.
ECEE408	Flexible AC Transmission System	3	0	3	Transmission problems and needs, emergence of FACTS-FACTS controllers, Variable Impedance type &

Course Code	Course Title	L	P	U	Description
					switching converter type Static Synchronous Compensator (STATCOM) configuration, characteristics and control; GCSC, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC), TJE; Steady state model and characteristics of a static voltage regulators and phase shifters-power circuit configurations; independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters.
ECEE409	HVDC Transmission	3	0	3	HVDC transmission - Bridge converters – rectifier and inverter operation, equivalent circuit representation, converter faults, commutation failure, protection issues in HVDC, DC reactors; DC circuit breakers and over voltage protection, HVDC cables; Harmonics in HVDC; Hybrid HVDC and Off-shore wind power evacuation through HVDC; Wide Area Monitoring Systems.
ECEE410	Power System Transients	3	0	3	Transients in electric power systems, Circuits with distributed constants, Reflection and refraction of travelling waves; Double frequency transients, Transients in switching a three phase reactor ,capacitor; Voltage distribution in transformer winding, Generators and motors Transient parameter; Protection of lines and stations -Modern lighting arrestors, Protection of alternators and industrial drive systems; Impulse voltages, currents - Measurement using sphere gaps.
ECEE411	High Voltage Engineering	3	0	3	Electro Static Fields, classification of Electric Fields, control of electric Field intensity, numerical methods for estimation of electric field intensity; Generation of High Dc and Ac Voltages, Generation of Impulse Voltages and Currents; Measurement of High Voltages and Currents, Testing of Electrical Equipment; Non-Destructive Test Techniques; Time domain and Frequency domain analysis; Townsend's ionisation coefficient, Paschen's law, Penning effect.
ECEE412	Power Quality	3	0	3	Introduction of power quality, terms used in PQ – sag, swell, surges, harmonics, transients, voltage fluctuations, spikes; interruption, causes of long interruption, over view of reliability evaluation to power quality, multiple events, single phase tripping, stochastic prediction of short interruption; causes of voltage sag, voltage sag calculation in non linear system, three phase faults, load influence on voltage sag; mitigation of AC drives and DC drives; IEC electromagnetic compatibility standards.
ECECEE413	Power Generation Systems	3	0	3	Hydro-electric power plants, Thermal steam power plants – selection of site, elements of power plant, plant layout, pumped storage plants, turbo-alternators, steam turbines, controls and auxiliaries. Nuclear power plants, Renewable power plants, Combined operation of power

Course Code	Course Title	L	P	U	Description
					plants.
ECEE414	Special Machines	3	0	3	Constructional features, of Variable Reluctance and Hybrid Motors, SYNREL Motors; Constructional features of Single and multi-stack configurations; Rotary and Linear SRMs; Magnetic Characteristics, EMF and torque equations; Ideal PMSM, EMF and Torque equations, Armature reaction MMF ,Synchronous Reactance ,Sine wave motor with practical windings, Torque/speed characteristics, Power controllers, Converter Volt-ampere requirements.
ECEE415	Electrical Machine Design	3	0	3	Design of rotating machines, Common design features of all rotating machines, mmf calculation for the magnetic circuit of rotating machines; Armature winding , commutator and brush Predetermination; Design of core and coils for single phase and three phase transformers Design of tank and cooling tubes-Predetermination of circuit parameters; Design of stator-Design of squirrel cage and slip ring rotors-Stator and rotor winding designs; Constructional features of synchronous machines-SCR-Output equation.
ECEE416	Utilization of Electrical Energy	3	0	3	Types of motors used in electric drive pulley drives, load equalization; Electrical Lighting definitions, Laws of illumination, Different type of lamps; Methods of heat transfer, Heating methods; Electric welding, Electric traction, systems of traction, comparison and control of traction motor; tractive effort for acceleration, specific energy consumption.
ECEE417	Machine Modeling And Analysis	3	0	3	Basic Two-pole DC machine, Voltage and Current relationship, Torque equation; Mathematical model of separately excited DC motor and DC Series motor in state variable form; Mathematical model of D.C. shunt motor D.C. Compound motor in state variable form, Transfer function of the motor ; Liner transformation – Phase transformation (a, b, c to α, β, o) – Active transformation (α .β, o to d, q), dq model based DOL starting of Induction Motors; Voltage and current Equations in stator reference frame, Rotor reference frame; Circuits model of a 3ph Synchronous motor, Two axis representation of Syn Motor, Voltage and current Equations in state space variable form , dq model based short circuit fault analysis- emphasis on voltage, frequency and recovery time.

4.Institute Core Courses Handouts

Course No:**ECCHEM111**	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-liquidextraction, separation by absorption and adsorption. An introduction into thescope of different types of equipment needed in chemical technology, includingreactors, distillation columns, extruders, pumps, mills, Emulgator, Scaling upoperations 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*", 6thEdition, 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.

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Course No:**ECELS112**	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.

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Course No:**ECMATH113**	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

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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:**ECPHY114**	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

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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.

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Course No:**ECTA115**	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

Course No:**ECTA116**	Course Title:**Computer Programming I**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

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

Course Contents

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Text Books:

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

Reference Books:

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

Course Outcomes

After successful completion of the course student will be able to

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

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Course No:**ECEVS117**	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.

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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.

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Course No:**ECES121**	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:**ECAO122**	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 theBinomial 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:**ECMATH123**	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.

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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.

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Course No:**ECPHY124**	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:**ECTA125**	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

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Course No:**ECTA126**	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.

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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.

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Course No:ECTA127	Course Title:**Computer Programming II**	L	P	U
		3	0	3

Course Learning Objectives

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

Course Contents

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Text Books:

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

Reference Books:

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

Course Outcomes

After successful completion of the course student will be able to

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

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Course No:**ECES211**	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 the skill in circuit designing on basic concepts of electrical machines and be able to apply them in practical situation.

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Course No:**ECES212**	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.

S.No	Name of the Experiment
1.	Verification of Gates
2.	Implementation Of Boolean Functions Using Logic Gates
3.	Implementation of Half Adder and Full Adder using NAND and Basic Gates
4.	Half Subtractor
5.	Full Subtractor
6	Adder- Subtractor Circuit Using IC 7483
7	Binary-Gray & Gray-Binary Converter
8	Implementation Of Multiplexers and Demultiplexers
9	Implementation of Decoders
10	SR &D-TYPE Flip-Flops
11	JK & T-TYPE Flip-Flops
12	Implementation of Parallel Adder using IC 7483

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*, 5thEdition, CENGAGE Learning, India, 2004.
2. ZVI Kohavi and Niraj K Jha, *Switching and Finite Automata Theory*, 3rdEdition, 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 through the lab activity.
- Digital circuits design skills get developed to fix small tasks.

Course No:**ECES213**	Course Title:**Engineerng Mechanics**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

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

Course Content

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

Curvilinear translation – Kinematics – equation of motion – projectile – D' Alembert'sPrinciple 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.

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Course No:**ECECON214**	Course Title: **Principles of Economics**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

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

Course Content

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

Text Books

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

Reference Books

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

Course No:**MATHC215**	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:**ECMATH216**	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.

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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:**ECES221**	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 fundamental electronic components.
- The lab activity develops the electronic circuit design skill to complete the small tasks.

Course No: ECTA223	Course Title: **Professional Communication**	L	P	U
		3	0	3

Course Learning Objectives

The course aims at acquiring the students

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

Course Contents

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Text Books:

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

Reference Books:

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

Course Outcomes

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

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

Course No:**ECMGTS224**	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,PrinciplesandPracticesforTomorrow'sLeaders",GaryDessler,3rdedition, Prentice Hall,1998.
2. Engineering Management, Fraidoon Mazda, 1st edition, Addison-Wesley, 1999

Course No:**ECAO225**	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, 2eJohn 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.

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Course No:**ECES226**	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:**TA 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

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Lab Name: MT- Electronics

S.No	Name of the Experiment
1.	STUDY OF ELECTRONIC COMPONENTS AND TEST EQUIPMENTS
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 – CLAMPERS
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
11	CE TRANSISTOR AMPLIFIER
12	JFET DRAIN & TRANSFER CHARACTERISTICS

LAb Name: MT- Electrical

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.	THEVININ'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

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Lab Name: MT- Mechanical

S.No Name of the Experiment

1. DETERMINATION OF YOUNG'S MODULUS
2. FINDING GRAIN FINENESS NUMBER
3. TO CALCULATE SHEAR STRESS GENERATED IN A SHAFT USING STRAIN GAUGE TRANSDUCER
4. PENSKY MARTEN'S FLASH AND FIRE POINT DETECTION
5. MEASUREMENT OF TEMPERATURE USING THERMISTOR
6. HARDNESS TEST OF METAL(S)
7. DETERMINATION OF DISTANCE OF OBJECT USING SURVEYING METHOD
8. THERMAL CONDUCTIVITY TESTING OF METAL ROD
9. MICRO STRUCTURES OF LOW & HIGHCARBON STEELS
10. MEASUREMENT OF AMOUNT OF FLOW & DISCHARGE COEFFICIENTS THROUGH ORIFICEMETER

Text Books

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

Reference Book

E.O. Docbelin ,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
- The student develops the skill in measurement techniques and calibration calculations used in engineering.

Course No:**ECAO312**	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.
- Develops the skills to design the stable systems for automation of electric and mechanical systems.
- Able to get a job in automation sector.

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

Course Learning Objectives:
Enablesonetodevisealgorithmsforthenumericalsolutionsofmathematicalproblems.
Applications to problems from Engineering are included for each method.

Course Content:

UNIT 1:

ComputerArithmeticandErrors, Intervalhalving/Bisection , Linearinterpolation methods,Newton'smethod,Muller's method, Fixedpointiteration:x=g(x)method, Multipleroots.

UNIT II:

The GaussianElimination andGauss- Jordanmethods,LU-decomposition approach,Norms,Conditionnumbers anderrorsinsolutions,Iterative methods-Gauss-Seidel and Jacobi methods

Unit-III:

Interpolation; Newton and Lagrangian polynomials, divideddifferences, Derivativesfromdifferencetables, Higherorderderivatives,Newton - Cotesintegration formulas,
Thetrapezoidalrule-acomposite.

UNIT IV:

Simpson'srules, Gaussian integration, TheTaylor Seriesmethod,Eulerand ModifiedEuler'smethod, Runge- Kuttamethods,Multistepmethods, Milne'smethod,TheAdams-Moulton method, Systemofequationsand higherorderequations

UNIT V:

Solution throughsetofequations,Derivative boundary conditions,Eigen - valueproblems(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, Gişbert. 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:ECHS312	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
ECHS313	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: Indian 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
ECHS314	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
ECHS315	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 PublicAdministration;
- To understand the administrative theories and concepts to make sense ofadministrative practices.
- To Understand public administration theory and concepts from multiple perspectives

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Course No:ECHS316	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

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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	

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Course No	Course Title	L	P	U
ECIP401	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 isimplemented during the final year of graduation in either of the semesters. This Program constitutes working onreal 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	

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Course No	Course Title	L	P	U
ECTS401	Thesis & Seminar	0	0	20

Objective of the course:

This course ECTS 401 is a must for all students with Thesis option for the eligibility of degree. This courseinvolves research work in an active area to satisfy the creative urge in a student and may involve advancedstudy learning and experimentation. This work may form the basis for dissertation of a higher degree. Alsothis 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

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

Operation Procedure

1. Student has to devote full semester for ECTS 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 comprisingof 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
ECCE 491/ECCS 491 EC 491/ECEE 491 ECME 491	Special Project	0	0	3

- **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

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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.

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Course No	Course Title	L	P	U
ECTIP 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	

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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.

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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 problemPresent technical solutions to various stakeholders in both written and oral forms

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B.Tech Electronics & Communication Engineering Program (ECE)

Course Handouts

Course No:**ECEC211**	Course Title:**Signals and Systems**	L	P	U
		3	0	3

Course Learning Objectives

- To develop the fundamental characteristics of signals and systems.
- To learn the concepts of vector space, inner product space and orthogonal series.
- To understand signals and systems in terms of both the time and transform domains.
- To development of the mathematical skills to solve problems involving convolution, filtering,modulation and sampling.

Course Content

UNIT- I

Vector spaces. Inner Product spaces. Schwartzin equality. Hilbertspaces. Orthogonalexpansions. Bessel's inequality and Parseval's relations.

UNIT- II

Continuous-time signals, classifications. Periodic signals. Fourier series representation,Hilbert transform and its properties.

UNIT- III

Laplace transforms. Continuous - time systems: LTI system analysis using Laplace and Fourier transforms.

UNIT- IV

Sampling and reconstruction of band limited signals. Low pass and band pass samplingtheorems. Aliasing. Anti-aliasing filter. Practical Sampling-aperture effect.

UNIT- V

Discrete-time signals and systems. Z-transform and its properties. Analysis of LSI systems using Z – transform.

Sr.No	Name of the Experiment
1.	Introduction to Matlab
2.	Basic Plotting of Signals Plotting Continuous-Time Signals Plotting Discrete-Time Signals Plotting unit step, unit impulse, ramp.
3.	Periodic sinusoidal sequences
4.	Trigonometric Fourier series coefficients of a rectangular periodic signal.
5.	Exponential fourier series coefficients of a periodic rectangular signal.
6.	Fourier transform of a square pulse .Plot its amplitude and phase spectrum.
7.	Convolution
8.	Generate a discrete time sequence by sampling a continuous time signal.
9.	Laplace transform of a signal.
10.	Z transform of a signal.

Text Books

1. B.P. Lathi, Principles of Signal Processing and Linear Systems, 1st edition, Oxford International version, New York, 2011.
2. A.V. Oppenheim, A.S. Willsky and S.H. Nawab,*Signals and Systems*, 2nd edition, PHI, New Delhi, 2002.

Reference Books

1. Luis F. Chaparro, *Signals and Systems Using Matlab*, 1stInternational edition, Elsevier, 2011,.
2. Simon Haykin and Van Veen, *Signals & Systems*, 2nd edition, Wiley, New Delhi.
3. Michel J. Robert, *Fundamentals of Signals and Systems*, McGraw Hill International Edition,2008.

Course Outcomes

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

- Apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis of signals.
- Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis.
- Classify systems based on their properties and determine the response of LSI system using convolution.
- The software used for the lab activity develops the skill to classify the signals in the telecommunication era.
- The lab and project activity develops the signal processing knowledge to catch the job in telecommunication era.

Course No:**EC221**	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 graph.

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.

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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.

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 structure for solving computing problems in respective language.
- Ability to solve problems independently and think critically.

