SCHEME OF COURSES - B.E. Electronics and Communication Engineering

UNIVERSITY OF DELHI

NETAJI SUBHAS INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM

Scheme of Courses
for
Bachelor of Engineering
in
Electronics and Communication Engineering

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

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SCHEME OF COURSES - B.E. Electronics and Communication Engineering

PREAMBLE

I. INTRODUCTION

Higher education is very important for the growth and development of any country. It is a living organ and requires continuous changes to ensure the quality of education. National Knowledge Commission and University Grants Commission have recommended many academic reforms to address the challenges of today's networked globalized world. People are coming together with the help of new technologies which is resulting towards new aspirations, expectations, collaborations and associations. The concept of "work in isolation" may not be relevant and significant anymore. The UGC guidelines on adoption of Choice Based Credit System may be an important step to revamp the processes, systems and methodologies of Higher Educational Institutions (HEIs). The teacher centric mode be changed to learner centric mode. Class room teaching and learning be made effective, relevant and interesting. Concepts and theories be explained with examples, experimentation and related applications.

A culture of discussions, arguments, interpretations, counter-interpretations, re-interpretations and opposing interpretations must be established. Research should not be confined only to redefinition, extension and incremental change. Innovation and creativity should become an epicenter for all research initiatives. The most important capital is the human capital and thus the ultimate objective is to develop good human beings with utmost integrity and professionalism for this new world.

The Choice Based Credit System supports the grading system which is considered to be better than conventional marking system. It is followed in many reputed institutions in India and abroad. The uniform grading system facilitates student mobility across institutions within and across countries and also enables potential employers to assess the performance of students. The Choice Based Credit System makes the curriculum interdisciplinary and bridges the gap between professional and liberal education.

II. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions have been moving from the conventional annual system to semester system. Currently many of the institutions have already introduced the Choice Based Credit System. The semester system accelerates the

teaching-learning process and enables vertical and horizontal mobility in learning. The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The Choice Based Credit System provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses to acquire more than the required credits and adopt an interdisciplinary approach to learning.

A. Programme Educational Objectives

This scheme and courses are related to four year Electronics and Communication Engineering programme with following Programme Educational Objectives (PEO).

1. Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Communications and allied disciplines.

2. Practice the ethics of their profession consistent with a sense of social responsibility and develop their engineering design, problem –solving skills and aptitude for innovations as they work individually and in multi disciplinary teams.

3. Be receptive to new technologies and attain professional competence through lifelong learning such as advanced degrees, professional registration, publications and other professional activities.

B. Types of Courses

Courses are the subjects that comprise the Electronics and Communication Engineering programme.

1. A course may be designed to comprise lectures, tutorials, laboratory work, field work, outreach activities, project work, vocational training, viva, seminars, term papers, assignments, presentations, self-study etc. or a combination of some of these components.

2. The learning outcomes of each course will be defined before the start of a semester.

3. Courses are of three kinds: Core, Elective and Foundation.

   i. **Core Course (CC)**: This is a course which is to be compulsorily studied by a student as a core requirement to complete the requirement of B.E. Electronics and Communication Engineering.

   ii. **Elective Course**: An elective course is a course which can be chosen from a pool of courses. It is intended to support the discipline of study by providing an expanded scope, enabling exposure to another discipline/domain and nurturing a student's proficiency and skill. An elective may be of following types:

      a) **Discipline Centric Elective (ED)**: It is an elective course that adds proficiency to the students in the discipline.

      b) **Generic Elective (EG):** It is an elective course taken from other engineering disciplines and enhances the generic proficiency and interdisciplinary perspective of students.

      c) **Open Elective (EO):** It is an elective course taken from non-engineering disciplines that broadens the perspective of an engineering student.

   iii. **Foundation Course**: A Foundation course leads to knowledge enhancement and provides value based training. Foundation courses may be of two kinds:

      a) **Compulsory Foundation (FC):** It is based upon content that leads to fundamental knowledge enhancement in sciences, humanities, social sciences and basic engineering principles. They are mandatory for all disciplines.

      b) **Elective Foundation (FE):** It can be taken from among a pool of foundation courses which aim at value-based education. They may provide hands-on training to improve competencies and skills or provide education on human, societal, environmental and national values.

4. Each course contributes certain credits to the programme. A course can be offered either as a full course (4 credits) or as a half course (2 credits). A full course is conducted with 3 hours of lectures and either 1 hour of tutorial or 2 hours of practical work per week. A half course is conducted with 2 hours of lectures.

5. A student of undergraduate programme has to accumulate about 50% credits from Core courses; about 20% credits from Foundation courses; and the remaining credits from Elective courses to become eligible for award of the degree.

6. A course (full/half) may also be designed without lectures or tutorials. However, such courses may comprise of field work, workshop, engineering drawing, outreach activities, project work, vocational training, seminars, self-study, sports, skills enhancement etc. or a combination of some of these.

7. A project work/dissertation is considered as a special course involving application of the knowledge gained during the course of study in exploring, analyzing and solving complex problems in real life applications. A candidate completes such a course with an advisory support by a faculty member.

8. Apart from the above courses Audit courses may be offered. They do not carry credits but aim at expanding knowledge or bridging deficiency in knowledge or skills.

C. Examination and Assessment

The following system will be implemented in awarding grades and CGPA under the CBCS system.

1. **Letter Grades and Grade Points:** A 10-point grading system shall be used with the letter grades as given in Table 1.

Table1: Grades and Grade Points

Letter Grade	Grade point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

2. **Fail grade:** A student obtaining Grade F shall be considered fail and will be required to reappear in the examination. If the student does not want to reappear in an **elective course** (that is, EG, ED, EO, FE *but not* CC or FC courses) then he/she can re-register afresh for a new elective course.
3. **Audit course:** For audit courses, 'Satisfactory' or 'Unsatisfactory' shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.
4. **Fairness in assessment:** The CBCS promotes continuous evaluation system where the weightage of end semester examinations should not be more than 60%. The departments shall design its own methods for continuous evaluation. It shall have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching-learning methods. In this regard, checks and balances will be implemented to ensure fair and effective assessment and examination process.
5. **Computation of SGPA and CGPA:** The following procedure shall be used to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

   i. The SGPA is the ratio of sum of the product of the number of credits and the grade points scored in all the courses of a semester, to the sum of the number of credits of all the courses taken by a student, that is:

$$SGPA(S_i) = \frac{\sum C_j \times G_j}{\sum C_j}$$

   where S_i is the i^{th} semester, C_j is the number of credits of the j^{th} course of that semester and G_j is the grade point scored by the student in the j^{th} course.

   ii. The CGPA is also calculated in the same manner taking into account all the courses taken by a student over all the semesters of a programme, that is:

$$CGPA = \frac{\sum C_i \times SGPA(S_i)}{\sum C_i}$$

where SPGA(S_i) is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iv. CGPA shall be converted into percentage of marks if required, by multiplying CGPA with 10.

III. PROGRAMME STRUCTURE

1. The B.E. Electronics and Communication Engineering programme consists of 8 semesters, normally completed in 4 years. The total span period cannot exceed 8 years.

2. The courses offered in each semester are given in the *Semester-wise Course Allocation* scheme for B.E. Electronics and Communication Engineering.

3. The courses under FC and common pool of electives offered for students of all disciplines under FE, EG and EO categories are listed under separate tables in the scheme. The discipline centric courses under CC and ED categories are listed separately.

4. A course may have pre-requisite course(s) that are given in the *Semester-wise Course Allocation scheme.*

5. A student can opt for a course only if he/she has successfully passed its pre-requisite(s).

6. A student has to register for all courses before the start of a semester.

7. After second year a student may register for courses leading to a minimum number of credits as prescribed in the scheme and a maximum of 28 credits. Normally, a student registers for courses leading to 22 credits.

8. B.E. Electronics and Communication Engineering programme consists of 176 credits. A student shall be awarded the degree if he / she has earned 168 or more credits.

IV. COURSE CODIFICATION

Programme Codes: The codes for various undergraduate programmes are as follows:

i. Biotechnology: BT
ii. Computer Engineering: CE
iii. Electronics and Communication Engineering: EC
iv. Instrumentation and Control Engineering: IC
v. Information Technology: IT
vi. Manufacturing Processes and Automation Engineering: MA
vii. Mechanical Engineering: ME

Departmental Course Codes: The codes for departmental core courses and discipline-specific electives are specific to each discipline. The first two characters are derived from departmental codes listed above. The third character is 'C' for core courses and 'D' for discipline-specific courses. This is followed by a 2-digit sequence number:

i. ECCyy: Core Course
ii. ECDyy: Discipline-centric Elective Course

Common Course Codes: The lists for courses offered under Compulsory Foundation (FC), Foundation Electives (FE), and Open Electives (EO) will follow a common code as shown below. The 3-digit sequence number 'yyy' is taken from the respective tables of different types of courses.

iii. FCyyy: Foundation Compulsory Course
iv. FEyyy: Foundation Elective Course
v. EOyyy: Open Elective Course

Generic Electives: A student may take a course under the category of Generic Elective (EG) offered by any other department of the institute under the category of Core Course (CC), and Discipline Centric Elective (ED). However, such options shall be offered to a student as per prescribed guidelines of the institute.

V. EVALUATION SCHEME

The courses are evaluated on the basis of continuous assessment, mid-semester examinations and end-semester examinations. The weightage of each of these modes of evaluation for the different types of courses are as in Table 2.

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

Table-2: Evaluation Scheme

Type of Course	Continuous Assessment (CA), Theory	Mid-Semester Exam (MS), Theory	End-Semester Exam (ES), Theory	Continuous Assessment (CA), Lab	End-Semester Exam (ES), Lab
FE courses	As specified in Table 3 of Foundation Electives				
CC/FC/ED/EG/EO Theory with Tutorial	25	25	50	Nil	Nil
CC/FC/ED/EG/EO Theory with Practical	15	15	40	15	15
Project I and Project II	Nil	Nil	Nil	40	60
Training	Nil	Nil	Nil	40	60
Audit Courses 1*	-	-	-	-	-
1*: The distribution of marks and the minimum marks required for getting "Satisfactory" for Audit courses will be determined by the Department.					

VI. EVALUATION AND REVIEW COMMITTEE

The Committee of Courses and Studies in each department shall appoint one or more Evaluation-cum-Review Committees (ERC), each committee dealing with one course or a group of courses. This ERC consists of all faculty members who are likely to teach such course(s) in the group.

The ERC has the following functions-

(i) To recommend appointment of paper setters/examiners of various examinations at the start of each semester.

(ii) To prepare quizzes, assignments, test papers etc. for Continuous Assessment (CA), Mid-Semester examination (MS) and End Semester (ES) examination

and to evaluate them. Normally, each concerned faculty member, who is also a member of ERC, will do this job for his/her class. However, in exceptional circumstances any part of the work may be entrusted to some other member of the ERC.

(iii) To consider the individual representation of students about evaluation and take remedial action if needed. After scrutinizing, ERC may alter the grades awarded upward/downward. The decision of the ERC shall be final.

(iv) To moderate assignments, quizzes etc. for courses given by each of the concerned faculty members for his/her class with a view to maintain uniformity of standards.

(v) To review and moderate the MS and ES results of each course with a view to maintain uniformity of standards.

(vi) To lay guidelines for teaching a course.

VII. ATTENDANCE, PROMOTION AND DETENTION RULES

1. A student should normally attend all the classes. However, a student will be allowed to appear in the examination if he/ she has put in a minimum of 75% attendance separately in each course for which he / she has registered. A relaxation up to a maximum of 25% may be given on the production of satisfactory evidence that (a) the student was busy in authorized activities, (b) the student was ill.
2. A student should submit the evidence to the fact 1(a) and / or 1(b) above within seven working days of resuming the studies. Certificates submitted later will not be considered.
3. No relaxation in attendance beyond 25% is permitted in any case.
4. If a student with satisfactory attendance will be promoted to the even semester irrespective of his/ her results in the odd semester examinations.
5. If a student fails to secure a minimum of 22 credits after the completion of second semester, he/ she will not be allowed to register in the third semester till he / she secures a minimum of 22 credits.
6. If a student fails to secure a minimum of 44 credits after the completion of fourth semester, he / she will not be allowed to register in the fifth semester till he / she secures a minimum of 44 credits.
7. There shall be no supplementary examinations. A student who has failed in a course will have to re-register for the course in a subsequent year.
8. If a student fails in any core course during the first four semesters (without repeating a year), he/she will have to re-register for such courses after the fourth semester.
9. If the student does not want to reappear in an **elective course** (that is, EG, ED, EO, FE but not CC or FC courses) then he/she can re-register afresh for a new elective course.

10. After second year a student may register for courses leading to a minimum credits as prescribed in the scheme and a maximum of 28 credits. Normally a student registers for courses leading to 22 credits.

VIII. DECLARATION OF RESULTS

1. The B.E. Electronics and Communication Engineering programme consists of 176 credits. A student will be awarded the degree if he/she has earned 168 or more credits.
2. CGPA will be calculated on the basis of the best 168 credits earned by the student.
3. The candidate seeking re-evaluation of a course shall apply for the same on a prescribed proforma along with the evaluation fee prescribed by the University from time to time only for the End Semester Examination within seven days from the date of declaration of result.
4. The Institution/University may cancel the registration of all the courses in a given semester if
   i. The student has not cleared the dues to the institution/hostel.
   ii. A punishment is awarded leading to cancellation of the student's registration.

IX. CURRICULUM MODIFICATION

The curriculum will be updated regularly within a period of 5 to 10 years since last revision, to keep pace with the advancements in the field of Electronics and Communication Engineering.

X. CENTRAL ADVISORY COMMITTEE

There shall be a Central Advisory Committee consisting of the following

a) Dean, Faculty of Technology, Chairman
b) Head of Institution
c) Dean, Under Graduate Studies
d) Dean, Post Graduate Studies
e) Heads of Departments

This Committee shall have the following functions-

1. Lay guidelines for executing all the provisions and stipulations of the programme.
2. Give an interpretation of the rules in case of differences of opinion, which shall be binding on all.

Program Outcomes (POs)

Electronics and Communication Engineering

After the completion of the Electronics and Communication Engineering programme the student will achieve the following outcomes:

1. Capability of applying knowledge of mathematics, basic sciences and engineering to solve Electronics Engineering problems.
2. Ability to create suitable models of complex systems and analyze them.
3. Capability to design/conduct experiments and draw inference and conclusions there from.
4. Ability to provide/devise solutions for engineering problems related to the needs of the Industries and Society.
5. Ability to apply knowledge of various electronics subjects to develop useful products/prototypes/hardware/software.
6. Capability to understand professional and ethical responsibilities.
7. Capability to communicate effectively, orally as well as in writing.
8. Ability to work independently as well as part of teams.

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

SCHEME - SEMESTER-WISE COURSE ALLOCATION

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING-SEMESTER I													
Course Code	Type	Course	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Pre-requisites
							Theory			Practical		
							CA	MS	ES	CA	ES	
FC001	FC	Mathematics-I	3	1	0	4	25	25	50	-	-	None
FC002	FC	Computer Programming	3	0	2	4	15	15	40	15	15	None
FC003	FC	Electrical and Electronics Engineering	3	0	2	4	15	15	40	15	15	None
FC004	FC	Physics	3	0	2	4	15	15	40	15	15	None
FC005	FC	English –I	2	0	0	2	25	25	50	-	-	None
FExxx 1*	FE	Foundation Elective	-	-	-	2	-	-	-	-	-	-
			23-25 2*			**20**						

1*: The course codes, LTP distribution and Evaluation Scheme for Foundation Electives are given in Table 3.

2*: The actual weekly load depends upon the elective chosen by student under FE (Refer Table 3).

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

B.E. - ELECTRONICS AND COMMUNICATION ENGINEERING- SEMESTER II												
Course No.	Type	Course	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Pre-requisites
							Theory			Practical		
							CA	MS	ES	CA	ES	
FC006	FC	Mathematics-II	3	1	0	4	25	25	50	-	-	None
FC007	FC	English - II	2	0	0	2	25	25	50	-	-	None
ECC01	CC	Electronic Engineering Materials	3	1	0	4	25	25	50	-	-	None
ECC02	CC	Electronics I	3	0	2	4	15	15	40	15	15	None
ECCO3	CC	Digital Circuits and Systems	3	0	2	4	15	15	40	15	15	None
ECC04	CC	Electrical Machines	3	1	0	4	25	25	50	-	-	None
FExxx 1*	FE	Elective Foundation	-	-	-	2	-	-	-	-	-	-
			26-28 2*			**24**						

1*: The course codes, LTP distribution and Evaluation Scheme for Foundation Electives are given in Table 3.

2*: The actual weekly load depends upon the elective chosen by the student under FE (Refer Table 3)

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING- AUDIT COURSES AFTER SEMESTER II					Evaluation Scheme	
Course No.	**Type**	**Course**	**LTP**	**Credits**	**Theory CA-MS-ES**	**Practical CA-ES**
ACxx	**Audit**	Audit Courses can be floated during summer break after 2nd semesters on: (I) Courses for improvement: These will not be shown on the degree. (II) Courses on new themes: These will be shown on the degree.	-	NIL	The evaluation scheme and minimum grades for getting "Satisfactory" level, will be decided by the Department. Student has to achieve the minimum grades prescribed for getting "Satisfactory" level.	