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

Course No:**ECEC311**	Course Title:**Microprocessor Programming & Interfacing**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To develop the basics of 8-bit and 16-bit Microprocessor, their architectures, internal organization and their functions, peripherals, and interfacing.
- To enable the students to acquire Assembly language programming skill which is the real essence of Microprocessor.
- To learn the concepts of microprocessor 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 interfacingD/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

Exp.No.	Name of Experiment
1	ALPs to add, subtract, multiplication, divide two 8-bit numbers
2	ALPs to add, subtract, multiplication, divide two 16-bit numbers
3	ALPs to perform logical operations and execution of Boolean expression.
4	ALP to move block of data using extra segment
5	ALP to perform Multi Byte addition
6	ALP to find the character from a given string
7	ALP to find the length of string
8	ALPs to find even and odd numbers
9	ALPs to find the largest and smallest numbers
10	ALPs to perform ascending and descending order
11	ALPs to find (i) Fibonacci series (ii) factorial of a number
12	ALPs to find the sum of squares, sum of cubes
13	ALP to find the median of an array
14	Traffic light controller interfacing
15	A/D converter interfacing
16	D/A converter interfacing
17	Stepper motor controller interfacing

Text Book

1. Douglas V. Hall, SSS P Rao, *Microprocessors and Interfacing*, 3rd edition, TMH, New Delhi, 2012.

Reference Books

1. K. Ray and K.M. Bhurchandanide, *Advanced Microprocessors and Peripherals*, 2nd edition, TMH,New Delhi,2011,
2. Liu, Gibson, *Micro computer systems: 8086/8088 family*, 2nd edition, PHI,New Delhi, 2011.

Course Outcomes

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

- Recall and apply the basic concept of digital fundamentals to Microprocessor based personal computer system.
- Identifythe 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 and develops the basic programming skills.
- The hardware oriented lab activity make the student clear about the manufacturing & internal structure of the programmable IC, which takes him/her to catch a job.

Course No:**EC312**	Course Title:**Communication Systems**	L	P	U
		3	2	4

Course Learning Objectives

- To understand the basic principles of Communication system.
- To study various analog modulation techniques and their implementation.
- To understand the principles and applications of sampling theorem.
- To study various digital modulation schemes.
- To analyze the performance of a digital communication system in the presence of noise and other interferences.

Course Content

UNIT-I

Introduction to Communication Systems, Communication Process, Elements of Communication System, Communication Channels.

UNIT-II

Amplitude modulation, Need for modulation, Basic forms of Amplitude Modulation and Demodulation. AM, DSB, SSB-SC Time domain and frequency domain description.
Angle Modulation, Fundamentals of FM, PM & its essential features, FM Generationand Demodulation.

UNIT-III

Random processes: Random variables, StationaryProcesses, Mean, Correlation, CovarianceFunctions, PSD, and Matched Filter.
Noise in AnalogModulation systems: Introduction to the effect of noise onAM System Effect of noise on FM system.

UNIT-IV

Pulse Modulation Systems**:** Basic Principles, PAM, PWM, PPM**, Basics of** PCM, Delta Modulation, ADM & DPCM. Digital data transmission:ASK, FSK, PSK Techniques,Probability of error, Pe. Multiplexing Techniques, FDM & TDM.

UNIT-V

Information Theory, Information, Entropy, Channel, Capacity, Shannon's Theorem,Shannon Hartley Theorem, Bandwidth - S/N Trade OffSource coding: Introduction, Coding Efficiency,Shannon-Fano Coding,Hoffman Coding.Channel coding: Introduction to Error-Control coding, Linear Block codes, Cyclic codes, Convolutional codes.

S.No	Name of the Experiment
1	Amplitude Modulation and Demodulation
2	Frequency Modulation and Demodulation
3	a. Pulse Amplitude Modulation &Demodulation
	b. Pulse Width Modulation and Demodulation
	c. Pulse Position Modulation and Demodulation
4	Frequency Division Multiplexing(FDM)
5	Pre-Emphasis and De-Emphasis
6	ASK, FSK, BPSK modulation & demodulation
7	PCM, DPCM modulation & demodulation
8	QPSK modulation & demodulation
9	Delta modulation & demodulation
10	Sampling and reconstruction techniques
11	Understanding noise generation & its applications

Text Books

1. Simon Haykin, *Communication Systems*, 5th edition, John Willey India Pvt. Ltd, India, 2009.
2. Principles of Communication Systems, Taub.Schilling, TMH, 3rd edition, 2008.

References Books

1. H Taub& D. Schilling, GautamSaha, *Principles of Communication Systems*, 3rd edition, TMH, New Delhi, 2007.
2. B. P. Lathi, Modern *digital and analog Communication systems*, 4th edition, Oxford University Press, New York, 2010.
3. Harold P.E, Stern Samy and AMahmond, *Communication Systems,* Pearson Edn., New Delhi, 2004.
4. Singh and Sapre, *Communication Systems: Analog and digital*, 2nd edition, TMH, New Delhi, 2007,.
5. K. Sam Shanmugam, *Analog and Digital Communication*, Wiley Publications, New Delhi, 2005.

Course Outcomes

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

- Understand the principles of AM and FM.
- Develop a prototype of Ameuture Radio.
- Evaluate the performance of a communication systems in terms of Noise.
- Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
- Perform the time and frequency domain analysis of the signals in a digital communication system.
- Understand various coding schemes that are used in digital communication system
- The hardware oriented lab activity develops the skill in finding the appropriate modulation techniques for signal processing.

Course No:**EC313**	Course Title:**Electromagnetic Fields and Waves**	L	P	U
		3	0	3

Course Learning Objectives

- To provide the knowledge and skills required to understand, Electromagnetic waves and propagation of them
- To enable the student to study the wave propagation through transmission structures such as transmission lines and Wave guides.
- To motivate the student to identify, formulate and solve fields and electromagnetic waves propagation problems in complex media.

Course Content

UNIT- I

Maxwell's equations and time varying EM fields: The equation of continuity for time varying fields,Maxwell's equations in differential and integral vector form and their interpretations, Current continuity for time-varying fields, conduction and displacement current, Conditions at a boundary surface of different media, Helmholtz equations.

UNIT- II

Electromagnetic waves: Uniform Plane waves: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization.

UNIT -III

EM Wave Characteristic at Boundaries:Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem – Applications, Power Loss in a Plane Conductor.

UNIT- IV

Guided waves and waveguides: Waves between parallel planes of perfect conductors, TE and TM waves, Characteristics of TE and TM waves, TEM waves, Velocities of propagation, Attenuation in parallel plane guides, Wave impedance, Electric field and current flow within the conductor. Rectangular wave-guides, phase velocity, cutoff-wavelength,wave impedance, and attenuation in rectangular waveguides.

UNIT- V

Transmission Lines: Transmission line model, types and Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Conditions for Lossless and Distortionless lines. Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR. The quarter and half wave lines, Impedancetransformations and matching, Smith Chart and Applications, Single and Double Stub Matching.

Text Book

1. David K. Cheng, *Field and Wave Electro-Magnetics*, 2nd edition, Pearson Education publishers, Delhi, 2011.

Reference Books

1. E.C.Jordan, K.G. Balmain, *E.M.Waves& Radiating Systems*, 2nd edition, Pearson Education, India, 2006.
2. Magdy F. Iskander, *Electromagnetic Fields and Waves*, 2nd edition, Wave Land Press Illinois , US ,2008

Course Outcomes

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

- Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems.
- Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.
- Describe and make calculations of plane electromagnetic waves in homogeneous media,including reflection of such waves in plane boundaries between homogeneous media.
- Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.
- Develop the designing skills on transmission lines for microwave signals.

Course No:**EC314**	Course Title:**Microelectronic Circuits**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To develop the student with the principles, operation and applications of the analog building blocks like diodes, BJT, FET for performing various functions.
- To learn the qualitative analysis using models, equations to illustrate the concepts and to gain the knowledge of existing analog circuits.
- To understand the working and analysis of amplifiers, feedback amplifiers and oscillators.

Course Contents

UNIT- I

Amplifier Analysis and Frequency response: Small signal amplifiers -Introduction, Low frequency response of transistor amplifiers, Introduction to various coupling schemes used in amplifiers, Cascaded & Cascode Systems.

UNIT- II

Feedback Amplifiers: Feedback concepts, Comparision between Positive and Negative feedback, Feedback Amplifiers Topologies, Analysis of feedback circuits.

UNIT -III

Oscillators:Oscillator operation,Phase Shift Operation,Wein's Bridge oscillator,Tuned oscillator CircuitCrystal oscillator.Quadrature Oscillator and sawtoothwave generator

UNIT -IV

PowerAmplifiers: Power amplifier construction and working, Series fed class A power amplifier, Transformer coupled class A power amplifier, Class B amplifier operation,class B amplifier circuits, Push-Pull Amplifier,Distortion in amplifiers, Power transistor heat sinking, Class C and Class D amplifiers.

UNIT- V

Tuned Amplifiers:Tuned Amplifier,Q-factor, Small signal tuned amplifiers,Effect of Cascading Single,Double tuned amplifiers,Stagger tuned amplifier.

S.No	Type	Name of the Experiment
1	**Hardware**	Bipolar Transistor as A Switch
2		Common Emitter or RC Coupled Amplifier
3		Schmitt Trigger Circuit
4		AstableMultivibrator Circuit
5		MonostableMultivibrator Circuit
6		Bi-Stable Multivibrator Circuit
7		RC Phase Shift Oscillator
8		Hartley Oscillator
9		Collpitts Oscillator
10		Single Stage Tuned Voltage Amplifier
11		Design of Power Bank
12	**Software**	Two Stage RC Coupled Amplifier Using BJT
13		RC Phase Shift Oscillator using Transistor
14		Class B Complementary Symmetry Amplifier

Text Books

1. A.S.Sedra&K.Smith, *Microelectronic Circuits*, 5th edition, Oxford higher education, 2009.

Reference Books

1. Robert L.Boylestad and Louis Nashelsky, *Electronic Devices and Circuit Theory*, 10th edition, Pearson, New Jersy, Coloumbus, ohio, 2011.
2. Microelectronic circuit Design, Richard. C. Jaeger, McGraw-Hill Companies Inc., International Edition.
3. CMOS circuit Design Layout and. Simulation, R Jacob Baker, Harry W.Li, David, Boyce, IEEE Press series on Microelectronic Systems, PHI
4. Jacob Millman, CCHalkias, Satyabrata Jit, *Electronic Devices and Circuits*, 3rd edition, TMH, New Delhi, 2011.
5. S. Shalivananan, N.Suresh Kumar, A.VallavaRaj, *Electronic Devices & Circuits*, Tata McGraw Hill,New Delhi,2003.

Course Outcomes

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

- Designing circuits using multistage amplifiers for various applications.
- Analyzing and design of amplifiers using negative feedback and positive feedback
- Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis
- Gain insight into the behavior of a physical system driven near resonance, in particular the relationship to the transient response and the significance of the quality factor Q
- The lab activity of this course make the student fit to get a job in electronic circuit design era.

Course No:**EC321**	Course Title:**Analog Electronics**	L	P	U
		2	2	3

Course Learning Objectives

- To design the circuits using operational amplifiers for various applications.
- To analyze and design amplifiers, active filters using Op-amp.
- To develop skills required for designing and testing integrated circuits
- To apply the gain-bandwidth concept and frequency response of the three basic amplifiers.
- To design the combinational logic circuits for different applications.

Course Contents

UNIT-I

Differential Amplifiers and Integrated Circuits: Basics of Differential Amplifier, Differential Amplifier using transistors, Types of Differential Amplifiers,DC analysis, AC analyis of Differential Amplifiers, Classification of IC's, IC package types.

UNIT-II

Operational Amplifiers: Op-Amp symbol and Terminals, Block Diagram representation of Op-Amp, Ideal Op-Amp characteristics, Characteristics and Performance parameters of Op-Amp, Voltage transfer curve, Equivalent circuit of practical Op-Amp, Slew rate, DC and AC characteristics of Op-Amp, Op-Amp 741, Stability and Frequency compensation

UNIT-III

Applications of Operational Amplifiers: Ideal and Practical Inverting and Non-inverting amplifier, Summer and adder circuit, Integrator and differentiator, Instrumentation amplifier, Sample &hold circuit, Comparators, Schmitt Trigger,Multi-vibrators, Triangular and Square wave generators, Non- Linear function generation,Second differential equations using OP-Amps

UNIT-IV

Feedback Amplifiers and Filters: Wien bridge oscillator,RC Phase shift oscillator, Butterworth Low pass and High pass unity gain designs and equal component design, Multi feedback filter and band pass filter

UNIT-V

555 TIMER,PLL ,ADC and DAC's: Timer IC 555, Functional diagram, Monostable and Astable operations and applications, PLL - introduction, block diagram and applications, Digital to Analog Conversion, Binary weighted, R-2R ladder D/A converter, Analog to Digital Conversion Techniques.

S.No	Name of the Experiment
1	Op-Amp Parameters 2
2	Low Pass Filter Using Op-Amp
3	High Pass Filter Using Op-Amp
4	Opamp as a Differential Summing & Subs tractor Amplifier
5	Band - Pass Filter
6	Opamp as a Wein Bridge Oscillator
7	Op-Amp as a Triangular Wav Generator
8	Opamp as a Sample and Hold Circuit
9	Opamp as a Quadrature Oscillator
10	IC 555 Timer as a PWM Modulator
11	Phase Locked Loop
12	Voltage Controlled Oscillator

Text Books:

1. Sedra and Smith, *Microelectronics Circuits*, Oxford Univ. Press, New York, 2014.

Reference Books:

1. I.S.Franco,*Design with Operational Amplifiers and Analog Integrated Circuits*, 3rdedition, TMH, New Delhi, 2003.
2. D. Roy Choudhury, *Linear Integrated Circuits*, 2nd edition, New Age International (p) Ltd, India , New Delhi, 2003.

Course Outcomes

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

- Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
- Elucidate and design the linear and nonlinear applications of an OP-Amp and special application ICs.
- Illustrate the function of application specific ICs such as Timers, PLL and its application in communication Field.
- The lab activity makes the student skill development in Op-amp based circuit designing.
- The project makes the student to get a job in the manufacturing circuits.

Course No:**EC403**	Course Title:**VLSI Design**	L	P	U
		3	0	3

Course Learning Objective

- To develop the concepts VLSI circuits and their design including testing.

Course Content

UNIT- I

Introduction to MOS Technologies: MOS, CMOS, BiCMOS Technology. The Inverter, Inverter Delay, Parasitic effects,driving large capacitive loads,Space Vs Time.

UNIT- II

Static and Dynamic Logic gates,Layout Design and Tools: Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools. Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays

UNIT- III

Combinational Logic Networks: Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing.

UNIT- IV

Sequential Systems: Memory cells and Arrays, Clocking disciplines, Design, Power optimization, Design validation and testing. Clocked circuits,Sequential Circuits, Adders/Multipliers

UNIT- V

VLSI system design: data and control path design, floor planning, Design methodology: logic, circuit and layout verification. Putting it all together – Microprocessor.

Text Books

1. Carver Mead and Lynn Conway, *Introduction to VLSI Systems*, Addison-Wesley, California, 1980.
2. K. EshraghianEshraghian. D, A. Pucknell, *Essentials of VLSI Circuits and Systems*, PHI, Delhi, 2005.