AC: Audit Course

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING-SEMESTER III												
Course No.	**Type**	**Course**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ECC05	CC	Mathematics III	3	1	0	4	25	25	50	-	-	None
ECC06	CC	Electronics II	3	0	2	4	15	15	40	15	15	None
ECC07	CC	Network Analysis and Synthesis	3	1	0	4	25	25	50	-	-	None
ECC08	CC	Signals and Systems	3	1	0	4	25	25	50	-	-	None
ECC09	CC	Electromagnetic Field Theory	3	1	0	4	25	25	50	-	-	None
FExxx 1*	FE	Elective Foundation	-	-	-	2	-	-	-	-	-	-
			23-25 2*			**22**						

1*: The course codes, LTP distribution and Evaluation Scheme for Foundation Electives are given in Table 3.

2*: The actual weekly load depends upon the elective chosen by the student under FE (Refer Table 3).

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B.E. ELECTRONICS AND COMMUNICATION ENGINEERING -SEMESTER IV												
Course No.	**Type**	**Course**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ECC10	CC	Linear Integrated Circuits	3	0	2	4	15	15	40	15	15	None
ECC11	CC	Data Structures	3	0	2	4	15	15	40	15	15	None
ECC12	CC	Transmission Lines and Waveguides	3	1	0	4	25	25	50	-	-	None
ECC13	CC	Probability Theory and Communication	3	0	2	4	15	15	40	15	15	None
ECC14	CC	Control Systems	3	1	0	4	25	25	50	-	-	None
FExxx 1*	FE	Elective Foundation	-	-	-	2	-	-	-	-	-	-
			25-27 2*			**22**						

1*: The course codes, LTP distribution and Evaluation Scheme for Foundation Electives are given in Table 3.

2*: The actual weekly load depends upon the elective chosen by the student under FE (Refer Table 3).

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING – AUDIT COURSES AFTER SEMESTER IV					Evaluation Scheme	
Course No.	**Type**	**Course**	**LTP**	**Credits**	**Theory CA-MS-ES**	**Practical CA-ES**
ACxxx	**Audit**	Audit Courses can be floated during summer break after 4th semester on: (i) Courses for improvement: These will not be shown on the degree. (ii) Courses on new themes : These will be shown on the degree.	-	NIL	The evaluation scheme and minimum grades for getting "Satisfactory' level, will be decided by the Department. Student has to achieve the minimum grades prescribed for getting "Satisfactory" level.	

AC: Audit Course

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING -SEMESTER V												
Course No.	**Type**	**Course**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ECC15	CC	Digital Signal Processing	3	0	2	4	15	15	40	15	15	None
ECC16	CC	Digital Communication	3	0	2	4	15	15	40	15	15	None
ECC17	CC	Microprocessor and its Applications	3	0	2	4	15	15	40	15	15	None
ECC18	CC	Antenna and Wave Propagation	3	0	2	4	15	15	40	15	15	None
1*	**EG/ED /EO**	Elective(s)	-	-	-	-	-	-	-	-	-	-
			2*			**16-28 3***						

1*: The LTP allocation, Evaluation Scheme and Pre-requisites for Electives are given in Tables 4-6. The course code will depend upon the elective(s) chosen by the student.

2*: The actual weekly load will depend upon the elective(s) chosen by the student.

3*: A student may register for courses leading to a minimum of 16 credits and a maximum of 28 credits. Normally, a student registers for courses leading to 22 credits.

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B.E. ELECTRONICS AND COMMUNICATION ENGINEERING-SEMESTER VI												
Course No.	**Type**	**Course**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ECC19	CC	Microwave Engineering	3	0	2	4	15	15	40	15	15	None
ECC20	CC	VLSI	3	0	2	4	15	15	40	15	15	None
ECC21	CC	Computer Networks	3	1	0	4	25	25	50	-	-	None
1*	**EG/ED /EO**	Elective(s)	-	-	-	-	-	-	-	-	-	-
			2*			**12-28 3***						

1*: The LTP allocation, Evaluation Scheme and Pre-requisites for Electives are given in Tables 4-6. The course code will depend upon the elective(s) chosen by the student.

2*: The actual weekly load will depend upon the elective(s) chosen by the student.

3*: A student may register for courses leading to a minimum of 12 credits and a maximum of 28 credits. Normally, a student registers for courses leading to 22 credits.

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING- TRAINING AFTER SEMESTER VI												
Course No.	**Type**	**Course**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ECC221*	**CC**	Training	--	-	-	2	-	-	-	40	60	None

1*: Students will undergo Training in the Industry/research organization/ reputed institution during the Summer vacation after sixth Semester. This will be evaluated as a VII Semester subject during end-semester examination.

Training gives exposure to students on the working of the industry on research directions and practical applications of Electronics and Communication Engineering and on work ethics.

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B.E. ELECTRONICS AND COMMUNICATION ENGINEERING -SEMESTER VII												
Course No.	**Type**	**Course**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ECC22 1*	CC	Training	-	-	-	2	-	-	-	40	60	None
ECC23 2*	CC	Project-I	-	-	-	4	-	-	-	40	60	None
3*	**EG/ED/ EO**	Elective(s)	-	-	-	-	-	-	-	-	-	-
			4*			**6-28 5***						

1*: Training undertaken by students during the Summer vacation after sixth Semester will be evaluated as a VII Semester subject during end-semester examination.

2*: Project work is based on the students' ability to understand, design and implement the fundamental concepts of the basic sciences, mathematics, engineering subjects and human values.

3*: The LTP allocation, Evaluation Scheme and Pre-requisites for Electives are given in Tables 4-6. The course code will depend upon the elective(s) chosen by the student.

4*: The actual weekly load will depend upon the elective(s) chosen by the student.

5*: A student may register for courses leading to a minimum of 6 credits and a maximum of 28 credits. Normally, a student registers for courses leading to 22 credits.

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B.E. ELECTRONICS AND COMMUNICATION ENGINEERING -SEMESTER VIII												
Course No.	**Type**	**Course**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ECC24 1*	CC	Project-II	-	-	-	4	0	0	0	40	60	None
2*	**EG/ED/ EO**	Elective(s)	-	-	-	-	-	-	-	-	-	-
			3*			4-28 4*						

1*: Project work is based on the students' ability to understand, design and implement the fundamental concepts of various basic sciences, mathematics, human values and engineering subjects.

2*: The LTP allocation, Evaluation Scheme and Pre-requisites for Electives are given in Tables 3-6.

3*: The actual weekly load will depend upon the elective(s) chosen by the student.

4*: A student may register for courses leading to a minimum of 4 credits and a maximum of 28 credits. Normally, a student registers for courses leading to 22 credits.

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TABLE-3 LIST OF FOUNDATION ELECTIVES										
Code	Name of Foundation Elective	LTP Allocation			Evaluation Scheme					Pre-Requisites
					Theory			Practical		
		L	T	P	CA	MS	ES	CA	MS	
FE001	Sports-I	0	0	4	-	-	-	60	40	None
FE002	Sports-II	0	0	4	-	-	-	60	40	FE001
FE003	NSS	0	0	4	-	-	-	60	40	None
FE004	NCC	0	0	4	-	-	-	60	40	None
FE005	Corporate Social Responsibility	2	0	0	25	25	50	-	-	None
FE006	Environmental Sciences	2	0	0	25	25	50	-	-	None
FE007	Environment development and Society	2	0	0	25	25	50	-	-	None
FE008	Spoken Skills in English	2	0	0	25	25	50	-	-	None
FE009	Financial Literacy	2	0	0	25	25	50	-	-	None
FE010	Introduction to Indian society	2	0	0	25	25	50	-	-	None
FE011	Soft Skills and Personality Development	1	0	2	-	-	-	60	40	None
FE012	Business Communication and Presentation Skills	1	0	2	-	-	-	60	40	None
FE013	Theatre	0	0	4	-	-	-	60	40	None

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FE014	Dance	0	0	4	-	-	-	60	40	None
FE015	Yoga	0	0	4	-	-	-	60	40	None
FE016	Digital Film Making	0	0	4	-	-	-	60	40	None
FE017	Workshop (Electrical and Mechanical)	0	0	4	-	-	-	60	40	None
FE018	Music	0	0	4	-	-	-	60	40	None
FE019	Sociology of development	2	0	0	25	25	50	-	-	None
FE020	Universal Human Values 1: Self and Family	2	0	0	25	25	50	-	-	None
FE021	Universal Human Values 2: Self, Society and Nature	2	0	0	25	25	50	-	-	FE020

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TABLE 4 - PART B: DISCIPLINE SPECIFIC ELECTIVES WITH TUTORIAL

TABLE 4: LIST OF DISCIPLINE CENTRIC ELECTIVES

PART A: WITH PRACTICAL

LTP Allocation			Evaluation Scheme				
			Theory			Practical	
L	T	P	CA	MS	ES	CA	ES
3	0	0	25	25	50	15	15