Reference Books

1. Neil Weste and Kamran Eshraghian, *Principles of CMOS VLSI Design*, 2nd edition Addison-Wesley, California, 2000.
2. David A. Johns, Ken Martin, *Analog Integrated Circuit Design*, Wiley Student Edn.,New Delhi, 2013

Course Outcomes

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

- Understand the techniques used for VLSI fabrication.
- Design CMOS logic circuits, switches and memory in VLSI
- Analyze the characteristics of VLSI circuits such as area, speed and power dissipation.
- Advanced FPGAs to realize Digital signal processing systems.
- Be able to complete a significant VLSI design project and get the chance to acquire a job in VLSI era.

Course No:**EC323**	Course Title:**RF & Microwave Engineering**	**L**	**P**	**U**
		3	**2**	**4**

Course Learning Objectives

- To inculcate understanding of the basics required for understanding of microwave circuit and its practical applications.
- To enable the students in analyzing the microwave circuits.
- To make the students to design and implement the microwave systems.

Course Content

UNIT- I

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnection of Two port networks, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behavior of Resistors, Capacitors and Inductors.

UNIT- II

Passive and Active Microwave Devices: Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers. Crystal and Schottkey diode detector and mixers, PIN diode switch, Gunn diode oscillator,MESFET, HEMT, IMPATT diode oscillator and amplifier, Varactor diode, Introduction to MMIC.

UNIT- III

Microwave Generation:Review of conventional vacuum Triodes, Tetrodes and Pentodes, High frequency effects in vacuum Tubes, Theory and application of two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, and Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator.

UNIT- IV

RF Amplifiers And Matching Networks : Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Stabilization Methods, Noise Figure, Constant VSWR, Broadband, High power and Multistage Amplifiers, Impedance matching using discrete components, Two component matching Networks, Frequency response and quality factor, T and Pi Matching Networks, Microstrip Line Matching Networks.

UNIT- V

Measuring Instruments : Principle of operation and application of VSWR meter, Power meter, Spectrum analyzer, Network analyzer, Measurement of Impedance, Frequency, Power, VSWR, Q-factor, Dielectric constant, Scattering coefficients, Attenuation, S-parameters.

s.no	Name of the Experiment
1	Study of microwave components
2	Mode characteristics of reflex klystron
3	V-I Characteristics of GUNN Diode
4	Attenuation Measurement
5	Frequency and Wavelength measurement in Rectangular waveguide
6	VSWR Measurement
7	To Understand the purpose and operation principle of the directional coupler by using CT-B Module
8	Measurement of Multi hole Directional coupler Parameters
9	Scattering Parameters of Magic-Tee
10	To Measure An Unknown impedance using Smith Chart
11	Theory and Experimentation of Circulator Using Network Analyzer

Text Books

1. David M. Pozar, *Microwave Engineering*, 3rdedition, Wiley India publishers, New Delhi, 2012.

Reference Books

1. Robert E Collin, *Foundations for Microwave Engineering*, 2nd Edition, John Wiley & Sons Inc, Kundli, 2005.
2. Reinhold Ludwig and Gene Bogdanov, *RF Circuit Design: Theory and Applications,* 1stedition, Pearson Education, Delhi, 2011.

Course Outcomes

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

- Explain the active & passive microwave devices & components used in Microwave Communication Systems.
- Analyze the multi- port RF networks and RF transistor amplifiers.
- Generate microwave signals and design microwave amplifiers.
- Measure and analyze microwave signal and parameters.
- Develop the skill toanalyze and design the passive microwave components.

Course No:**EC324**	Course Title:**Digital Signal Processing**	L	P	U
		3	0	3

Course Learning Objectives

- To provide a framework for the filter design aspects of digital signal processing.
- To develop the design methodology of digital FIR & IIR filters.
- To learn thesampling rate conversions and its applications to multirate digital signal processing.

Course Content

UNIT- I

DTFT, Frequency response of discrete time systems, All pass inverse and minimum phase systems.

UNIT- II

DFT, Relationship of DFT to other transforms, FFT, DIT and DIF, FFT algorithm, Linear filtering using DFT and FFT.

UNIT- III

Frequency response of FIR filter types, Design of FIR filters, IIR filter design, Mapping formulas, Frequency transformations.

UNIT- IV

Direct form realization of FIR and IIR systems, Lattice structure for FIR and IIR systems, Finite-word length effects. Limit cycle oscillations.

UNIT- V

Sampling rate conversion by an integer and rational factor, Poly phase FIR structures for sampling rate conversion.

Sr.No	Name of the Experiment
1	Sine Wave Generation using MATLAB
2	Difference Equation using MATLAB
3	Linear Convolution using MATLAB
4	Circular Convolution using MATLAB
5	FIR Filter design (Low Pass/High Pass) Using Windowing Technique using MATLAB
6	IIR Filter design (LP/HP)
7	To Find FFT of the Given 1-D Signal And Plot
8	Power Spectral Density of sinusoidal signals
9	Program to generate Sum of Sinusoidal Signals
10	Impulse Response

Text Books

1. Li Tan, Jean Jiang, *Digital Signal Processing- Fundamentals and Applications*, 2nd edition, Elsevier, 2013.
2. J.G.Proakis, D.G. Manolakis, *Digital Signal Processing*, 4th edition, Pearson Education, New Delhi, 2007.

Reference Books

1. A.V.Oppenheim & R.W.Schafer, *Discrete Time Signal processing*, 2nd edition, Pearson Education, Delhi, 2003.
2. S.K.Mitra, *Digital Signal Processing*, 3rdedition, Tata McGraw Hill, New Delhi, 2006.

Course Outcomes

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

- Analyze discrete-time systems in both time & transform domain and also through pole-zero placement.
- Analyze discrete-time signals and systems using DFT and FFT.
- Design and implement digital finite impulse response (FIR) filters and digital infinite impulse response (IIR) filters.
- Understand and develop multirate digital signal processing systems.
- The software used for lab activity make them to get a job in research and simulation sector of any manufacturing industry.

Course No:EC325	Course Title:Title: Mobile Telecommunication Network	L	P	U
		2	2	3

Course Learning Objectives

- To understand the basics in the field of Mobile communication.
- To have thorough knowledge of the recent advances in the field of Mobile communication technology.

Course Content

UNIT I

To Introduce Wireless Communication Systems: History and evolution of wireless communication systems, 2G cellular networks, 2.5G, 3G systems, WLL,WLANS/ PANS, Introduction to 4G and 5G systems .

UNIT II

Cellular concept -frequency reuse- co channel interference-adjacent channel interference-power control for reducing interference-improving capacity in cellular systems-cell splitting-sectoring- hand off strategies-channel assignment strategies- Trunking and Erlang capacity calculations.

UNIT III

Mobile radio propagation- free space propagation model- ground reflection model- large scale path loss- small scale fading and multipath propagation-impulse response model of a multi-path channel- parameters of a mobile multipath channel- multi path delay spread-Doppler spread coherence bandwidth- coherence time- time dispersion and frequency selective fading frequency dispersion and time selective fading.

UNIT IV

Fundamental concepts of spread spectrum systems-performance of direct sequence spread spectrum systems- analysis of DSSS- processing gain and anti jamming margin-frequency hopped spread spectrum systems. Multi user detection in CDMA. RAKE receiver concepts, Diversity, combining methods - space time processing.

UNIT V

Standards of wireless communication systems- GSM, IMT -2000, UMTS, Wideband CDMA, WiFi, Wi-Max. GSM architectures, objectives, servicing frequency bands-GSM sub systems, Radio link features in GSM. Introduction to multi carrier communication: OFDM, MC CDMA.

Text Book

Rappaport T.S, *Wireless Communication Principles and practices*, 3rd edition, Pearson Education Asia, New Delhi, 2003.

Reference Books

1. Andrea Goldsmith, *Wireless Communications*, Cambridge University press, USA, 2005.
2. Vijay k Garg, Joseph E Wilkes, *Principles and Applications of GSM*, Pearson Education, Noida, India, 2009.
3. A.J Viterbi, *CDMA-Principles of Spread Spectrum*, Addison Wesley, Boston, USA, 1995.
4. KamiloFeher, *Wireless Digital Communication*, PHI, New Delhi, 1995.
5. A F Molisch, *Wireless communications*, Wiley India, 2008.

Course Outcomes

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

- Understand the basics of propagation of radio signals
- Understand how radio signals can be used to carry digital information in a spectrally efficient manner.
- Gain insights into how diversity afforded by radio propagation can be exploited to improve performance
- Understand the basic principles behind radio resource management techniques such as power control, channel allocation and handoffs.
- Understand communication between two mobile equipments using GSM and CDMA technology
- The project activity develops the skill in finding the appropriate modulation techniques for signal processing.

Course No:**EC402**	Course Title:**High Speed Communication Networks**	L	P	U
		3	0	3

Course Learning Objectives

In the last few years, the world of information networks has undergone significant changes that will revolutionize the future of communications. Data rates have reached the gigabit per second range. Optical fibers have become the transmission medium of choice. Standardization activities have very aggressively produced a set of well established standard for future LANs, MANs and WANs. It has become very difficult for computer and communications professionals to follow these rapidly evolving technologies and standards. This course cover all aspects of High Performance Networks: Technology and Protocols provides a timely technical overview of the start-of-the-art in high performance networking.

Unit 1

The TCP/IP protocol architecture, Internetworking, Packet switching networks, Frame relay networks, Asynchronous Transfer mode (ATM) protocol architecture, High speed LANs. Multistage networks.

Unit 2

Overview of probability and stochastic process, Queuing analysis, single server and multi-server queues, queues with priorities, networks of queues.

Unit 3

Self-similar Data traffic Congestion control in data networks and internets, Link level flow and error control, TCP traffic control, Traffic and congestion control in ATM networks.

Unit 4

Overview of Graph theory and least cost paths, Interior routing protocols, Exterior routing protocols and multicast. Quality of service in IP networks, Integrated and differentiated services.

Unit 5

Protocols for QOS support-Resource reservation protocol, Multiprotocol label switching, Real time transport protocol.

Text Book:

1. Harry Perros, High-Speed Communication Networks, Springer Science & Business Media, 06-Dec-2012

Reference books:

1. Ahmed N. Tantawy, High Performance Networks: Technology and Protocols, Springer Science & Business Media, 2012.
2. James P. G. Sterbenz, Joseph D. Touch, High-Speed Networking: A Systematic Approach to High- Bandwidth Low-Latency Communication, John Wiley & Sons, 2002

Course Outcomes

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

- recognize different levels of communication networks
- reproduce characteristics of high-speed network technologies
- apply channel models to determine transmission performances
- analyse signal transmission through communication channels
- develops the skill to create models of access networks and channels
- develops the skill to compute performances of multiple access to communication channels

Course No:**EC403**	Course Title:**Wireless Communications Networks**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To develop the communication network concepts, with emphasis on wireless technologies.

Course Content

UNIT- I

Multiple Access Techniques For Wireless Communication: Introduction, FDMA, TDMA, Spread Spectrum, Multiple access, SDMA, Packet radio, Packet radio protocols, CSMA protocols, Reservation protocols

UNIT- II

Introduction To Wireless Networking: Introduction, Difference between wireless and fixed telephone networks, Development of wireless networks, Traffic routing in wireless networks.

UNIT- III

Wireless Data Services: CDPD, ARDIS, RMD, Common channel signaling, ISDN, BISDN and ATM, SS7, SS7 user part, signaling traffic in SS7.

UNIT- IV

Mobile IP And Wireless Access Protocol : Mobile IP Operation of mobile IP, Co-located address, Registration, Tunneling, WAP Architecture, overview, WML scripts, WAP service, WAP session protocol, wireless transaction, Wireless datagram protocol.

UNIT- V

Wireless LAN Technology : Infrared LANs, Spread spectrum LANs, Narrow bank microwave LANs, IEEE 802 protocol Architecture, IEEE802 architecture and services, 802.11 medium access control, 802.11 physical layer.

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Text Books

1. Theodore, S. Rappaport, *Wireless Communications, Principles, Practice*, 2nd edition, PHI, New Delhi,2002.
2. William Stallings, *Wireless Communication and Networking*, PHI, New Delhi, 2003.

Reference Books

1. KamiloFeher, *Wireless Digital Communications*, 2nd edition, PHI, New Delhi, 1995.
2. KavehPah Laven and P. Krishna Murthy, *Principles of Wireless Networks*, Pearson Education, New Delhi, 2002.
3. Andreaws F. Molisch, *Wireless Communications*, Wiley India, 2006.
4. Dharma Prakash Agarwal and Qing-An Zeng, *Introduction to Wireless and Mobile Systems*, Thomson, Singapore, 2006.

Course Outcomes

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

- Understand the wireless communications and networks, and the associated technologies.
- Gain knowledge of networking and wireless networking.
- The project activity develops the skill in finding the appropriate modulation techniques for signal processing.

Course No:**EC404**	Course Title:**Optical Fiber Communication**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To develop the students in understanding the basics of signal propagation through optical fibers.
- To design components & devices required for the optical communication and to understand optical impairments

Course Contents

UNIT- I

Optical Fibers: Transmission Mechanisms, Structure, Wave Guiding. Step-index and graded index optical fibers. Modal analysis.Classification of modes.Single Mode Fibers.

UNIT- II

Pulse Dispersion: Material and waveguide dispersion, Absorption, scattering and bending losses. Dispersion Shifted Fibers

UNIT- III

Optical Power Launching and Coupling: Fiber to fiber joints.Splicing techniques. Optical fiber connectors.

UNIT- IV

Optical sources and detectors: Laser fundamentals. Semiconductor Laser basics. LEDs.PIN and Avalanche photodiodes, Optical Tx/Rx Circuits.

UNIT- V

Design considerations of fiber optic systems: Noise in detection process. Bit error rate. Optical receiver operation. Power Budget and Rise time Budget. WDM.

Text Books

1. G.Keiser, *Optical Fiber Communications*, 5th edition, McGraw Hill, New Delhi, 2013.
2. G.P.Agarwal, *Fiber Optic Communication Systems*, 3rdedition, Wiley, Lausanne, Switzerland, 2002.

Reference Books

1. M.M.K.Liu, *Principles and Applications of Optical Communications*, Tata McGraw Hill, New Delhi, 2010.
2. A.Ghatak & K.Thygarajan, *Introduction to Fiber Optics*, Cambridge, U.K, 1999.

Course Outcomes

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

- Identify and understand the structures of Optical fiber and types.
- Understand, analyze the channel impairments like losses and dispersion,various coupling losses
- Classify the Optical sources and detectors and to familiar with Design considerations of fiber optic systems
- Able to get a job in telecommunication sector.

Course No:**EC405**	Course Title:**Satellite Communications**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To introduce the principle of Satellite Communication and its practical applications
- To enable the students to understand various aspects in the design of sub-systems for satellite communication.
- To make the students to innovate the design of satellite based applications in day-to-day life.

Course Contents

UNIT- I

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, Geo stationary and non Geo-stationary orbits, Look Angle Determination, Limits of visibility,eclipse-Sub satellite point,Sun transit outage,Launching Procedures, launch vehicles and propulsion.

UNIT- II

Spacecraft Technology, Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget, E/N calculation, performance impairments, system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime.