Code	Name of Elective	Pre-Requisites
ECD 01	Statistical Signal Processing	ECC15
ECD 15	Video Processing	ECC15
ECD 02	Speech Processing	ECC15
ECD 16	Radar SP	ECC15
ECD 03	Image Processing	ECC15
ECD 17	Wavelets and applications	ECC15
ECD 04	Wireless Communication	ECC16
ECD 18	Cryptography	ECC15
ECD 05	BiCMOS AIC	ECC10
ECD 19	Pattern Recognition	ECC15
ECD 06	Low power VLSI Design	ECC20
ECD 20	VLSI DSP	ECC15
ECD 07	Analog filter design	ECC10
ECD 21	Selected topics in SP	ECC15
ECD 08	Embedded System Design	ECC17
ECD 22	Detection and estimation theory	ECC16
ECD 09	Computer Architecture & Digital Hardware design	ECC17
ECD 23	Optical fiber networks	ECC16
ECD 10	Microstrip Circuit Design	ECC12
ECD 24	Selected topics in Communication	ECC16
ECD 11	Advanced Antenna theory and Design	ECC18
ECD 25	Information theory	ECC16
ECD 12	RF and Microwave Circuit Design	ECC19
ECD 26	Satellite communication	ECC16
ECD 13	Advanced DSP	ECC15
ECD 27	Optical wireless Communication	ECC16
ECD 14	Digital System design using VHDL/Verilog	ECC03
ECD 28	MIMO Communication	ECC16

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ECD 29	Coding Theory	ECC16
ECD 30	Telecommunication Switching	ECC16
ECD 31	Wireless Sensor Networks	ECC16
ECD 32	Cognitive Radio	ECC16
ECD 33	Green Communication	ECC16
ECD 34	Analog CMOS Design	ECC06
ECD 35	Mixed Signal Design	ECC10
ECD 36	IC Testing & Characterization	ECC20
ECD 37	Electronic Design Automation	ECC20
ECD 38	Optimization of CMOS Integrated Circuits	ECC20
ECD 39	Selected topics in Analog Signal Processing	ECC20
ECD 40	VLSI Technology & Design	ECC20
ECD 41	System in Chip	ECC20
ECD 42	Deep sub-micron CMOS IC Design	ECC20
ECD 43	Semiconductor memory Design	ECC20
ECD 44	Device modeling and circuit simulation	ECC10
ECD 45	ASIC Design	ECC20
ECD 46	Pulse Digital Circuits	ECC03
ECD 47	Switching theory & Automata	ECC03

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ECD 48	Robotics & Automation	ECC17
ECD 49	Computational Electromagnetics	ECC19
ECD 50	Radar and Navigation	ECC18
ECD 51	Phased Array Antennas	ECC18
ECD 52	Advanced Microwave Engineering	ECC19
ECD 53	Electromagnetic Interference and Compatibility	ECC09
ECD 54	RF MEMS and their Applications	NONE
ECD 55	Quantum Field Theory	NONE
ECD 56	Selected topics in Microwave Engineering	ECC19

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TABLE 5
GENERIC ELECTIVES (EG) **A STUDENT MAY TAKE ANY COURSE OFFERED BY ANY DEPARTMENT OF THE INSTITUTE UNDER THE CATEGORIES OF CORE COURSE (CC) AND DISCIPLINE CENTRIC ELECTIVE (ED). HOWEVER, SUCH OPTIONS SHALL BE OFFERED TO A STUDENT AS PER PRESCRIBED GUIDELINES OF THE INSTITUTE**

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TABLE-6 LIST OF OPEN ELECTIVES										
Code	Name of Open Elective	LTP Allocation			Evaluation Scheme					Pre-Requisites
					Theory			Practical		
		L	T	P	CA	MS	ES	CA	MS	
EO001	Technical Communication	3	1	0	25	25	50	-	-	None
EO002	Disaster Management	3	1	0	25	25	50	-	-	None
EO003	Basics of Financial Management	3	1	0	25	25	50	-	-	None
EO004	Basics of Human Resource Management	3	1	0	25	25	50	-	-	None
EO005	Project Management	3	1	0	25	25	50	-	-	None
EO006	Basics of Corporate Law	3	1	0	25	25	50	-	-	None
EO007	Biological computing	3	1	0	25	25	50	-	-	None
EO008	Basics of social sciences	3	1	0	25	25	50	-	-	None
EO009	Entrepreneurship	3	1	0	25	25	50	-	-	None
EO010	Social work	3	1	0	25	25	50	-	-	None
EO011	Intellectual Property and Patenting	3	1	0	25	25	50	-	-	None
EO012	Supply Chain Management-Planning and logistics	3	1	0	25	25	50	-	-	None
EO013	Organization Development	3	1	0	25	25	50	-	-	None
EO014	Industrial Organisation and Managerial Economics	3	1	0	25	25	50	-	-	None
EO015	Global Strategies and Technology	3	1	0	25	25	50	-	-	None
EO016	Engineering System Analysis and Design	3	1	0	25	25	50	-	-	None

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EO017	Biology for Engineers	3	1	0	25	25	50	-	-	None
EO018	Energy, Environment and Society	3	1	0	25	25	50	-	-	None
EO019	Public Policy and Governance	3	1	0	25	25	50	-	-	None
EO020	Numerical Methods	3	0	2	15	15	40	15	15	None
EO021	Mathematical Statistics	3	1	0	25	25	50	-	-	None
EO022	Abstract and Linear Algebra	3	1	0	25	25	50	-	-	None
EO023	Optimization Techniques	3	1	0	25	25	50	-	-	None
EO024	Introduction to Mathematical Software and Programming Languages	2	0	4	15	15	40	15	15	None
EO025	Mathematical Finance	3	1	0	25	25	50	-	-	None
EO026	Quantum Electronics	3	0	2	15	15	40	15	15	None
EO027	Laser Systems and Applications	3	0	2	15	15	40	15	15	None
EO028	Optoelectronics and Photonics	3	0	2	15	15	40	15	15	None
EO029	Electromagnetic Theory and Waveguides	3	0	2	15	15	40	15	15	None
EO030	Polymer Science and Technology	3	0	2	15	15	40	15	15	None
EO031	Semiconductor Physics and Devices	3	0	2	15	15	40	15	15	None
EO032	Elements of Fibre Optics	3	0	2	15	15	40	15	15	None
EO033	Material Physics	3	0	2	15	15	40	15	15	None
EO034	Advanced Electromagnetic Theory and Relativity	3	0	2	15	15	40	15	15	None
EO035	Fibre and Integrated Optics	3	0	2	15	15	40	15	15	None
EO036	Condensed Matter Physics	3	0	2	15	15	40	15	15	None

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EO037	Microwave	3	0	2	15	15	40	15	15	None
EO038	Fundamentals of Instrumentation and experimental techniques in Physics	3	0	2	15	15	40	15	15	None
EO039	Lasers and Photonics	3	0	2	15	15	40	15	15	None

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SYLLABUS OF FOUNDATION CORE COURSES

Course No.	Title of the Course	Course Structure	Pre-Requisite
FC001	Mathematics I	3L-1T-0P	**None**

COURSE OUTCOMESS (CO):

1. Analyze and test infinite series for its convergence.
2. Find Taylor's series expansion, maxima & minima of functions of one and more variables.
3. Calculate length, area, radius of curvature, surface of revolution and volume of revolution.
4. Calculate area of a given region and volume enclosed by a surface.

COURSE CONTENT:

Infinite Series: Tests for convergence of series (Comparison, Integral, Ratio's, Raabe's, Logarithmic and nth root), Alternating series, Absolute convergence, Conditional convergence.

Function of Single Variable: Hyperbolic functions, Taylor's and Maclaurin's theorems with remainder terms, Polar Curves, Angle between tangent and radius vector, Curvature and Radius of Curvature, Asymptotes, Curve tracing, Applications of definite integral to area, arc length, surface area and volume of revolution (in Cartesian, parametric and polar co-ordinates).

Function of Several Variables: Partial Derivatives, Differentiability, Total differential, Euler's theorem, Jacobian, Taylor's theorem, Maxima and Minima for functions of two or more variables, Extreme values, Lagrange's method of undetermined multipliers, Differentiation under the integral sign.

Multiple Integrals: Evaluation of double integral (in Cartesian and polar co-ordinates) change of order of integration, integration by change of variables and its applications in area, mass, and volume. Triple integral (in Cartesian, cylindrical and spherical co-ordinates) and its application in volume.

SUGGESTED READINGS:

1. G. B. Thomas and R. L. Finney, ``Calculus and Analytic Geometry,'' Pearson Education
2 R. K. Jain and S. R. K. Iyenger, ``Advanced engineering mathematics,'' Narosa Publication
3 Erwin Kreyszig, `` Advanced engineering mathematics,'' Wiley Publication
4 Michael Greenberg, ``Advanced engineering mathematics,'' Pearson Education

Course No.	Title of the Course	Course Structure	Pre-Requisite
FC002	Computer Programming	3L-0T-2P	**None**

COURSE OUTCOMESS (CO):

1. To understand the basic terminology program structures used in computer programming to solve real world problems.

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2. To learn the process of representing problems and writing, compiling and debugging programs..
3. To develop programming skills in using different types of data, decision structures, loops functions, pointers, data files and dynamic memory allocation/de-allocation.
4. To understand the need for continuing to learn new languages to solve complex problems in different domains.