UNIT- III

Earth Segment: Introduction, Receive, Only home TV systems, Outdoor unit, Indoor unit for analog (FM) TV, Master antenna TV system, Community antenna TV system, Transmit, Receive earth stations, Problems, Equivalent isotropic radiated power, Transmission losses , Free-space transmission, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses, Link power budget equation, System noise, Antenna noise, Amplifier noise temperature, Amplifiers in cascade, Noise factor ,Noise temperature of absorptive networks, Overall system noise temperature , Carrier to- Noise ratio, Uplink , Saturation flux density , Input back off, The earth station, HPA, Downlink , Output back off, Satellite TWTA output, Effects of rain, Uplink rain, Fade margin , Downlink rain, Fade margin, Combined uplink and downlink ,C/N ratio, Inter modulation noise.

UNIT- IV

Satellite Access: Modulation and Multiplexing: Voice, Data, Video, Analog, digital transmission system, Digital video Broad cast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression, encryption.

UNIT -V

Satellite Applications: INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, and Satellite Navigational System. Direct Broadcast satellites (DBS) - Direct to home Broadcast (DTH), Digital audio broadcast (DAB) -World space services, Business TV (BTV), GRAMSATand Internet.

Text Book

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, *Satellite Communications*, 2nd edition,Wiley India Pvt. Ltd., New Delhi. 2006.

Reference Book

1. Dennis Roddy, *Satellite Communication*, 4th edition, McGraw Hill India, Ghaziabad, 2006.

Course Outcomes

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

- Understand various modules and their working of a satellite Communication System at various orbits.
- Understand the modern communication applications of satellites and the various Multiple Access techniques.
- Develops the skill to formulate and solve engineering problems related to Satellite communication systems and satellite link design

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Course No:**EC406**	Course Title:**Mobile Communication**	L	P	U
		3	0	3

Course Learning Objectives

- To understand the basics in the field of Mobile communication.
- To have thorough knowledge of the recent advances in the field of Mobile communication technology.

Course Content

UNIT I

To Introduce Wireless Communication Systems: History and evolution of wireless communication systems, 2G cellular networks, 2.5G, 3G systems, WLL,WLANS/ PANS, Introduction to 4G and 5G systems .

UNIT II

Cellular concept -frequency reuse- co channel interference-adjacent channel interference-power control for reducing interference-improving capacity in cellular systems-cell splitting-sectoring- hand off strategies-channel assignment strategies- Trunking and Erlang capacity calculations.

UNIT III

Mobile radio propagation- free space propagation model- ground reflection model- large scale path loss- small scale fading and multipath propagation-impulse response model of a multi-path channel- parameters of a mobile multipath channel- multi path delay spread-Doppler spread coherence bandwidth- coherence time- time dispersion and frequency selective fading frequency dispersion and time selective fading.

UNIT IV

Fundamental concepts of spread spectrum systems-performance of direct sequence spread spectrum systems- analysis of DSSS- processing gain and anti jamming margin-frequency hopped spread spectrum systems. Multi user detection in CDMA. RAKE receiver concepts, Diversity, combining methods - space time processing.

UNIT V

Standards of wireless communication systems- GSM, IMT -2000, UMTS, Wideband CDMA, WiFi, Wi-Max. GSM architectures, objectives, servicing frequency bands-GSM, sub systems, Radio link features in GSM. Introduction to multi carrier communication: OFDM, MC CDMA.

Text Book

Rappaport T.S, *Wireless Communication Principles and practices*, 3rd edition, Pearson Education Asia, New Delhi, 2003.

Reference Books

1. Andrea Goldsmith, *Wireless Communications*,Cambridge University press, USA, 2005.
2. Vijay k Garg, Joseph E Wilkes, *Principles and Applications of GSM*, Pearson Education, Noida, India, 2009.
3. A.J Viterbi, *CDMA-Principles of Spread Spectrum*, Addison Wesley, Boston, USA, 1995.
4. KamiloFeher, *Wireless Digital Communication*, PHI, New Delhi, 1995.
5. A F Molisch, *Wireless communications*, Wiley India, 2008.

Course Outcomes

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

- Understand the basics of propagation of radio signals
- Understand how radio signals can be used to carry digital information in a spectrally efficient manner.
- Understand the basic principles behind radio resource management techniques such as power control, channel allocation and handoffs.
- Understand communication between two mobile equipments using GSM and CDMA technology
- Develops the skill to gain insights into how diversity afforded by radio propagation can be exploited to improve performance

Course No:**EC407**	Course Title:**Antennas and Wave Propagation**	L	P	U
		3	0	3

Course Learning Objectives

- To understand the basic mechanism of radiation by antenna elements.
- To understand the various practical antennas and analyze their performance parameters
- To analyze, design an antenna for wireless communications.

Course Content

UNIT- I

Antennas Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area (or Beam Solid Angle), Radiation Intensity, Beam Efficiency, Directivity D and Gain G, Directivity and Resolution, Antenna Apertures, Effective Height, The radio Communication link, Fields from Oscillating Dipole, Single-to-Noise Ratio(SNR), Antenna Temperature, Antenna Impedance.

UNIT- II

Point Sources and Their Arrays: Introduction, Point Source ,Power Theorem and its Application to an Isotropic Source, Radiation Intensity, Arrays of Two Isotropic Point Sources, Non-isotropic but Similar Point Sources and the Principle of Pattern Multiplication, Pattern Synthesis by Pattern Multiplication, Linear Arrays of n Isotropic Point Sources of Equal Amplitude and Spacing, Linear Broadside Arrays with Non-uniform Amplitude Distributions. General Considerations.

UNIT- III

Electric Dipoles, Thin Liner Antennas and Arrays of Dipoles and Apertures: The Short Electric Dipole, The Fields of a Short Dipole, Radiation Resistance of Short Electric Dipole, Thin Linear Antenna, Radiation Resistance of $\lambda/2$ Antenna, Array of Two Driven $\lambda/2$Elements: Broadside Case and End-Fire Case, Horizontal Antennas Above a Plane Ground, Vertical Antennas Above a Plane Ground, Yagi-Uda Antenna Design, Long-Wire Antennas, folded Dipole Antennas.

UNIT- IV

The Loop Antenna: Design and its Characteristic Properties, Application of Loop Antennas, Far Field Patterns of Circular Loop Antennas with Uniform Current, Slot Antennas, Horn Antennas, Helical Antennas, The Log-Periodic Antenna, Micro strip Antennas. Reflector **Antennas:** Flat Sheet Reflectors, Corner Reflectors, The Parabola-General Properties, A Comparison Between Parabolic and Corner Reflectors, The Paraboloidal Reflector, Patterns of Large Circular Apertures with Uniform Illumination, Reflector Types (summarized), Feed Methods for Parabolic Reflectors.

UNIT- V

Ground Wave Propagation: Plane Earth Reflection, Space Wave and Surface Wave. Space Wave Propagation: Introduction, Field Strength Relation, Effects of Imperfect Earth, Effects of Curvature of Earth.Sky wave Propagation: Introduction structural Details of the ionosphere, Wave Propagation Mechanism, Refraction and Reflection of Sky Waves by ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation Between MUF and the Skip Distance, Multi-Hop Propagation, Wave Characteristics.

Text Book

1. John D. Kraus and Ronald J. Marhefka, *Antennas for all applications*, 3rd edition, Tata McGraw-Hill New Delhi, 2002.

Reference Books

1. Constantine Balanis, *Antenna Theory: Analysis and design*, 3rdedition, Wiley India, Delhi, 2008.
2. Jordan & Balmain,*Electromagnetic wave & radiating systems*, 2ndedition, Pearson Publication, Delhi, 2008.

Course Outcomes

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

- Select the appropriate portion of electromagnetic theory and its application to antennas.
- Assess the need for antenna arrays and mathematically analyze the types of antenna arrays.
- Distinguish primary antennas from secondary antennas and analyze their characteristics by applying optics and acoustics principles.
- Outline the factors involved in the propagation of radio waves using practical antennas.
- Developes the skill to distinguish the receiving antennas from transmitting antennas, analyze and justify their characteristics

Course No:**EC408**	Course Title:**Radar Systems**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To introduce the fundamental concepts of RADAR and the method of detection by EM wave reflection.
- To study different types of RADAR systems, their modules and their operation and the areas of applications.
- To innovate in the analysis and design of RADAR based detection methods in applicative areas of weather-forecasting, ground resources estimation.

Course Content

UNIT-I

Introduction Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Related Problems. Radar Equation : Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment). Related Problems.

UNIT- II

CW and Frequency Modulated Radar : Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Measurement Errors, Multiple Frequency CW Radar.

UNIT- III

MTI and Pulse Doppler RADAR: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, And Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler radar.

UNIT- IV

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse. Target Reflection Characteristics and Angular Accuracy. Tracking in Range, Acquisition and Scanning Patterns. Comparison of Trackers.

UNIT- V

Detection of Radar Signals in Noise : Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise. UNIT VIII Radar Receivers – Noise Figure and Noise Temperature. Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers.

Text Books

1. Merrill Skolnik, *Introduction to Radar Systems*, 3rd edition, Mc Graw Hill India, Ghaziabad, 2002.

Reference Books

1. Byron D. Edde, *Radar: Principles, Technology*, Application's, 1st edition Pearson Education, Noida, 2001.

Course Outcomes

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

- Understand the principles of Radar system and its working
- Analyze the Radar signal Detection techniques
- Learn the essentials of operation of radar systems, the principles of Radar detection in the presence of noise and clutter
- Develops the skill to analyze the techniques of detection of Moving Target Indication by Doppler radar
- The study of working of the tracking Radar makes the student fit to get a job in missile manufacturing and research sector.

Course No:**EC409**	Course Title:**RF and Microwave MEMs**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives:

- To inculcate understanding of the basics required for understanding of microwave circuit and its practical applications.
- To enable the students in analyzing the microwave circuits.
- To make the students to design and implement the microwave systems.

Unit 1

Review of Transmission line Theory, terminated transmission lines, smith chart, impedance matching, Micro strip and coplanar waveguide implementations.

Unit 2

Microwave network analysis, ABCD parameters, S parameters, Networks.

Unit 3

Basics of high frequency amplifier design, device technologies, biasing techniques, simultaneous tuning of 2 port circuits, noise and distortion.

Unit 4

Feedback systems, phase locked loops, LNA design, impedance match noise performance, linearity, noise and large signal performance, Power amplifier design, various classes of power.

Unit 5

MEMS technologies and components for RF applications.

Text Books

1. David M. Pozar, *Microwave Engineering*, 3rdedition, Wiley India publishers, New Delhi, 2012.
2. Gabriel M. Rebeiz RF MEMS: Theory, Design, and Technology, John Wiley & Sons, 2004

Reference Books

1. Robert E Collin, *Foundations for Microwave Engineering*, 2nd Edition, John Wiley & Sons Inc, Kundli, 2005.
2. Reinhold Ludwig and Gene Bogdanov, *RF Circuit Design: Theory and Applications,* 1stedition,Pearson Education, Delhi, 2011.

Course Outcomes

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

- To understand the microwave system design and their performance tuning
- To understand the operation of major classes of MEMS devices/systems
- To give the fundamentals of standard micro fabrication techniques and processes
- To understand the unique demands, environments and applications of MEMS devices
- Develops the skills to work with MEMS devices.

Course No:**EC410**	Course Title:**Smart Antennas for Mobile Communication**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

Smart antennas boost the power of a wireless network, saving energy and money and greatly increasing the range of wireless broadband.This course reflects the latest developments in CDMA and smart antennas, including the IS-95 and J-STD-008 CDMA standards, 14.4K vocoders, and techniques for designing RF location systems that meet the FCC's stringent E-911 requirements.

Unit 1

Applications of Antenna Arrays to Mobile Communications.

Unit 2

Introduction to Smart Antennas, Spatial Processing for Wireless Systems, Key Benefits of Smart Antennas, Smart antenna introduction.

Unit 3

Smart antenna configuration, SDMA, architecture of smart antenna systems.

Unit 4

Smart Antennas Techniques for CDMA.

Unit 5

CDMA System Range and Capacity Improvement Using Spatial Filtering

Text Book:

1. Joseph C. Liberti, Theodore S. Rappaport, Smart Antennas for Wireless Communications: IS-95 and Third Generation CDMA Applications, Prentice Hall PTR, 1999.

Reference books:

1. Frank Gross, Smart Antennas for Wireless Communications: With MATLAB, McGraw Hill Professional, 2005,
2. Constantine A. Balanis, Panayiotis I. Ioannides, Introduction to Smart Antennas, Morgan & Claypool Publishers, 2007.

Course Outcomes

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

- Study the CDMA spatial processors to analyze the multi-cell systems.
- Analyze the channel models for smart antenna systems.
- Study the environmental parameters for signal processing of smart antenna systems.
- Evaluate the requirements for the design and implementation of smart antenna systems based on these student able to become an entrepreneur.

Course No:**EC411**	Course Title:**Low Power VLSI Design**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

Unit 1

Physics of Power Dissipation in CMOS FET Devices, Power Estimation.

Unit 2

Modeling in signals, Signal Probability calculation, Probabilistic Techniques for signal activity estimation.

Unit 3

Statistical Techniques, Estimation of Glitching power, Sensitivity Analysis.

Unit 4

Power estimation using the input vector compaction, power dissipation in domino CMOS, high level power estimation, Information theory based approaches, Estimation of maximum power.

Unit 5

Synthesis for Low Power, Low Power Static RAM Architectures, Low Energy Computing using Energy Recovery Techniques.

Text Book:

1. Low Power VLSI Design: Fundamentals, Angsuman Sarkar, Swapnadip De, Manash Chanda, Chandan Kumar Sarkar Walter de Gruyter GmbH & Co KG, Technology & Engineering. 2016.

Reference books:

1. Kaushik Roy, Sharat C. Prasad, Low-Power Cmos Vlsi Circuit Design, John Wiley & Sons, 2009.

2. Abdellatif Bellaouar, Mohamed Elmasry, Low-Power Digital VLSI Design: Circuits and Systems, Springer Science & Business Media, 2012.

Course Outcomes

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

- To recall and identify the VLSI power estimation, design of CMOS logic circuits, switches and memory
- Probabilistic Techniques for signal activity estimation and Statistical Techniques
- To apply Low power VLSI techniques for meeting current and future VLSI challenges faced by the organization
- To generalize the design techniques and analyze the characteristics of VLSI power dissipation
- Synthesis for Low Power, Low Power Static RAM Architectures

Course No:**EC412**	Course Title:**Digital Design Using HDLS**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

To design the digital circuits, behavior and RTL modeling of digital circuits using Verilog HDL, verifying the models and synthesizing RTL models to standard cell libraries and FPGAs, students will have practical experience by designing, modeling, implementing and verifying several digital circuits, the different technologies related to HDLs, construct, compile and execute Verilog HDL programs, the digital components and circuits that are testable, reusable, and synthesizable.

Unit 1

Introduction to Verilog HDL: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Function Verification, System Tasks, Programming Language Interface, Module, Simulation and Synthesis Tools. Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators.

Unit 2

Gate Level Modeling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances of Primitives, Design of Flip-Flops with Gate Primitives, Delay, Strengths and Construction Resolution, Net Types, Design of Basic Circuit. Modeling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignment to Vector, Operators.

Unit 3

Behavioral Modeling: Introduction, Operations and Assignments, Functional Bifurcation, 'Initial' Construct, Assignments with Delays, 'Wait 'Construct, Multiple Always Block, designs at Behavioral Level, Blocking and Non-Blocking Assignments, The 'Case' Statement, Simulation Flow, 'If' an 'if-Else' Constructs, 'Assign- De-Assign' Constructs, 'Repeat' Construct, for loop, 'The Disable' Construct, 'While Loop', Forever Loop, Parallel Blocks, Force-Release, Construct, Event.

Unit 4

Switch Level Modeling: Basic Transistor Switches, CMOS Switches, Bidirectional Gates, Time Delays with Switch Primitives, Instantiation with 'Strengths' and 'Delays' Strength Contention with Tri reg Nets. System Tasks, Functions and Compiler Directives: Parameters, Path Delays, Module Parameters. System Tasks and Functions, File Based Tasks and Functions, Computer Directives, Hierarchical Access, User Defined Primitives.

Unit 5

Sequential Circuit Description: Sequential Models - Feedback Model, Capacitive Model, Implicit Model, Basic Memory Components, Functional Register, Static Machine Coding, Sequential Synthesis. Components Test and Verification: Test Bench - Combinational Circuits Testing, Sequential Circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification.

Text Book:

1. T.R. Padmanabhan, B Bala Tripura Sundari, Design through Verilog HDL, Wiley, USA, 2009.
2. Zainalabdien Navabi, Verilog Digital System Design, 2nd edition, TMH, USA, 2007.

Reference books:

1. 1. Stephen Brown, Zvonkoc Vranesic, Fundamentals of Digital Logic with Verilog Design, 2nd edition, TMH, North America, 2010.
2. Sunggu Lee, Advanced Digital Logic Design using Verilog, State Machines & Synthesis for FPGA, Cengage Learning, Boston,USA,2012.
3. Samir Palnitkar, Verilog HDL, 2nd edition, Pearson Education, New Delhi, 2009.
4. Michel D. Ciletti, Advanced Digital Design with Verilog HDL, PHI,New Delhi, 2009

Course Outcomes

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

- Develop the skills to describe implementable code for digital circuits using Verilog hardware description languages (HDL) using all its constructs, Know the difference between synthesizable and non-synthesizable code. Understand many digital circuits practically.
- Develop the skills of designing any application digital systems such as advanced counters, state machine based systems.
- Attain the ability of analyzing the digital system in terms of various styles of Verilog HDL based digital design and understand the difference of pros and cons of each style.
- Able to synthesize and implement any sequential and combinational digital system.
- The softwarebased teaching make the student fir to gat a job in designing and simulation era.

Course No:**EC413**	Course Title:**CMOS Analog Integrated Circuit Design**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

To develop and design of integrated circuits in the CMOS technology.

Unit 1

The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

Unit 2

Analog CMOS Sub-Circuits: MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

Unit 3

CMOS Amplifiers: Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

Unit 4

CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, PowerSupply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

Unit 5

Comparators: Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

Text Book:

1. Philip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design , International 2nd edition, Oxford University Press, Newyork, 2010 .
2. Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th edition, Wiley India,New Delhi, 2010.

Reference books:

1. David A. Johns, Ken Martin, Analog Integrated Circuit Design, Wiley Student Edn, New Delhi, 2013.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, TMH Edition, New Delhi, 2007.
3. Baker, Li and Boyce, CMOS: *Circuit* Design, Layout and Simulation, PHI, New Delhi, 2008.

Course Outcomes

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

- To recall and identify the CMOS VLSI, design of CMOS logic circuits, switches and memory
- To design CMOS logic circuits, CMOS Amplifiers
- To apply CMOS Operational Amplifiers for meeting current and future VLSI challenges faced by the organization.
- To generalize the design techniques and analyze the characteristics of CMOS VLSI circuits
- The advanced tools like Cadence to realize the layout and make the student suitable to get ajob in VLSI based companies.

Course No:**EC414**	Course Title:**VLSI Design for Testability**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

This course is a comprehensive introduction and reference for all aspects of IC testing. It includes all of the basic concepts and theories necessary for students, from practical test strategies and industrial practice, to the economic and managerial aspects of testing. In addition to detailed coverage of digital network testing, VLSI testing also considers in depth the growing area of testing analogue and mixed analogue/digital ICs, used particularly in signal processing.

Unit 1

Fundamentals of Test and Design for Testability (DFT), Fault Modeling, Testing For Single Stuck Faults (SSF), Testability Trade-Offs, Techniques.

Unit 2

Scan Architectures and Testing, Controllability and Absorbability, Generic Boundary Scan, Full Integrated Scan, Storage Cells for Scan Design.

Unit 3

Board Level and System Level DFT Approaches, Boundary Scans Standards.

Unit 4

Compression Techniques, Syndrome Test and Signature Analysis, Built-In Self-Test (BIST), Memory BIST (MBIST).

Unit 5

Introduction to Automatic in Circuit Testing (ICT), JTAG Testing Features.

Text Book:

1. Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, VLSI Test Principles and Architectures: Design for Testability, Elsevier, 2006.

Reference books:

1. Laung-Terng Wang, Charles E. Stroud, Nur A. Touba, System-on-Chip Test Architectures: Nanometer Design for Testability, Morgan Kaufmann, 2010.
2. Stanley Leonard Hurst, VLSI Testing: Digital and Mixed Analogue/digital Techniques, IET, 1998

Course Outcomes

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

- To recall and identify the VLSI faults, Test generation for VLSI circuits
- To obtain sequential ATPG methods
- To apply fault tolerance techniques for VLSI faults faced by the organization
- To compare the different fault tolerance techniques in VLSI
- To generalize the faulty tolerance techniques and analyze the faults
- Synthesis for Fault models for diagnosis.

Course No:**EC415**	Course Title:**Digital Systems**	L	P	U
		3	0	3

Course Learning Objectives

The objective of the course is to develop the ability to analyze and design digital systems. It aims at through understanding of combinational and sequential digital circuits design with timing constraints.

Unit 1

Introduction to S/W & H.W aspects of digital design. Introduction to PLD, ASIC and digital design levels. Logic signals and gates, Logic Families, RTL, I2L, DTL, TTL

Unit 2

CMOS logic levels, MOS transistors. CMOS inverter, NAND, NOR and Non-inverting gates, AND-ORTNVERT & OR-AND-INVERT gates and Fan-in, CMOS steady state electrical behavior. CMOS dynamic electrical behavior

Unit 3

Combinational logic circuits design. Switching logic theorems, Duality, Logic functions. Combinational logic analysis and synthesis. Timing hazards. Timing diagrams, propagation delay. Timing specifications and analysis

Unit 4

Sequential logic circuits design. Bi-stable elements, Latches and flip-flops. Clocked synchronous state machine analysis (state machine structure and output logic). Clocked synchronous state machine design. (Characteristic equations and analysis of state machines with D Flip-flops), Timing diagrams and specifications of sequential circuits.

Unit 5

Design aspects of sequential circuits. Switch debouncing, simple switch debouncer circuit. Impediments of synchronous design. Synchronizer failure and meta-stability. CPLD design and applications, FPGA design and applications

Text Book:

1. Digital Design Principles & Practices, John F Wakerly, Pearson education, Third edition, 2001

Reference books:

1. Modern Digital Electronics, RP Jain, TMH, Third edition, 2001.
2. Computer logic design, M.Morris Mano, Prentice-hall 1972.

Course Outcomes

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

- Develops the skill to describe how analog signals are used to represent digital values in different logic families, including characterization of the noise margins. Evaluate combinational and sequential logic designs using various technology families and various performance metrics.
- Attain the skill to analyze any complex combinational and sequential circuits
- With various technology families of CPLD and FPGA families introduced can synthesize various advanced circuits

Course No:**EC416**	Course Title:**Embedded System (H/W)**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To develop the concepts of the modern embedded system concepts, embedded 16-bit and 32- bit processors

Course Content

UNIT-I

Introduction to Embedded systems, Processors embedded into a system, embedded hardware units and Devices in a system, embedded software in a system, Embedded System on chip, Classification of embedded systems, skills required for embedded designers, Examples of embedded systems. Real Time system – Hard RTS, Soft RTS, Introduction to sensors and Actuators.

UNIT-II

Mixed Signal Microcontroller: MSP430 series. Block diagram. Address space. On-chip peripherals -analog and digital. Register sets. Addressing Modes. Instruction set. Programming. FRAM vs flashfor low power and reliability.

UNIT-III

MSP430 InterfacingSerial data transfer - UART, SPI, and I2C. Interrupts. I/O ports and port expansion. ADC, PWM, DC motor, Stepper motor andLCD interfacing.

UNIT-IV

ARM 7 Block diagram. Address space. On - chip peripherals - analog and digital. Register sets. Addressing Modes. Instruction set. Programming

UNIT-V

ARM 7 Interfacing Serial data transfer - UART, SPI, and I2C. Interrupts. I/O ports and port expansion. ADC, PWM, DC motor, Stepper motor and LCD interfacing

Text Books

1. John H. Davies, "*MSP430 Microcontroller Basics*", 1st edition, Elsevier Ltd, Burlington USA, 2008.
2. Warwick A. Smith, "*ARM Microcontroller Interfacing: Hardware and Software*", 1st edition, Elektor Netherland, 2010.

Reference Books

1. Adrian Fernandez, Dung Dang, "*Getting Started with the MSP430 Launch pad*", 1st edition, Elsevier Ltd., USA, 2013
2. Steve Furbur, "*ARM System-On-Chip Architecture*", 2nd edition, Pearson education, New Delhi, 2009.
3. Raj Kamal, "*Embedded Systems: Architecture, Programming and Design*", 2nd edition, TMH Publisher Company limited, New Delhi, 2008.

Course Outcomes

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

- Distinguish and analyze the properties of 16bit and 32bit embedded processors.
- Analyze the data transfer information through serial & parallel ports.
- The project oriented syllabus make the student fit to become entrepreneur.

Course No:**EC417**	Course Title:**Hardware Software Co-Design**	L	P	U
		3	0	3

Course Learning Objectives

This course gives an introduction to the subject of embedded systems design, with emphasis on integration of custom hardware components with software. The key problem addressed is how can an embedded systems designer strike a balance between flexibility and efficiency? The course describes how combining hardware design with software design leads to a solution to this important computer engineering problem.

Unit 1: Hardware Software Co- Design Issues.

Unit 2: Synthesis Algorithms, Prototyping and Emulation, Target Architectures.

Unit 3: Compilation Techniques and Tools for Embedded Processor architectures.

Unit 4: Design Specification and Verification.

Unit 5: Languages for System - Level Specification and Design.

Text Book:

1. Jørgen Staunstrup, Wayne Wolf, Hardware/Software Co-Design: Principles and Practice, Springer Science & Business Media, 2013.

Reference books:

1. Patrick R. Schaumont, A Practical Introduction to Hardware/Software Codesign, Springer Science & Business Media, 2012.
2. Giovanni DeMicheli, M.G. Sami, Hardware/Software Co-Design, Springer Science & Business Media, 2013.

Course Outcomes

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

- To recall and identify the Hardware Software Co- Design Issues.
- To design Prototyping and Emulation
- To apply the Compilation Techniques for Embedded Processor Architectures.
- To compare the Compilation Tools for Embedded Processor Architectures
- To generalize the design techniques and analyze the characteristics of Co- Design Issues
- Use Languages for System Level Specification & Design

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Course No:**EC418**	Course Title:**Embedded Real Time Operating System**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

This course covers the basic concepts and principles of operating systems, showing how to apply them to the design and implementation of complete operating systems for embedded and real-time systems. It includes all the foundational and background information on ARM architecture, ARM instructions and programming. It describes the design and implementation of a complete OS for embedded systems in incremental steps, explaining the design principles and implementation techniques. For Symmetric Multiprocessing (SMP) embedded systems.

Unit 1

Introduction to Operating Systems. Various Approaches to Design of Operating Systems.

Unit 2

Overview of Hardware Support for Operating Systems. Introduction to UNIX, Typical Real Time Application, Hard Vs Soft Real Time Systems, a Reference Model of Real Time Systems: Processors and Resources.

Unit 3

Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency Functional Parameters, Resource Parameters of Jobs and Parameters of Resources.

Unit 4

Approaches to Real Time Scheduling, Operating Systems, Fault Tolerance Techniques.

Unit 5

Case Studies-VX Works, RT Linux.

Text Book:

1. K.C. Wang, Embedded and Real-Time Operating Systems, Springer, 2017.

Reference books:

1. Qing Li, Caroline Yao, Real-Time Concepts for Embedded Systems, CRC Press, 2003.

2. Janez Puhan, Operating Systems, Embedded Systems, and Real-Time Systems, FE Publishing, 2015

Course Outcomes

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

- Get complete knowledge on concepts of RTOS
- Analyze kernel objects such as memory management, process management of RTOS
- Get practice and implement in ARM programming tools
- Design and simulate ARM based interfaces and drivers
- Get familiar in ARM tool chain under Ubuntu (15.10) Linux and emulated ARM virtual machines under QEMU

Course No:**EC419**	Course Title:**DSP Processors and Architecture**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

The book is designed for a first course in Digital Signal Processors. It blends the Digital Signal Processing theory with its applications on systems using Digital Signal Processors.

Unit 1

Review of Digital signal processing, Architectures for Programmable DSP Devices, basic architectural features.

Unit 2

DSP computational building blocks. Bus architecture and memory, data addressing capabilities, address generation unit, programmability and program execution, speed issues, features for external interfacing.

Unit 3

Programmable Digital Signal Processors, Commercial Digital Signal Processing Devices, implementation of Basic DSP Algorithms.

Unit 4

Interfacing Memory and Parallel IO Peripherals to Programmable DSP Devices.

Unit 5

Interfacing Serial Converters to a Programmable DSP Device.

Text Book:

1. B. Venkataramani, M. Bhaskar, Digital Signal Processors: Architecture, Programming and Applications, Tata McGraw-Hill Education, 2002.

Reference books:

1. Kuo, Digital Signal Processors: Architectures, Implementations, and Applications, Pearson Education India, 2005.
2. Sen-Maw Kuo, Woon-Seng Gan, Digital Signal Processors: Architectures, Implementations, and Applications, Pearson Prentice Hall, 2005.

Course Outcomes

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

- Understands the concepts of digital signal processing techniques.
- Acquire knowledge of DSP computational building blocks and knows how to Achieve speed in DSP architecture or processor.
- Develop basic DSP algorithms using DSP processors.
- Acquire knowledge about various addressing modes of DSP TMS320C54XX and are able to program DSP processor.