COURSE CONTENT:

C Programming Language

Thinking like a programmer: problem solving. Components of a problem, algorithm, checking for errors and inconsistencies, writing a pseudocode.

Boolean Logic: Binary Number systems and codes and operations.

Introduction to programming& Basics of C: Concepts of Algorithm and Flowcharts, Process of compilation, Basic features of C Language like Identifier, Keywords, Variable, data types, Operators and Expression, basic screen and keyboard I/O, Control Statements, iteration, nested loops, Enumerated data types, bitwise operators, C Preprocessor statements.

Arrays and Pointers: One and multidimensional dimensional arrays, strings arrays, operations on strings, Array and Pointers, Pointers and strings, Pointer to Pointer, other aspect of pointers,User Defined Data Types: Structures, Unions, bit fields.

Functions: Concept of modular programming, Using functions, Scope of data, Recursive functions, Pointers and functions, Command line arguments.

Linked List: Dynamic memory allocation, singly link list, traversing, searching, insertion, deletion.

Files: Types of files, working with files, usage of file management functions.

C++ Programming Language

Moving from C to C++: Concepts of Object Orientation, Objects, classes, encapsulation, data abstraction, inheritance, delegation, software reuse. Inheritance visibility rules using public, private, protected, member functions: Constructors / destructors, operator (::),accessing member functions within a class, new, delete.

Friend functions and classes, static data and functions, function templates, pointers within a class, passing / returning objects as arguments.

Functions Polymorphism – virtual functions, function overloading, variable definition at the point of use, reference variables, strict type checking, default arguments, type conversion.

Exception handling, streams based I/O.

Trends: Kinds of programming languages.

Guidelines for practical work based on programming concepts:

Programs for temperature conversion, area of triangle, counting frequencies of letters, words to understand the basic data types, input-output, control flags.

Programs for decision making using selection, looping, processing of arrays for sorting, searching , string manipulations, matrix operations.

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Programs for parameter passing to functions, returning values, interactions among functions, pointer with arrays, strings, call by reference.

Programs using structure , pointers and files for linked lists , inventory management etc.

Program using bit wise operators to simulate the combinational circuits.

Program showing the concept of objects, access specifiers and inheritance.

SUGGESTED READINGS:

1. B. W. Kernighan and D.M. Ritchie," The C programming language,'' Prentice Hall India
2. Herbert Schildt , ``C: The Complete Reference,'' Tata McGraw Hill.
3. Yashwant Kanitkar, ``Let us C,'' BPB Publication
4. Byron Gottfried, `` Schaum's Outline of Programming with C,'' Schaum Series, Tata McGraw Hill
5. Budd, ``Object Oriented Programming ,'' Addison Wesley
6. D Samantha, ``Object oriented Programming in C++ and Java,'' Prentice Hall India
7. Stroustrup, ``Programming in C++,'' Special Edition, Addison Wesley.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FC003	Electrical and Electronics Engineering	3L-0T-2P	**None**

COURSE OUTCOMESS (CO):

1. To understand the basic concepts of magnetic, AC & DC circuits
2. To learn the basics of semiconductor diodes, BJTs
3. Will be able to analyze basic electrical and electronic circuits

COURSE CONTENT:

D.C. Circuits and Theorems: Ohm's Law, KCL, KVL Mesh and Nodal Analysis, Circuit parameters, energy storage aspects, Superposition, Thevenin's, Norton's, Reciprocity, Maximum Power Transfer Theorem, Millman's Theorem, Star-Delta Transformation. Application of theorem to the Analysis of dc circuits.

A.C.Circuits: R-L, R-C, R-L-C circuits (series and parallel), Time Constant, Phasor representation, Response of R-L, R-C and R-L-C circuit to sinusoidal input Resonance-series and parallel R-L-C Circuits, Q-factor, Bandwidth.

Magnetic Circuits: Magnetomotive Force, Magnetic Field Strength; Permeability, Reluctance, Permeance, Analogy between Electric and Magnetic Circuits.

Semiconductor Diodes and Rectifiers: Introduction, general characteristics, energy levels, extrinsic materials n & p type, ideal diode, basic construction and characteristics, DC & AC resistance, equivalent circuits, drift & diffusion currents, transition & diffusion capacitance reverse recovery times, temperature effects, diode specifications, different types of diodes (Zener, Varactor, Schouky, Power, Tunnel, Photodiode & LED), Half wave & full wave rectifiers. Switched Mode Power Supply.

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Bipolar junction transistor: Introduction, Transistor, construction, transistor operations, BIP characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations, Eber-Moll's model.

Bias Stabilization: Need for stabilization, fixed bias, emitter bias, self bias, bias stability with respect to variation in I_{co} V_{BE} & β, Stabilization factors, thermal stability.

SUGGESTED READINGS:

1. Vincent Del Toro, ``Electrical Engineering Fundamentals,'' Prentice Hall of India
2. Mittle and Mittal, ``Basic Electrical Engineering,'' Tata Mc-Graw Hill Publication.
3. Boylestad and Nashelsky, ``Electronic Devices and Circuit Theory,'' Pearson Publication.
4. Millman & Grabel, ``Microelectronics,'' Tata Mc-Graw Hill Publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FC004	Physics	3L-0T-2P	**None**

COURSE OUTCOMESS (CO):

1. Knowing important concepts and phenomena linked to relativity, waves and oscillations and be able to do analytical and numerical calculations for faithful measurements, observations and gravitational wave communications.
2. The course is helpful to the students in understanding various optical wave phenomena which are required for optical & electromagnetic wave communications and in optical devices.
3. Concepts of Laser and Optical Fiber for modern developments in physics which are helpful in designing and developing new devices used in optical communications, medicine, environment, industries and related physics.

COURSE CONTENT:

Relativity: Special Relativity**,** Lorentz Transformations, Velocity addition, Time dilation, Length Contraction, Variation of mass with velocity, Mass and energy, Relativistic momentum and relativistic energy, General theory of relativity, Einstein's theory of Gravitation, Gravitational waves, Gravity and Light.

Oscillations and Waves: Damped and forced oscillations, Sharpness of resonance, Q-factor, Application in resonance, Acoustic waves, Pressure wave equations, Intensity pressure relation, Acoustic impedance, Reflection and transmission of acoustic waves, Impedance matching; Ultrasonics and its applications.

Optics: Interference: Interference due to thin films, Newton's rings, and determination of the wavelength of sodium light, Interference due to wedge shaped film. Diffraction: Fraunhofer diffraction due to single slit and N Slits, Plane transmission grating, Rayleigh criterion of resolution, Resolving power of a grating, Polarization: Polarization in light, Birefringence, Nicol prism, Quarter and half wave plates, Production and analysis of plane, Circularly and elliptically polarized light, Optical rotation, specific rotation, Polarimeter.

Quantum Theory of Light : Hertz's Experiments- Light as an Electromagnetic Wave, Blackbody radiation, Light Quantization, Compton Effect , X-rays.

LASERS : Absorption and emission of radiation, Main features of a laser, Spatial and temporal coherence, Einstein Coefficients, condition for light amplification, Basic requirement for Laser, Population Inversion - Threshold Condition, Line shape function , Optical Resonators , Three level and four level systems.

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Classification of Lasers: Solid State Laser-Ruby laser and Gas Laser- He-Ne laser (Principle, Construction and working), Optical properties of semiconductor, Semiconductor laser (Principle, Construction and working), Applications of lasers in the field of medicine, Industry, Environment and Communication.

Fibre Optics : Need for fiber Optic Communication, Physical nature of Optical fiber, Theory of Light propagation in optical fiber, Acceptance angle and numerical aperture, Step index and graded index fibers, Single mode and multimode fibers, Losses in optical fiber, Optical Fiber cables and bundles, Dispersion in optical fibers: Intermodal and Intramodal dispersion.

TERM WORK Experiments: Any ten experiments based on the theory course or related subject as above. For examples : Wavelength by diffraction grating, Newton's rings experiments and bi-prism assembly, resolving power of a Telescope, Nodal-Slide assembly , specific rotation of cane sugar by Polarimeter, dispersive power of Prism, Wavelength of He-Ne laser by diffraction, refractive index for O-ray and E-ray, Brewester's law, Ultrasonic interferometer, numerial aperture of an optical fibre, other experiments based on LASER and optical fiber.