Course No:**EC421**	Course Title:**Microcontroller and Applications**	L	P	U
		3	0	3

Course Learning Objectives

This course is designed to introduce the students of diverse branches to Microcontrollers and provide sufficient information and tools to develop and debug microcontroller based applications. In addition to establishing a foundation of assembly language programming, a comprehensive treatment of Microcontroller interfacing will also be provided. With this background the students should be able to explore the design and interfacing of Microcontroller-based embedded systems, after finishing this course.

Unit 1

Microcontrollers and Embedded processors, overview of 8051 family, 8051 microcontroller hardware, oscillator and clock, CPU registers, Register banks and stack, flags, PSW, SFR's, I/O ports, internal memory, 8051 pin description. 8051 programming model, Assembly Language programming, Data types, directives.

Unit 2

Addressing modes of 8051, memory access using various addressing modes, Bit addresses for I/O and RAM, I/O port programming, Arithmetic instructions, signed number concepts and arithmetic operations. Jump. Loop and Call Instructions, Time delay calculations. Logic and compare instructions, rotate and swap instructions, data serialization, single bit instructions, operations with carry, reading input pins

Unit 3

Data types and time delay in 8051 C, I/O programming, logic operations, Data conversion, Accessing code and data serialization using 8051 C. Programming 8051 timers (Mode 1 & Mode 2) in assembly and C language. Counter programming in assembly and C language. Basics of Serial communication, 8051 connection to RS232, programming 8051 for serial port for transmission, Programming 8051 serial port for reception, Serial Port programming in C, Introduction to I2C, CAN. 8051 Interrupts, programming timer interrupts, external hardware interrupts, serial communication interrupts, interrupt priority in 8051, Interrupt programming in C

Unit 4

LCD Interfacing, Sending code or data with checking busy flag, keyboard Interfacing. Interfacing & programming parallel ADC 0808/0809 & serial ADC MAX1112, DAC and sensor to 8051. Semiconductor memory, types of memory, memory address decoding, interfacing with external ROM, data memory space, accessing external memory in C. Interfacing 8255, programming 8255, modes of 8255, 8255 connection to stepper motor, LCD,& ADC, 8051 C programming for 8255.

Unit 5

DS12887 RTC interfacing, RTC programming in C only, Alarm, SQW and IRQ features of DS12887. Relays and Optoisolators, Stepper motor interfacing, DC motor interfacing and PWM using Assembly language and C. PIC Microcontrollers: Overview and features, PIC 16C6X/7X FSR, Addressing modes, memory organization, I/O ports, interrupts, Timers.

Sr.No Name of the Experiment

1. Study and familiarization of 8051 Microcontroller trainer kit
2. Assembly Language Program for addition of 8-bit numbers stored in an array
3. Assembly Language Program for Multiplication by successive addition of two 8-bit numbers
4. Assembly Language Program for finding largest no. from a given array of 8-bit numbers
5. Assembly Language program to arrange 8-bit numbers stored in an array in ascending order
6. Stepper motor control by 8051 Microcontroller
7. Interfacing of 8-bit ADC 0809 with 8051 Microcontroller
8. Interfacing of 8-bit DAC 0800 with 8051 Microcontroller and Waveform generation using DAC
9. Implementation of Serial Communication by using 8051 serial ports
10. Assembly Language Program for use of Timer/Counter for various applications
11. Traffic light controller/Real-time clock display
12. Simple test program using ARM 9 mini 2440 kit (Interfacing LED with ARM 9 mini 2440 kit)

Text Book:

1. Mazidi, Mazidi & Rolin. D. McKinlay,"The 8051 Microcontroller and Embedded Systems; using Assembly and C", Second Edition, Pearson Education, Asia, 2006.

Reference books:

1. Ayala K. J.,"The 8051 Microcontroller Architecture, Programming & Applications", Penram International Publishing Pvt.Ltd, 1997.
2. Kenneth Hintz & Daniel Tabak, ''Microcontrollers: Architecture, Implementation & Programming, Tata McGraw- Hill Edition, 2005.
3. 8 - bit Embedded Controller Handbook, - Intel.
4. Myke Predko,"Programming and Customizing the 8051 Microcontroller", Tata Mc-Graw Hill, 1999.
5. Ajay Deshmukh, ''Microcontrollers: Theory and Applications", Tata McGraw Hill, 2005.
6. A K Ray & K M Bhurchandi, ''Advanced Microprocessors and Peripherals; Architecture, Programming and Interfacing", Tata Mc Graw Hill, 2000.

Course Outcomes

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

- Identify and evaluate the properties of Microprocessors & Microcontrollers.
- Analyze data transfer through serial & parallel ports.
- Use their practical knowledge through laboratory experiments.
- Design, simulate and analyze a Microcontroller-based application
- Lab activity and project make the student suitable to become an entrepreneur.

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Course No:**EC422**	Course Title:**Image Processing**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To understand the basic concepts, methodologies and algorithms of digital image processing
- To apply the principles of image processing to various fields such as computer vision systems, biomedical image analysis, Character recognition, and multimedia processing & retrieval

Course Content

UNIT- I

Linearity and space invariance, PSF, Discrete images and image transforms, 2-D sampling and reconstruction, Image quantization, 2-D transforms and properties. Fundamental steps in Digital Image Processing, Relationship between pixels

UNIT –II

Image enhancement-Histogram modeling, equalization and modification. Image smoothing, Image sharpening. Spatial filtering, Replication and zooming, Generalized cepstrum and homomorphic filtering.

UNIT- III

Image restoration-image observation models.Inverse and Wiener filtering. Filtering using image transforms. Constrained least-squares restoration. Generalized inverse, SVD and interactive methods. Recursive filtering.Maximum entropy restoration. Bayesian methods.

UNIT- IV

Image compression-sub sampling, coarse quantization and frame repetition. Pixel coding - PCM, entropy coding, run length coding Bit-plane coding. Predictive coding.Transform coding of images. Hybrid coding and vector DPCM. Interframe hybrid coding.

UNIT -V

Image analysis-applications, Spatial and transform features. Edge detection, boundary extraction, AR models and region representation. Moments as features. Image structure. Morphological operations and transforms.Texture, Scene matching and detection. Segmentation and classification.

Expt. No	Name of the experiment
1	Read and display of images
2	Arithmetic & Logical operation
3	Image manipulation
4	Geometric transformations
5	Histogram equalization
6	Intensity transformation functions
7	Gray level slicing ,Bit level slicing
8	Segmentation of an image
9	Spatial Filtering techniques
10	Laplacian Derivative
11	Image Morphology
12	Digital Water Marking
13	Edge detection using operators

Text Books

1. Rafael C. Gonzalez & Richard E Woods, *Digital Image Processing*, 3rd edition, Pearson, New Delhi, 2009.

Reference Books

1. S Sridhar, *Digital Image Processing*, 1st edition, Oxford University Press, New Delhi, 2011.
2. A.K. Jain, *Fundamentals of Digital Image Processing*, 1st edition, PHI, New Delhi, 1988.

Course Outcomes

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

- Analyze image transforms, types and their properties
- Explore the causes for image degradation and understand the restoration methods
- Evaluate the image compression techniques in spatial and frequency domain.
- Understand feature extraction techniques for image analysis and recognition.
- The lab activity and project make the student suitable to get job in research sector.

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Course No:**EC423**	Course Title:**Sensors and Actuators**	L	P	U
		3	0	3

Course Learning Objectives

It deals with various types of Sensors & Transducers and their working principle, Resistive, Capacitive and Inductive transducers, some of the miscellaneous transducers and characteristics of transducers

Unit 1

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data. Standards and Calibration.

Unit 2

Variable resistance transducers: Potentiometers, metal and semiconductor strain gauges and their signal conditioning circuits, strain gauge applications: Load and torque measurement.

Unit 3

Inductive transducers- Transformer type, synchros, eddy current transducers, proximity detectors. Capacitive transducers, tacho generators and stroboscope.

Unit 4

Piezoelectric transducers and their signal conditioning, photoelectric transducers, Hall Effect sensors, Magnetostrictive transducers, Basics of Gyroscope, Seismic instrument and accelerometers.

Unit 5

Digital displacement sensors, Fiber optic sensor, Semiconductor sensor and Smart sensors.

Text Book:

1. Bentley, J.P. (2000) Principles of measurement systems. 3rd edn. India: Pearson Education India.
2. Doebelin, E. (2003) Measurement Systems - Application and Design. 4th edn. New York: McGraw-Hill.

Reference books:

1. Sze, S.M. (ed.) (1994) Semiconductor sensors. New York: Wiley, John & Sons.
2. Murty, D.V.S. (2009) Transducers and instrumentation. 2nd edn. New Delhi: PHI Learning Private.
3. Patranabis, D. (2004) Sensors and transducers. 2nd edn. New Delhi: Prentice-Hall of India Pvt.

Course Outcomes

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

- Use concepts in common methods for converting a physical parameter into an electrical quantity
- Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light.
- Choose a proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
- Predict correctly the expected performance of various sensors
- Develps the skill to locate different types of sensors used in real life applications and paraphrase their importance

Course No:**EC424**	Course Title:**Data Compression and Encryption**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To understand the fundamentals of data compression, data encryption and network security.
- To analyze the real time encryption and security methods

Course Content

UNIT- I

Data Compression - Compression Techniques, Lossless compression, Lossy compression, measure of performance, modeling and coding, different types of models, and coding techniques,Text Compression, Minimum variance Huffman coding,extended Huffman coding, Adaptive Huffman coding. Arithmetic coding, Dictionary coding schemes, LZ 77, LZ 78, LZW

UNIT-II

Audio,Image and Video Compression: High quality digital audio, frequency and temporal masking, Lossy sound compression, μ-law and A-law companding, andMP3 audio standard,PCM, DPCM JPEG, JPEG –LS and JPEG2000standards,Intra frame coding, motion estimation and compensation,introduction to MPEG -2 H-264 encoder and decoder

UNIT-III

Data Security: Security goals, cryptography, stenographycryptographic attacks, services and mechanics.Integer arithmetic, modular arithmetic, and linear congruence, Substitution cipher, transposition cipher, stream and block cipher, and arithmetic modes for block ciphers Data encryption standard, double DES, triple DES,attacks on DES, AES, key distribution center.

UNIT- IV

Number theory and Asymmetric Key Cryptography: Primes, factorization, Fermat's little theorem, Euler's theorem and extended Euclidean algorithm RSA, attacks on RSA, Diffie Hellman key exchange , key management and basics of elliptical curve cryptography, Message integrity, message authentication, MAC, hash function, HMAC and digital signature algorithm.

UNIT-V

System Security: Malware, Intruders, Intrusion detection system,firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking, Secure Electronic Payment system.

Text Books

1. Khalid Sayood, *Introduction to Data Compression*, 3rdedition, Morgan Kaufmann, 2000.
2. David Saloman, *Data Compression: The complete reference*, 5th edition, Springer publication, 2007.

Reference Books

1. Behrous forouzen, *Cryptography and Network Security*, 2nd edition, Tata McGraw–Hill Education, New Delhi, 2011.
2. Berard Menezes, *Network Security and Cryptography*, 1st edition, learning publication Cengage, USA, 2010.
3. William Stallings, Cryptography and Network Security, 5th edition, Pearson Education Asia Publication, 2011.

Course Outcomes

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

- Implement text, audio and video compression techniques.
- Understand symmetric and asymmetric key cryptography schemes
- Understand network security and ethical hacking
- The project activity of this make the student suitable to a get job in app design software companies.

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Course No:**ECEE401**	Course Title:**Stochastic control system**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives:

- To equip students with fundamentals of uncertainties, randomness and noise in engineering systems
- To equip students with knowledge of tools and techniques from probability theory and systems theory
- To equip students with knowledge of stochastic control theory for their research

Course contents:

Unit-I

Introduction: noise, uncertainty, and randomness in engineering systems. Review of signals and systems, probability First look: Markov chains as stochastic systems, Markov chains as nonlinear systems. Markov chains as linear systems in the space of probabilities. Analysis by z-transform techniques &stability

Unit-II

Random signals and probabilistic systems. Random processes as signals (discrete- and continuous-time), in time and frequency domain. Events through Wiener's viewpoint (random waveform passing through "gates" to motivate independent increments, Markov property; inspiration for Feynman's path integral). Examples: random walk, Poisson process and other point processes; Wiener process; white and colored noise.

Unit-III

Moments, auto- and cross-correlation in time and frequency domain; spectral methods. Input-output relations; theorems of Bussgang and Campbell; fluctuation-dissipation relations. Basic analysis of convergence and stability via Lyapunov (or potential) functions. Uncertainty: Dynamical view: evolution of uncertainty and information in time. Packet arrivals and departures in networks, queues as stochastic systems. A glimpse of Bayesian filtering.

Unit-VI

Noise: Noise mechanisms in physical systems, shot noise, Johnson-Nyquist noise, van der Ziel (1/f) noise, amplifier noise, noise and Bayesian filtering in remote sensing systems. Randomness and determinism. Law of Large Numbers and the Central Limit Theorem through the lens of linear systems. Variance reduction by averaging (examples: invention of least squares; financial risk allocation in portfolios following Harry Markowitz; Monte Carlo simulation). Heuristic derivation of large-deviation bounds via Taylor series and Stirling approximation (example: probabilistic interpretation of multiplexing gain in telephony).

Unit-V

Feedback and control. Basics of controlled Markov chains: X [t+1] =f(X[t], U[t], Z[t]). b. Stabilization and optimization via feedback. c. Case study: stochastic gradient descent in machine learning

Textbook:

P. R. Kumar and P. Varaiya, Stochastic Systems, 1986, ESTIMATION, IDENTIFICATION AND ADAPTIVE CONTROL, P. R. Kumar and P. Varaiya, Prentice Hall Inc.

Course Outcomes:

- Gain knowledge about noise, uncertainty, and randomness in the context of engineering systems
- Can analyze using tools and techniques from probability theory and systems theory
- Develops the skill to implement deterministic system model

Course No: **ECEE402**	Course Title: **Process Control**	L	P	U
		3	0	3

Course Learning Objectives:

- To learn basics of process control and the instrumentation used for it.
- To know concepts, and mathematical modeling and its use for control purposes.
- To go deeper into the design of feedback controllers. A special emphasis will be placed on the controller tuning and stability analysis.
- To learn several advanced control systems under the process control

Course contents:

Unit-I

Review of systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances, interacting and non interacting type of systems. Control valves, types, function, hydraulic, pneumatic actuators, solenoid, stepper motors.

Unit-II

Stability Analysis: Frequency response, design of control system, control modes, definition, characteristics and comparison of P, PI, PD, PID controllers.

Unit-III

Dynamic behavior of feedback controlled process for different control modes, control system quality, IAE, ISE, IATE criterion, controller tuning and process identification, Zigler-Nichols and Cohen-Coon tuning methods, Bode-Nyquist Plots - Process modelling.

Unit-IV

Special Control Techniques: Principle, analysis and application of, cascade, ratio, feed forward, override, split range, selective controls, computing relays, simple alarms, Smith predictor, internal model control, theoretical analysis of complex processes.