SUGGESTED READINGS:

1. Arthur Beiser, Shobhit Mahajan,`` Concepts of Modern Physics,'' Mc-Graw Hill
2. Serwey , Moses, Moyer, ``Modern Physics,'' Cengage Learning
3. D S Mathur, ``Mechanics,'' S Chand & co.
4. Jenkins and White, ``Fundamentals of Optics,'' McGraw Hill
5. N. Subramaniam and Brij Lal, ``A Text Book of Optics,'' S Chand &Co.
6. Indu Prakash, ``A Text Book of Practical Physics, Volume-1,'' Kitab Mahal Publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FC005	English I	2L-0T-0P	**None**

COURSE OUTCOMESS (CO):

1. The course will focus on the four integral skills of language, improving the proficiency levels in all of them and to learn to use language as a tool for effective communication.
2. This course will widen the understanding of the learners in all genres of literature (short stories, poetry, autobiographies..) with the help of expository pieces .
3. The course will strive to equip the learner with the ability to express oneself and be understood by others with clarity and precision, in both written and spoken forms.
4. This course will encourage creative use of language through translation, paraphrasing and paragraph writing.
5. Along with the above, the course will also build confidence and encourage the students to use a standard spoken form of English in order to prepare them to face job interviews, workplace and in higher studies.

COURSE CONTENT:

- Practice in dictation, punctuation and spellings, listening and reading comprehension.
- Practice with well formed sentences with stress on remedial grammar.
- Exercises in unseen comprehension, paraphrasing, paragraph writing & summarizing.

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- Reinforcement in letter writing, preparing CVs, writing book reviews.
- Exposure to the nuances and usages of the language through newspapers and magazines as an exercise to be in line with current form of language used.
- Proficiency in spoken English with focus on confidence building and standard pronunciation through language lab sessions.

Literature

1. Sadat Hasan Manto: Toba Tek Singh,
2. Abdul Kalam: Wings of Fire (excerpts)
3. Jhumpa Lahiri: The Namesake (excerpts)
4. Khaled Hosseini: The Kite Runner (excerpts)
5. Mohan Rakesh: Halfway House

Language Skills

1. Dictation, punctuation and spellings, listening and reading comprehension.,
2. Correspondence(formal & informal)
3. Reading editorials, columns, speeches & essays

SUGGESTED READINGS:

Margaret M Maison, ``*Examine Your English*,'' Orient Blackswan.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FC006	Mathematics II	3L-1T-0P	**None**

COURSE OUTCOMESS (CO):

1. Solve system of equations and know the concepts of eigenvalue and eigenvector.
2. Know the concepts of Ordinary Differential Equations and its applications.
3. Know the concepts of Special Functions.
4. Know the concepts of Laplace Transforms and its application to solve Differential Equations

COURSE CONTENT:

Matrices: Rank, inverse and normal form of a matrix using elementary transformations, consistency of linear system of equations; linear dependence/ independence, linear transformations, eigenvalues and eigenvectors of a matrix, Cayley-Hamilton theorem, diagonalization.

Ordinary Differential Equations: Second & higher order linear differential equation with constant coefficients, general solution of homogenous and non- homogenous equations, Euler-Cauchy equation, Application to mass- spring system and electrical circuits. Power series method.

Special Functions: Beta and Gamma functions, Dirichlet's Integral. Legendre equation, Legendre polynomials and its properties, Bessel equation, and Bessel function of first kind and its properties, ber and bei functions.

Laplace Transforms: Basic properties, Laplace transform of derivatives and integrals. Laplace of periodic

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functions. Laplace transforms solution of IVP and simultaneous linear differential equations, unit step function, Dirac-Delta function. Inverse Laplace transform, Convolution theorem.

SUGGESTED READINGS:

1. G. B. Thomas and R. L. Finney, `` Calculus and Analytic Geometry,'' Pearson Education.
2 R. K. Jain and S. R. K. Iyenger, ``Advanced engineering mathematics,'' Narosa Publication
3 Erwin Kreyszig, ``Advanced engineering mathematics,'' Wiley Publication
4 Michael Greenberg,`` Advanced engineering mathematics,'' Pearson Education.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FC007	English II	2L-0T-0P	**None**

COURSE OUTCOMESS (CO):

1. The course will focus on the four integral skills of language, improving the proficiency levels in all of them and to learn to use language as a tool for effective communication.
2. This course will widen the understanding of the learners in all genres of literature (short stories, poetry, autobiographies..) with the help of expository pieces .
3. The course will strive to equip the learner with the ability to express oneself and be understood by others with clarity and precision, in both written and spoken forms.
4. This course will encourage creative use of language through translation, paraphrasing and paragraph writing.
5. Along with the above, the course will also build confidence and encourage the students to use a standard spoken form of English in order to prepare them to face job interviews, workplace and in higher studies.

COURSE CONTENT:

Literature

1. Anton Chekov: The Bet
2. Guy de Maupassant: The Necklace
3. D H Lawrence: Odour of Chrysanthemums
4. R K Narayan: Malgudi Days
5. Sarojini Naidu: Bangle Sellers
6. Rupert Brooke: The Soldier/Siegfried Sassoon: Suicide in the Trenches

Language Skills

1. translation, paragraph writing, paraphrasing, summarizing,
2. comprehension
3. Presentations/book reviews/reading exercises

SUGGESTED READINGS:

1. Martin Hewing, ``Advanced English Grammar,'' Cambridge University Press.
2. Meenakshi Raman & Sangeeta Sharma, ``Technical Communication,'' Oxford University Press.
3. Renu Gupta, ``A Course in Academic Writing,'' Orient Blackswan.

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SYLLABUS OF CORE COURSES

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC01	Electronic Engineering Materials	3L-1T-0P	**None**

COURSE OUTCOMESS (CO):

This course prepares students to take advanced courses in the related fields and finally equips them to take up R&D in materials science and solid state physics. This course is very helpful in understanding the various phenomena/mechanisms which are very useful in designing electronic devices, energy storage devices, superconducting and innovative & compact design based on nano technology.

COURSE CONTENT:

Crystal Structures, Imperfections and Bonding in Solids - Bravis lattice, Miller indices, Simple crystal structure, Different kinds of bondings. Types of imperfections, effect of imperfections, Point defects, Edge and Screw dislocations, Berger's vector, Crystal growth-Introduction.

Classical and Quantum Theory of Metals: Free electron model, Energy distribution of electrons in a metal, Fermi Dirac Probability function, Fermi level, Conduction process.

Band Theory of Solids : Isolated- Atom Approach to Band Theory, Bloch theorem, Kronig - Penney Model, Effective mass of an electron, conduction in metals, semiconductors and insulators , Energy band diagram.

Semiconductors: Carrier concentration in intrinsic and extrinsic semiconductors, effect of temperature and impurity on conductivity, life time, recombination process, Hall Effect, drift and diffusion, compensated semi conductors. Semiconductor devices: junction transistor, FET and IC.

Dielectric Materials : Dielectric polarization, types of polarization, local electric field, Clausius-Mossotti relation, Debye's equation and molecular structure, dielectric breakdown, piezoelectricity , ferroelectricity, electrats, ceramics, effect of frequency and temperature on polarization.

Magnetic Materials: Ferromagnetism, Antiferro, Ferri-ferro magnetism, ferrites, magnetic storage.

Superconductors: Types of superconductors, Meissner effect, BCS theory, Josephson's effect, London penetration depth, high temperature superconductors, future applications.

Introduction to Nanoscience and Nanotechnology: Basic principles of Nanoscience and Nanotechnology, Synthesis of nanoparticles (mechanical grinding, wet chemical synthesis, sol-gel processing, gas phase synthesis, gas condensation processing, chemical vapor condensation), properties of nanoparticles , categories of nanomaterials, quantum well, quantum wire and quantum dots, carbon nanotubes – structure, properties and uses, applications of nanotechnology.

TERM WORK Experiments: Any ten experiments based on the theory course or related subject as above. For examples : Current sensitivity and resistance of a Ballistic Galvanometer, calibration of a given Voltmeter and Ammeter, sparking potential of a Neon Lamp, resistivity of a semiconductor using Four Probe Method, Band Gap of a given specimen, high resistance by Leakage Method, work function by using Richardson Equation, susceptibility of $MnCl_2$, to determine the Plank's Constant, characteristics of a GM

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Tube, Diode characteristics, Solar cell characteristics, e/m by Thomson's method, Uses of CRO for different measurement, Hall effect and Hall coefficient.