Unit-V

Introduction to adaptive and self tuning control, distributed control systems

Reference Book(s)

1. 'Process Systems analysis and Control', D.R. Coughanour, Mc.Graw Hill, II Edition, 1991.

2. 'Process Dynamics and Control', D.E.Seborg, T.F.Edger, and D.A.Millichamp, John Wiley and Sons, II Edition, 2004.

3. 'Principle and Practice of Automatic Process Control', C.A.Smith and A.B.Corripio, John Wiley and Sons, 1985.

4. 'Process control', Peter Herriot, Tata McGraw Hill.

Course Outcomes:

Upon successful completion of course student will be able to;

- Appreciate importance of industrial process control and instrumentation
- To model details and intricacies of different stages of process control
- To design various feedback controllers based on design specifications of process control.

Course No:**ECEE403**	Course Title:**Digital Control Systems**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To enhance the knowledge of modeling and design of Digital control systems.
- To emphasis on using control system design tools for analysis of controlled system during its discrete-time implementation.

Course Content:

UNIT-I

Introduction- Comparison between analog and digital control-Importance of digital control-Structure of digital control- Examples of digital control system- Difference equations- Z-transform- MATLAB examples.Frequency response of discrete time systems- Properties of frequency response of discrete time systems-Sampling theorem.

UNIT-II

ADC model- DAC model- Transfer function of zero order hold- DAC, Analog Subsystem, and ADC Combination Transfer Function- Closed loop transfer function- Steady state error and its constants (MATLAB commands).

UNIT-III

Definitions of stability (Asymptotic stability, exponential stability etc)-stable z-domain pole placement locations- stability conditions-Stability determination (routh array)-Nyquist criterion.

UNIT-IV

Root locus- root locus design (p-control, Pi- control, pd) - Z-domain root locus- z-domain root locus design-digital implementation of analog controller design (differencing methods forward and backward) - bilinear transformation-direct z- domain controller design-frequency response design- Finite time response settling time.

UNIT-V

Concept of state space method-state space representations of discrete time systems- solving discrete time state space equations- Pulse transfer function matrix- Discretization of continuous state space equations-Liapunov stability analysis(discrete time) Controllability-observability-design Via pole placement-state observers.

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Text Book(s):

1. Moudgalya, K.M. (2007) *Digital control*. United States: Wiley, John & Sons.
2. Gopal, M. (1989) *Digital control engineering*. New York: John Wiley.

Reference Books

1. Fadali, S.M. and Visioli, A. (2012) *Digital control engineering: Analysis and design*. 2nd edn. Oxford: Elsevier Science.
2. Ogata, K. (1994) *Discrete-time control systems*. 2nd edn. New York, NY, United States: Prentice-Hall.

Course Outcomes

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

- Understand the fundamental differences between continuous time control and digital control.
- Gain in-depth knowledge and critical understanding of the theory and principles of digital control systems and their applications
- Distinguish the specific characteristics and differences of discrete/digital, hybrid and analog systems.
- Transform an analog system to discrete and vice versa
- Analyze the behavior of a discrete system in time domain and in frequency domain
- Develops the skill to design and synthesize controllers that will be implemented using digital hardware.

Course No:**ECEE404**	Course Title:**Power system controls and stability**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives:

- To develop the over-view of the power system operation
- To understand various controls working in power system to ensure its reliable operation
- To analyze power system stability under both steady state and transient conditions
- To apply stability determining criterion like equal area methods under different fault conditions
- To learn dynamic model of synchronous machine

Course content

UNIT-I

Electrical Power System Background**:** Overview of power systems - generation, transmission and distribution; utility-scale systems versus industrial power systems; utility restructuring and deregulation; smart grid. Fundamentals**:** Phasors; RMS; active and reactive power; three phase systems.

UNIT-II

Transformers**:** Models; three phase connections; per unit normalization; tap changing. Auto transformers, three winding transformers, Transformers with Off-Nominal Turns Ratio.Power Flow Analysis**:** Power flow formulation; solution techniques; decoupling; applications.

UNIT-III

Power System Operation and Control**:** Voltage and frequency regulation; generation and system control; load control.Generator-voltage control, Turbine-Governor control, Load-frequency control. Faults and System Protection**:** Symmetrical components; protection devices.

UNIT-IV

Grid Connection of Renewable Generation**:** Wind farm topology; variability inherent in renewable generation; voltage regulation. Economic Operation and Competitive Markets**:**Economic dispatch; electricity markets.

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UNIT-V

Transient stability: The swing equation, Simplified synchronous machine model and system equivalent, The equal area criterion, Numerical integration of the swing equation, Multimachine stability, Design methods for improving transient stability.

Textbook(s)

1. J.D. Glover, M.S. Sarma and T.J. Overbye, *Power System Analysis and Design*, 4th Edition, Bangalore, Thomson Asia (2008).

Reference Book(s)

1. Anderson, P.M. and Foud, A. A., Power System Control and Stability, 2nd edition, Delhi, Wiley India Edition (2011).
2. Kimbark, E., Power System Stability, Vol. I, II & III, IEEE Computer Society Press (2004).
3. Kundur, P., Power System Stability and Control, Newyork, McGraw Hill (2006).

Course Outcomes:

Upon successful completion of the course student will have:

- Knowledge of various controls working in power systems ensuring reliable operation
- Knowledge of various power dispatch techniques used in economic load scheduling
- Knowledge of mathematical tools for analyzing stability of power systems

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Course No:**ECEE405**	Course Title:**Vehicular Electric Power System**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To make the student understand the fundamental concepts, principles and analysis of hybrid and electric vehicles.
- To understand the latest developments in power system in air craft, sea and undersea vehicles

Course Content

UNIT-I

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles,impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power sourcecharacterization, transmission characteristicsmathematical models to describe vehicle performance.Capabilities, Automation system computer facilities.

UNIT-II

Introduction to electric components used in hybrid and electric vehicles- Configuration and control of DC Motordrives Induction Motor drives, Permanent Magnet Motor drives, and Switched Reluctance Motor drives- drivesystem efficiency.

UNIT-III

Introduction to energy management strategies used in hybrid and electric vehicle, classification of differentenergy management strategies, comparison of different energy management strategies, implementation issuesof energy strategies.

UNIT-IV

Open Access Distribution - Changes in Distribution Operations- The Development of Competition –Maintaining Distribution Planning

UNIT-V

Electrical power system in air craft, sea and undersea vehicles, space vehicles-hybrid vehicle control strategies-supporting subsystem

Text Book(s)

1. Emadi, A., Ehsani, M. and Miller, J.M. (eds.) (2003) *Vehicular electric power systems: Land, sea, air, and space vehicles*. New York, NY: Taylor & Francis.

Reference Books

1. Boldea, I. and Nasar, S.A. (2005) *Electric drives, Second edition*. United Kingdom: CRC Press.
2. Mi, C., Masrur, A.M. and Gao, D.W. (2011) *Hybrid electric vehicles: Principles and applications with practical perspectives*. Oxford, United Kingdom: Wiley-Blackwell

Course Outcomes

On successful completion of the course, the student would be able to

- Understand the various aspects of hybrid and electric vehicles
- Plan the selection of electrical machines for hybrid and electric vehicles
- Select various energy storage technologies for hybrid and electric vehicles
- Implement energy management techniques for hybrid and electric vehicles
- Demonstrate the power system of various vehicular system

Course No:**ECEE406**	Course Title:**Power Electronics Applications and Drives**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To understand the basic concept of DC and AC Drives
- To understand the various control techniques involved with both DC and AC Drives
- To brief about the working principle of Special Electrical Drives

Course Content:

UNIT-I:

Introduction to solid state drives, various components-power converters, motors, loads, coupling mechanisms, Stability of drive.

UNIT-II

Modeling of d.c.motor drives. Transfer function and state-space models. Experimental determination of drive parameters. Speed control using ac to dc converters, Input performance parameters, Speed reversal schemes.

UNIT-III

Chopper fed d.c.motor drives. Four quadrant operation. Input filters design. Dynamic braking with dc chopper. Type-c chopper fed regenerative braking. Operation with non- receptive lines.

UNIT-IV

Power converters for induction motor speed control. Harmonic behavior of induction motors-harmonic currents and harmonic torques using per phase equivalent circuit. Stator voltage control schemes. Speed control of wound type motors.

UNIT-V

State-space modeling of induction motors. Voltage source-Inverter fed operation. Field oriented control schemes. Current source – inverter drives. Principle of vector control

Text Books

1. R.Krishnan, "*Electric Motor Drives-Modeling, Analysis, and Control*", 1st Edition, Pearson Education, Delhi 2003.
2. G.K. Dubey, "*Fundamentals of Electrical Drives*", 2nd Edition, Narosa Publishing house, Delhi, 2008.

Reference Books

1. P.C.Sen,"Thyristor DC Drives" John Wiley& Sons Publishers, New York, 2008.
2. B.K.Bose, "Modern Power Electronics and AC drives", 2nd Edition, Pearson Education Publications, 2005.

Course Outcomes:

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

- Gain fundamental concepts of power electronic converter fed DC and AC machines.
- Analyze the converter fed motor under different torque/speed conditions.
- Develops the skill to design converter fed drives with existing/new control techniques

Course No:**ECEE407**	Course Title:**Advanced Power Electronics**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To learn the role of Power Electronics in utility-related applications
- To learn basic concepts of soft-switching and their applications

Course Content

Unit-I:

Review of basic control theory – Control design techniques such as P, PI, PID and lead lag compensatordesign. Review of state space control design approach – State feedback controller and observer design.

Unit-II

Control of DC-DC converters - State space modeling of Buck, Buck-Boost, Cuk, Sepic, Zeta Converters -Equilibrium analysis and closed loop voltage regulations using state feedback controllers and sliding mode controllers.

Unit-III

Control of rectifiers - State space modeling of single phase and three phase rectifiers - State feedback controllers and observer design for output voltage regulation for nonlinear loads - Analysis of continuous and discontinuous mode of operation.

Unit-IV

Modeling of Brushless DC motors and its speed regulations – State space model, sensor less speed control of BLDC motor and Sliding mode control design for BLDC motor - Modeling and control of switched reluctance motor.

Unit-V

Modeling of multi input DC-DC converters and its application to renewable energy - Output voltage regulation of multi input DC-DC converter using state feedback controllers.

Text Book(s)

1. Sira-Ramírez, H., Silva-Ortigoza, R. and Sira-Ramirez, H.J. (2006) Control design techniques in power electronics devices. London: Springer London.

Reference Books

1. Tan, S.-C., Lai, Y.-M. and Tse, C.K. (2011) Sliding mode control of switching power converters: Techniques and implementation. Boca Raton, FL: Taylor & Francis.
2. Bose, B.K. (2006) Power electronics and motor drives: Advances and trends. Amsterdam: Elsevier Science.
3. Boldea, I. and Nasar, S.A. (2005) Electric drives, Second edition. United Kingdom: CRC Press.

Course Outcomes

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

- Recognize different control techniques and design of compensators, controllers and observers
- Model and analyze various closed loop controllers
- Design controllers for different rectifiers and to analyze various modes of operation
- Develops the skill to model and design of various controllers for BLDC and Reluctance motors

Course No:**ECEE408**	Course Title:**Flexible AC Transmission System**	L	P	U
		3	0	3

Course Learning Objectives

- To understand basic concepts, principles and operation of fast high power electronic controllers known as Flexible AC Transmission Systems (FACTS).
- To understand use of FACTS devices like SVC, TCSC, STATCOM, SSSC to enhance controllability, stability and power transfer capability of AC transmission systems with fastest control speed.
- To understand the influence of measurement systems, network resonances and harmonic interactions on the performance of FACTS control systems
- To understand the interactions amongst various FACTS Controllers and techniquesfor their coordination and placement

Course Content

UNIT- I

Introduction: The concept of flexible AC transmission - reactive power control in electrical power transmission lines -uncompensated transmission line – series and shunt compensation. Overview of FACTS devices - Static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified Power Flow controller (UPFC) - Integrated Power Flow Controller (IPFC)

UNIT- II

Static Var Compensator (Svc) And Applications: Voltage control by SVC – advantages of slope in dynamic characteristics – influence of SVC on system voltage. Applications - enhancement of transient stability – steady state power transfer – enhancement of power system damping – prevention of voltage instability

UNIT- III

Thyristor Controlled Series Capacitor (Tcsc) and Applications: Operation of the TCSC - different modes of operation – modeling of TCSC – variable reactance model – modeling for stability studies. Applications - improvement of the system stability limit – enhancement of system damping – voltage collapse prevention

UNIT- IV

Emerging Facts Controllers: Static Synchronous Compensator (STATCOM) – operating principle – V-I characteristics – Unified Power Flow Controller (UPFC) – Principle of operation - modes of operation – applications – modeling of UPFC for power flow studies.

UNIT- V

Co-Ordination Of Facts Controllers: FACTs Controller interactions – SVC–SVC interaction - coordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination

Text Books

1. 1. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc.
2. A.T.John, "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE), 1999.

Reference Books

1. Narain G.Hingorani, Laszio. Gyugyl, "Understanding FACTS Concepts and Technology of Flexible AC Transmission System", Standard Publishers, Delhi 2001.
2. K.R. Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International Publishers, New Delhi, 2007.

Course Outcomes

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

- Analyze the application of various power electronics based FACTS devices for the control of active and reactive power in the system
- Understand the control schemes of various FACTS devices
- Analyze passive and active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems
- Digital simulation and case study of various FACTS controllers.
- Develops the skill to design and analyze Custom power devices for power quality improvement.

Course No:**ECEE409**	Course Title:**HVDC Transmission**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To understand and analyze the HVDC transmission systems
- To plan an appropriate transmission system between two destinations based on the load requirement and anticipated technical performance of power transmission

Course Content

UNIT-I

Introduction to HVDC transmission - Bridge converters – rectifier and inverter operation, equivalent circuit representation, power reversal, desired features of control and actual control characteristics.

UNIT-II

Basic HVDC controllers, converter faults, commutation failure, bypass action in bridges, protection issues in HVDC - DC reactors, voltage and current oscillations

UNIT-III

DC circuit breakers and over voltage protection, HVDC cables

UNIT-IV

Harmonics in HVDC - characteristics and uncharacteristic harmonics, troubles due to harmonics, harmonic filters – active and passive filters, active and reactive power exchange in converters and recent trend in HVDC transmission – Hybrid HVDC and Off-shore wind power evacuation through HVDC

UNIT-V

Introduction to Wide Area Monitoring Systems.

Text Books

1. Rao, S. (2009) *EHV-AC, HVDC transmission & distribution engineering: Theory, practice and solved problems*. 3rd edn. New Delhi: Khanna Publishers.

2. Begamudre, R.D. (2009) *Extra high voltage A.C. Transmission engineering*. 3rd edn. New Delhi, India: New Age International Pvt Ltd Publishers.

Reference Book

1. Padiyar, K.R. (2008) *HVDC power transmission systems: Technology and system interactions*. New Delhi: John Wiley & Sons (Asia) Pte.