SUGGESTED READINGS:

1. A. Bieser, ``Concepts of Modern Physics,'' McGraw Hill
2. John Allison, ``Electronic Engineering Materials and Devices,'' Tata McGraw Hill
3. A .J Dekker, ``Electronic Engineering Materials,'' Prentice Hall
4. LH Van Vlack, ``Elements of Material Science and Engg,'' Addision Wesley
5. C Kittel, ``Solid State Physics,'' Wiley Publication
6. A.S. Vasudeva, ``Modern Engineering Physics,'' S. Chand Publication.
7. C.P Poole and F .J Owens, ``Introduction to nanotechnology,'' Wiley Publication

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC02	Electronics I	3L-0T-2P	**None**

COURSE OUTCOMES (CO):

1. Review of basic concepts of semiconductor physics
2. An understanding of operation of p-n junction diode with its small and large signal models with its terminal characteristics and derivation of diode equation.
3. Application of diode in rectifier with filter, clipper and clampers
4. Zener diode as regulator.
5. An understanding of physical structure of Bipolar junction transistor with operation in various modes of operation with derivation of collector current equation.
6. Understanding of load line and need for biasing with various types of biasing techniques and current mirrors.
7. Analysis of EC, CB, CC and CE with Re as an amplifier
8. An understanding of physical structure of JFET and MOSFET with operation, and both T type and π type of models.
9. Understanding of load line and need for biasing with various types of biasing techniques with analysis of CS, CD , CG and Cs with Rs as an amplifier.
10. Understanding of Thyristors and other semi conductor devices

COURSE CONTENT:

Review of semiconductor physics: Conduction in metal and electron gas, current density, conductivity, and resistivity, concept of holes and electrons, n and p type semiconductor. Mass action law, carrier concentrations, generation and recombination of charges, effect of temperature on properties of silicon, drift and diffusion current, Einstein relationship, total current, graded semiconductor and calculation of barrier potential, step graded junction.

p-n junction diode: The ideal diode, Terminal characteristics and physical operation of junction diode; forward biased region, reverse biased region, and breakdown regions, Derivation of diode equation. Modelling the diode's forward characteristics; The exponential model, graphical analysis using exponential model, iterative analysis using exponential model, the need for rapid analysis, the piecewise linear model,

the constant voltage drop model, the ideal diode model, the small signal model and its application, analysis of diode circuits.

Diode applications: Limiting and clamping circuits, rectifier circuits and smoothing filter, zener diode, avalanche diode, zener diode as regulator.

Bipolar Junction Transistor: Physical structure & modes of operation, operation of the BJT in active mode, circuit symbols and conventions, graphical representation of transistor characteristics, analysis of transistor circuits at DC, the transistor as an amplifier and switch.

Biasing the BJT amplifiers: classification of discrete circuit bias arrangement, two power supply version of classical bias arrangement, biasing using collector to base feedback resistor, biasing using constant current source: simple current mirror, Wilson and widlar current source, current source with gain, cascade current source.

Small signal equivalent models (both T and Π models), Graphical Analysis, Basic single-stage BJT amplifier configurations, characterization (CE,CB, CC and CE with R_E), The Ebers-Moll model for BJT, The basic BJT logic inverter

MOSFET, JFET: Structure and physical operation of enhancement type MOSFET, current voltage characteristics of enhancement type MOSFET, MOSFET circuits at DC, MOSFET as an amplifier. Biasing in MOS amplifier circuits, Basic configuration of single-stage IC MOS amplifiers, The CMOS digital logic inverter, The MOSFET as an analog switch, The MOSFET internal capacitance & high frequency model, The JFET

Thyristors & other special semiconductor devices, Unijunction transistor, SCR and its control circuit, DIAC

SUGGESTED READINGS:

1. A Sedra and K Smith, ``Microelectronics Circuit,'' Oxford University Press
2. Boylestad and Nashelsky, ``Electronics Devices and Circuits,'' Prentice Hall India
3. Millman and Grabel, ``Microelectronics,'' Tata Mc-Graw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC03	Digital Circuits and Systems	3L-0T-2P	**None**

COURSE OUTCOMES (CO):

1. Helping the students to gain insight into the subject, to develop suitable hardware/software that addresses the industrial/social problems effectively.
2. Introduce the concept of number systems with emphasis on binary numbers, its algebra and minimization techniques.
3. Design and analysis of combinational and sequential logic circuits.
4. Understanding various logic families used for the fabrication of digital ICs.
5. Understanding of various circuits like analog to digital convertors, digital to analog convertors, analog to frequency convertors etc.
6. To motivate the students towards professionalism effective communication skills and team work.

COURSE CONTENT:

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Number System: Conversion from one base to another, complements, Binary codes (BCD, 2421, excess-3, 84-2-1, gray), conversion form binary to gray and vice-versa, error correcting code (parity addition, Hamming code), Boolean Algebra: Axioms, Canonical & standard forms, Logic gates, Simplification of Boolean functions (up to 5 variables) using (i) K-map (ii) Tabulation (Quin-Mclusky) method, NAND & NOR implementation

Combinational Logic: Design procedure, Adders, Subs tractors, Code conversion, Binary parallel adder, Decimal adder, Magnitude comparator, Decoders, Encoders, Priority encoder, Multiplexer, Demultiplexer, ROM, PLA.

Sequential Logic: Flip-Flops, Analysis of sequential circuits, State reduction, State table, Excitation table, Design procedure, Registers, Shift registers, Ripple counter, Synchronous counter, Incorporate self correcting conditions in counters, Timing Sequences(Ring counter & Johnson counter).

Logic Families: Characteristics, RTL, DTL, TTL (including tri-state logic), ECL, IIL, PMOS, NMOS, CMOS (Basic circuits of all families with problems based on them), Comparison of families.

Data convertors: DAC, ADC, V/F

SUGGESTED READINGS:

1. M M Mano, ``Digital logic and computer design ,'' Prentica Hall India
2. Millman & Grabel, ``Microelectronics,'' Tata McGraw Hill
3. Donald D. Givone, ``Digital principles & design,'' Tata McGraw Hill
4. R. P. Jain, ``Modern digital electronics,'' Tata McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC04	Electrical Machines	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

1. To prepare students to perform the analysis of any electromechanical system.
2. To empower students to understand the working of electrical equipment used in everyday life.
3. Ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.

COURSE CONTENT:

Magnetic circuits, Single phase transformer – equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers – connections, parallel operation; auto-transformer; energy conversion principles; DC machines – types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors – principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines – performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

SUGGESTED READINGS:

1. E. Fitzgerald, C. Kingsley Jr and Umans, ``Electric Machinery, '' McGraw Hill
2. Kothari & Nagrath, ``Electric Machines,'' Tata McGraw Hill
3. S. K. Bhattacharya, ``Electrical Machines,'' Tata McGraw Hill

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4. B. L. Theraja, and A. K. Theraja, ``Text of Electrical Technology; Vol,'' S. Chand Publication

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC05	Mathematics III	3L-1T-0P	**None**

COURSE OUTCOMES (CO):

1. Know the concepts of Fourier series, Fourier transforms and Harmonic analysis and its applications.
2. Know evolution of Partial Differential Equations and its methods of solutions for real life problems.
3. Know the concepts of functions of complex variables and its applications to evaluate real integrals.
4. Know the concepts of vector calculus such as gradient, curl, divergence and integral theorems such as Green's Theorem, Stoke's Theorem and Gauss Divergence Theorem and their applications in various fields.

COURSE CONTENT:

Fourier Series & Transforms: Periodic functions, Fourier series, Functions of any period p. Even and odd functions, Half range series, complex form of Fourier series, Harmonic analysis. Fourier transform and its properties, Fourier cosine and sine transforms and their properties, applications to PDE.

Partial Differential Equations: Solution of first order equations- Lagrange, non linear first order, Charpit's method, higher order linear equations with constant coefficients. Separation of variables, Solution of Heat, Wave and Laplace equations.

Complex Variables: Functions of a complex variable, analytic functions, harmonic functions, Cauchy - Riemann equations (Cartesian and polar form). Linear fractional transformation, Conformal mapping, Mapping of elementary functions (exponential, trigonometric, hyperbolic and logarithm functions), Contour integration, Cauchy's integral theorem and formula, Power series and its convergence, Taylor's and Laurent series, zeroes, Singularities, Residue theorem, Evaluation of real integrals(around unit circle, no singularity on real line , and singularity on real line) .

Vector Calculus: Differentiation of a vector function, scalar and vector fields, Gradient, Divergence, Curl, line integral, independence of path, Green's theorem and applications. Surface Integral, Stoke's theorem and applications; Volume Integrals, Gauss Divergence theorem and applications

Linear Algebra: Vector spaces, linear transformation

SUGGESTED READINGS:

1. Jain and Iyenger, ``Advanced Engineering Mathematics,'' Narosa Publication
2 Kreyszig, ``Advanced Engineering Mathematics,'' Wiley Publication
3 Greenberg, ``Advanced Engineering Mathematics,'' Pearson Education

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC06	Electronics II	3L-0T-2P	**None**

COURSE OUTCOMES (CO):

1.Understand about rectifiers, transistor and FET amplifiers and its biasing. Also compare the performances of its low frequency models. Solve the problems based on small signal and large signal analysis.
2. Discuss about the frequency response of MOSFET and BJT amplifiers. Understand the functioning of

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transistor in low and high frequency region.
3. Illustrate about MOS and BJT differential amplifiers and its characteristics.
4. Discuss about the feedback concepts and construct feedback amplifiers and oscillators. Also summarizes its performance parameters.
5. Explain about power amplifiers and its types and also analyze its characteristics.