Course Outcomes

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

- Distinguish between the usage of EHVAC and HVDC transmission systems
- Judge when and where to use EHAV / HVDC transmission systems in practice
- Plan an appropriate electric power transmission system between two destinations to satisfy the pre-defined load requirement without compromising the technical performance
- Design implementation circuitry for various controllers used in HVDC transmission systems
- The project activity make the student suitable to get job in power generarion sectors.

Course No:**ECEE410**	Course Title:**Power Systems Transients**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To understand different types switching transients in power systems and their control using circuits
- To study Lightning phenomena and the production of lighting surges.
- To understand Travelling waves in distributed parameter multi-conductor lines, Simulation of surge diverters in transient analysis
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system

Course Content

UNIT- I

Review and importance of various types of power system transients. RL circuit transient with sine wave excitation - double frequency transients – basic transforms of the RLC circuit transients. Review of different types of power system transients - effect of transients on power systems and power system planning.

UNIT- II

Over voltages in power systems due to switching transients. Resistance switching and its equivalent circuit. Load switching and its equivalent circuits. Current suppression and current chopping its effective equivalent circuit. Capacitance switching its effect of source regulation, capacitance switching with a restrike, with multiple restrikes.

UNIT- III

Electrification of thunderclouds, lightning current surges and lightning current parameters. Modeling of lightning stroke and factors for good line design. Protection using ground wires, tower footing resistances.

UNIT- IV

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Concept of travelling wave and its step response. Bewely's lattice diagram, standing waves and natural frequencies. The reflection and refraction of travelling waves.

UNIT- V

Over voltage protective devices – shielding wires, rods gaps and surge diverters, principles of insulation co ordination-recent advancements in insulation co ordination – design of EHV system.

Text Books

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2ndEdition, 1991.
2. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

Reference Books

1. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
2. Peterson H.A., transients in power systems, Dover Publications, New York, 1963. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.

Course Outcomes

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

- Gain knowledge of knowledge of power system transients and insulation coordination.
- Can analyze the use of EMTP and EMTDC/PSCAD package, Insulation Coordination.
- Understand insulation coordination procedures for high voltages systems.
- Develops the skill to design Lightning arrestors and surge absorbers for Power systems.

Course No:**ECEE411**	Course Title:**High Voltage Engineering**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objective

- To make the students understand and gain knowledge of high voltage engineering

Course Content

UNIT-I

Electro Static Fields, Their Control and Estimation:Electric Field intensity, Electric strength, classification of Electric Fields, control of electric Field intensity, basic equations for potential and field intensity in electrostatic fields, Analysis of electric field intensity in homogenous and multidielectric electric fields, numerical methods for estimation of electric field intensity.

UNIT-II

Generation of High Dc and Ac Voltages, Generation of Impulse Voltages and Currents

UNIT-III

Measurement of High Voltages and Currents, High Voltage Testing of Electrical Equipment

UNIT-IV

Non-Destructive Test Techniques: Measurement of resistance, measurement of dielectric constant and loss factor, High voltage Schering Bridge, measurement of large capacitances, partial discharges measuring and diagnostic techniques. Time domain and Frequency domain analysis of dielectric materials subjected to an electric field.

UNIT-V

Breakdown Mechanism of Gaseous Liquid and Solid Insulating Materials : Introduction, Mechanism of breakdown in gases, Townsend's first ionization coefficient, cathode processes, secondary effects, Townsend's second ionisation coefficient, Townsend breakdown mechanism, streamer or kanal mechanism of spark, Paschen's law, Penning effect, Breakdown in non-uniform fields, principles of breakdown in solid and liquid dielectrics, Applications of gas, liquid and solid dielectrics.

Text Book

1. Naidu, M.S. and Kamaraju, V. (2008) *High voltage engineering*. 4th edn. New Delhi: McGraw-Hill Inc., US.

Reference Books

1. Arora, R. and Mosch, W. (2011) *High voltage and electrical insulation engineering*. United States: Wiley, John & Sons.

2. Wadhwa, C.L. (2006) *High voltage engineering*. 2nd edn. New Delhi: New Age International Pvt Ltd Publishers.

3. Kuffel, E., Zaengl, W.S. and Kuffel, J. (2014) *High voltage engineering fundamentals*. 2nd edn. Oxford: Butterworth-Heinemann/Newnes.

Course Outcomes

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

- Design the insulation of HV power equipment.
- Estimate electric field intensity of different electrode configurations.
- Understand the testing methods of high voltage equipment
- Understand the Breakdown mechanism of Gas, Liquid and solid insulation

Course No:**ECEE412**	Course Title:**Power Quality**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To know different terms of power quality.
- To Illustrate of voltage power quality issue – short and long interruption
- To construct study of characterization of voltage sag magnitude and three phase unbalanced voltage sag.
- To know the behavior of power electronics loads; induction motors, synchronous motor etc by the power quality issues
- To prepare mitigation of power quality issues by the VSI converters.

Course Content

UNIT- I

Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring.

UNIT- II

Interruptions – Definition – Difference between failures, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption, Short interruptions: definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems.

UNIT- III

Voltage sag – definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration. Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT- IV

Voltage sag – equipment behavior of power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

UNIT- V

Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller. Power Quality and EMC Standards: Introduction to standardization, IEC Electromagnetic compatibility standards, European voltage characteristics standards.

Text Books

1. Math H J Bollen "Understanding Power Quality Problems", IEEE Press.
2. R.C. Dugan, M.F. Mc Granaghan and H.W. Beaty, "Electric Power Systems Quality." New York: McGraw-Hill. 1996.

Reference Books

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994).
2. Power Quality VAR Compensation in Power Systems, R. Sastry Vedam Mulukutla S. Sarma, CRC Press.
3. A Ghosh, G. Ledwich, Power Quality Enhancement Using Custom Power Devices. Kluwer Academic, 2002.

Course Outcomes

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

- Know the severity of power quality problems in distribution system;
- Understand the concept of voltage sag transformation from up-stream (higher voltages) to down-stream (lower voltage);
- Develops the skill to compute the concept of improving the power quality to sensitive load by various mitigating custom power devices.

Course No:**ECECEE413**	Course Title:**Power Generation Systems**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives:

- To understand the working of different types of power generation systems
- To realize the necessity for interconnected operation of different power stations

Course Content:

UNIT-I

Hydro-electric power plants – selection of site, elements of power plant, classification, water turbines, governor action, hydro-electric generator, plant layout, pumped storage plants.

UNIT-II

Thermal steam power plants – selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.

UNIT-III

Nuclear power plants – selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.

UNIT-IV

Renewable power plants – Solar power generation – Photo-voltaic and solar thermal generation – solar concentrators, Wind power generation – types of wind mills, wind generators, tidal, biomass, geothermal and magneto-hydro dynamic power generation, micro-hydel power plants, fuel cells and diesel and gas power plants

UNIT-V

Combined operation of power plants – plant selection, choice of size and number of generator units, interconnected systems, real and reactive power exchange among interconnected systems. Major electrical equipment in power plants, DC systems in power plants, station control - switch yard and control room. Economic considerations – types of costs, tariff and consumers.

Text Books:

1. Chakrabarti, A., Soni M.L., Gupta P.V., and Bhatnagar U.S., (*2010) A Text Book on Power Systems Engg.* 2nd Revised Edition, New Delhi, DhanpatRai and Sons.
2. Gupta, J.B. (2013) *Course in power systems*. New Delhi, India: Kataria, S. K
3. Gupta, B.R., (2009) *Generation of Electrical Energy*. New Delhi, S. Chand Limited.

Reference Books:

1. Wadhwa, C.L., 2010 '*Generation Distribution and Utilisation of Electrical Energy'*, 3rdEdition, New Age InternationalPublishers.
2. Deshpande, M.V, 2009 `*Elements of Electrical Power Systems Design'*, 1st Edition Pitman, New Delhi, PHI LearningPrivate Limited.

Course Outcomes:

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

- Appreciate the different types of tariff, consumers and different types of power generation plants.
- Determine the significance of various components of the power generation plants.
- Correlate the importance of interconnected operation of different power generation systems.
- Plan an appropriate scheduling of electric power to satisfy the demand constraint.

Course No:**ECEE414**	Course Title:**Special Machines**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To expose the students to the construction, principle of operation and performance of special electrical machines as an extension to the study of basic electrical machines.
- To understand Operation and performance of variable reluctance motors, Hybrid motors, Switched reluctance motors, Permanent magnet synchronous motor.

Course Content

UNIT-I

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance and Hybrid Motors – SYNREL Motors – Voltage and Torque Equations - Phasor diagram - Characteristics.

UNIT-II

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi-stack configurations – Torque equations – Modes of excitations – Characteristics – Drive circuits – Microprocessor control of stepping motors – Closed loop control.

UNIT-III

Constructional features – Rotary and Linear SRMs - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Closed loop control of SRM - Characteristics.

UNIT-IV

Permanent Magnet materials – Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power controllers – Motor characteristics and control.

UNIT-V

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature reaction MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements.

Text Book(s)

1. T.J.E. Miller, 1993 '*Brushless Permanent Magnet and Reluctance Motor Drives*', Clarendon Press, Oxford.
2. T. Kenjo, 1995 '*Stepping Motors and Their Microprocessor Controls*', Clarendon Press London.

Reference Books

1. Krishnan, R. (2001) *Switched reluctance motor drives: Modeling, simulation, analysis, design, and applications*. United States: CRC Press.
2. P.P. Aearnley, 2002 '*Stepping Motors – A Guide to Motor Theory and Practice*', Peter Perengrinus London.
3. T. Kenjo and S. Nagamori, 1988 '*Permanent Magnet and Brushless DC Motors*', Clarendon Press, London.

Course Outcomes

Upon successful completion of the course the students would be able

- To formulate and then analyze the working of special electrical machines using mathematical model.
- To analyze and understand working principle and working of reluctance motors, Stepping motors, Switched reluctance motors, Permanent magnet brushless D.C. motors and Permanent magnet synchronous motors.
- Upon completion of this subject student able to start design of special machines and become entrepreneur.

Course No:**ECEE415**	Course Title:**Electrical Machine Design**	**L**	**P**	**U**
		3	**0**	**3**

Course Learning Objectives

- To make the student learn analytical design analysis of electrical machines
- To understand the step by step procedure for the complete design of electrical machines.

Course Content

UNIT-I

General concepts in the design of rotating machines-output equation-Magnetic and electric loadings-Common design features of all rotating machines-Conducting, insulating and magnetic materials used in electrical apparatus - mmf calculation for the magnetic circuit of rotating machines-Leakage reactance calculation.

UNIT-II

Armature winding –output equation-Choice of specific loadings-Choice of poles-design of conductors, winding, slot, air gap, field poles and field coils, commutator and brush-Predetermination of efficiency, temperature rise and open circuit characteristics from design data (qualitative treatment only).

UNIT-III

Output equation-Design of core and coils for single phase and three phase transformers-Design of tank and cooling tubes-Predetermination of circuit parameters, magnetising current, losses, efficiency, temperature rise and regulation from design data (qualitative treatment only).

UNIT-IV

Output equation-Choice of specific loadings-Design of stator-Design of squirrel cage and slip ring rotors-Stator and rotor winding designs-Predetermination of circuit parameters, magnetising current, efficiency and temperature rise from design data (qualitative treatment only).

UNIT-V

Constructional features of synchronous machines-SCR-Output equation-specific loadings-Main dimensions-Stator design-Design of salient pole field coil.

Text Book(s)

1. A.K. Sawhney and A. Chakrabarti (2010*) A Course in Electrical Machines Design:* 6th Edition, DhanpatRai and Sons Publications, Delhi.

Reference Books

1. Sen, S.K. (2001) *Principles of electrical machine design with computer programs*: Second Edition, India: Oxford & IBH Publishing Co Pvt.
2. Rai, H.M., *(1994) Principles of Electrical Machines Design: 3rd* Edition, SathyaPrakash Publications, New Delhi.

Course Outcomes:

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

- Develops the skill to understand the design of main dimensions and other major part of the transformer and DC and AC rotating machines.
- Capable of evaluating the procedure for the design of main dimensions and other major part of the transformer and DC and AC rotating machines.
- Equipped to apply in-depth knowledge related to the design of electrical machines.

Course No:ECEE416	Course Title:**Utilization Of Electrical Power**	L	P	U
		3	0	3

Course Learning Objectives

- To introduce fundamental concepts of utilization of electrical energy which emphasis on types of Electrical Drives, Electrical heating, Illumination and Electrical Traction
- To provide students with the skills to understand the analytical methods related to illumination design, Electrical heating, Electrical traction and Electrical drives.

Course Content

UNIT-1

Electrical Drives :Advantages, Characteristics of different mechanical loads, Types of motors used in electric drive pulley drives etc., Examples of selection of motors for different types of domestic loads, Selection of drive for applications , load equalization, Rating of motor, Applications of Electrical drives

UNIT-II

Nature of light, Electrical Lighting definitions: Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux, Laws of illumination, Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics mercury vapour lamp, fluorescent lamp, Incandescent lamp, neon lamp, LED lamp Main requirements of proper lighting, Types of lightning schemes.

UNIT-III

Electric Heating: Advantages of electrical heating, Methods of heat transfer, heating methods: Resistance heating, design of heating element Induction heating, Electric arc heating, Dielectric heating and eddy current heating.

UNIT-IV

Electric welding: resistance welding, arc welding. Electric traction: requirements of an ideal traction system, systems of traction, requirements of ideal traction motors, comparison and control of traction motor.

UNIT-V

Mechanics of train movement, tractive effort for acceleration, train resistance, gradient, coefficient of adhesion, speed time curves, specific energy consumption.

Text Book(s)

1. Taylor E Openshaw, "*Utilisation of Electric Energy*", Orient Longman Pvt.ltd., SI edition reprint, India, 2006.
2. Partab H., "*Art and Science of Utilisation of Electrical Energy*", Third edition, DhanpatRai and Sons, New Delhi, 2006.

Reference Books

1. Wadhwa C. L, "*Generation, Distribution and Utilization of Electrical Energy*" Revised Edition,New Age Internationl (P) Ltd. Publications, New Delhi, 1993.
2. J B Gupta"*Utilization of electric power and electric traction*", S K Kataria& Sons, New Delhi, 2012.
3. Vedam Subrahmanyam "*Electrical Drives: Concept and applications*"Tata McGraw-Hill, New Delhi, 1996.

Course Outcomes

After going through this course the students would be able to:

- Select the proper motor for practical applications. They acquire the knowledge of electrical drives, types of motors used in Industries, types of loads and load equalization.
- Understand illumination and its related terms, laws. They get familiar about photometry integrated sphere and designing of lightning schemes like flood lightning, street lightning etc.
- Know different types of electrical heating like resistance, induction and dielectric heating
- Get familiar with practical implementation of electrical heating
- Know special features of traction motors, types of electrical traction systems in India.
- Know mechanics of traction analysis of speed time curves specific energy consumption. .

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

ICFAI FOUNDATION FOR HIGHER EDUCATION HYDERABAD

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 includingIP-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:

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

Whereu1 , 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

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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.

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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.

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