COURSE CONTENT:

Amplifier stages at low frequencies: Cascade BJT amplifier, compound transistor stages (Darlington pair, CC-CE and Cascode amplifier), Millers theorem and its dual, Differential amplifier and its dc and ac analysis using BJT and MOSFET, Differential amplifier with active load

Frequency response of an amplifier: s-domain analysis: poles, zeros and Bode plot, The step response of an amplifier, The CE short circuit current gain, The high frequency response of CE, CS, emitter follower, source follower, CB and CG amplifier, The low frequency response of CE, CS, emitter follower, source follower, CB and CG amplifier, Frequency response of cascaded stages, Frequency response of cascode stage, Effect of coupling and bypass capacitor.

Feedback amplifier: The general feedback structure, Properties of negative feedback, Four basic feedback topologies, Analysis of Series- series, series shunt, shunt series and shunt- shunt feedback amplifier.

Oscillators: Sinusoidal oscillators, Barkhausen criteria, Phase shift oscillator, Wien's bridge oscillator, LC oscillators, crystal oscillator

Power amplifier: Classification of output stages, Class A output stage, transfer characteristics, efficiency of class A amplifier, Class B output stage, transfer characteristics, efficiency of class B amplifier, Push Pull amplifier, Class AB output stage, biasing of class AB output stage, Harmonic distortion. Regulated power supply

IC fabrication: Monolithic IC technology, Planar processor, BJT and FET fabrication, CMOS technology, miscellaneous aspects of IC fabrication

SUGGESTED READINGS:

1. A Sedra and K Smith, ``Microelectronics Circuit,'' Oxford University Press
2. Boylestad and Nashelsky, ``Electronics Devices and Circuits,'' Prentice Hall India
3. Millman and Grabel, ``Microelectronics,'' Tata McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC07	Network Analysis and Synthesis	3L-1T-0P	**None**

COURSE OUTCOMES (CO):

1. Use knowledge of basic laws to analyze complex networks and choose most appropriate method for solving the networks in time and frequency domain
2. Determine the transient response, Steady state response, network functions for networks
3. Understand the two-port network parameters, and design of transfer functions RL,RC,LC networks and its driving point functions
4. Synthesize one port network using Foster–I,II and Cauer-I, II Forms.

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5. Understand the basics of op-amps and Nullor as universal device
COURSE CONTENT: Two port parameters: Z,Y,H,G & transmission parameters, equivalent circuits, conversion of parameters, various types of inter-connection of two port networks; series-series, parallel-parallel, series-parallel, parallel-series and cascade connections. Review of Laplace transform and its properties, analysis using transform methods, impulse response and network function, convolution integral and its application, steps response, initial value and final value theorems and their applications Driving point function and transfer functions, ladder networks, poles and zeroes, relation between location of poles and time response, stability of networks Ideal op-amp, basic analog circuits using ideal op-amp: controlled sources, integrators, differentiators, adders, subtractor, Impedance converters and inverters, simulated inductance, generalized impedance converter Introduction to state variable theory, the concept of state and state variables, formulation of state equation of passive networks, formulation of state equation from transfer functions, op-amp realization of state equation using integrators and adders. State transition matrix and its properties, solution of linear time invariant differential equation using state variable method: general solution and its application Various types of passive RLC filters, Impedance scaling, Frequency transformations and their applications in designing passive filters from low pass prototypes, Op-amp RC filters: Sallen-Key and other single-op-amp filters, biquad filters Pathalogical elements : nullator, norator, and nullor, representation of ideal op-amp and ideal transistor by a pair of nullator and norator, representation of the four controlled sources by nullator-norator models, equivalent circuits of GIC using nullator-norator models Sinusoidal oscillators: basic theory, Wein Bridge, RC phase shift, twin-T and quadrature oscillator Introduction to MOS-Switched capacitor filters: MOS Switched capacitor as a resistor, basics building blocks, development of first order and second order filters
SUGGESTED READINGS: 1. F.F. Kuo, ``Network analysis and synthesis,'' John wiley Publication 2. M.E. Valkenberg, ``Analog Filter Design'' Oxford University Press. 3. L.T. Bruton, ``RC- Active circuits,'' Prentice Hall Publication

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC08	Signal and Systems	3L-1T-0P	**None**
COURSE OUTCOMES (CO): 1. Helping the students to gain insight into the subject, to develop suitable hardware/software that addresses the industrial/social problems effectively. 2. Impart the understanding about the fundamentals of signals and systems and their classification 3. Application of Fourier series/ Fourier transform for both continuous and discrete time signals and			

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the study of their properties. 4. To develop understanding of interconversion of signals. 5. Study and application of Laplace and Z transform
COURSE CONTENT: Classification of signals and systems, system properties, Continuous-time Fourier series and its properties, Discrete-time Fourier series and its properties, Continuous-time Fourier transform and its properties, Discrete-time Fourier transform and its properties, application to analysis of systems, Laplace transform, its properties, and its application to system analysis, Z-transforms, its properties and applications to system analysis, Hilbert transform and its properties, Representation of band pass signals
SUGGESTED READINGS: 1. Oppenheim, Willsky and Nawab, ``Signals & Systems,'' Prentice Hall India 2. Haykin and Van Veen, ``Signals & Systems,'' Wiley Publication 3. Tarun Kumar Rawat, ``Signals & Systems,'' Oxford University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC09	Electromagnetic Field Theory	3L-1T-0P	**None**

COURSE OUTCOMES (CO):

1. Helping the students to gain insight into the subject, to develop suitable hardware/software that addresses the industrial/social problems effectively.
2. Apply vector calculus to static electric-magnetic fields in different engineering situations.
3. Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems.
4. Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.
5. Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.
6. To motivate the students towards professionalism effective communication skills and team work.

COURSE CONTENT:

Review of Vector Analysis, Electrostatics Field, Coulomb Law and field Intensity, Electric fields due to Cartesian, Circular Cylindrical and Spherical Coordinate Systems, Vector Calculus: Basic Concept of Scalar and Vector Field (cross product and Dot product), Differential length, area and volume, Line, Surface and Volume integrals, Del operator, Gradient of a scalar, Divergence of a vector and divergence theorem, Curl of a vector and stoke theorem, Laplacian of a scalar and vector fields.

Electrostatic Field, Coulomb Law and Electric field Intensity, Electric fields due to point charge and continuous Line charge distributions, Electric Flux density, Gauss Law and its applications, Electric Potential, Relationship between E and V, Electric dipole and flux lines, Energy density in electrostatic fields. Properties of Dielectric Materials, Convection and conduction currents, conductors, Polarization in Dielectrics, Dielectric constants and strength, Continuity equation and relaxation time, Electric Field Boundary

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conditions. Poisson's and Laplace's equations, Uniqueness Theorem, General Procedure for solving Poisson's or Laplace's equation one dimensional and two dimensional cases, Resistance and Capacitance. Biot Savart's Law, Ampere's Law and its application, Magnetic Flux Density, Magnetic Scalar and Vector Potentials. Magnetic Forces and Magnetic Materials: Forces due to Magnetic Fields, Magnetic Torque and Moments, Magnetic dipole, Magnetization in Materials, Magnetic Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic circuits.

Time Varying Fields and Maxwell's Equation: Faraday's Law, Displacement Current, Maxwell's equations in Point Form and Integral Form with its physical significance, Wave Propagation in Lossy Dielectrics, Free Space and in good Conductors, Poynting Theorem, Reflection of a plane wave at Normal and Oblique Incidence.

Introduction to Computational Electromagnetic Methods.

SUGGESTED READINGS:

1. E. C. Jordan and G.B. Balmain, "Electromagnetics Waves and Radiating Systems," Prentice –Hall of India
2. A. Pramanik, "Electromagnetism Theory and Application," Prentice –Hall of India
3. David K Cheng, “Field and Wave Electromagnetics,” Pearson Education
4. M.N.O. Sadiku, "Principles of Electromagnetics " Oxford University Press.
5. W. H. Hayt and J. A. Buck "Engineering Electromagnetics," McGraw Hill Education

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC10	Linear Integrated Circuits	3L-0T-2P	**None**

COURSE OUTCOMES (CO):

1. To understand the basic op-amp circuit building blocks and understand their limitations due to non-ideal parameters of the op-amps
2. To develop the capability of analyzing GIC-based impedance simulators and be able to design and test second order filters using various simulated elements
3. To be able to realize single-resistance-controlled oscillators from modified Wien bridge oscillator circuits
4. To understand the use of op-amp in saturation as a comparator, zero crossing detector, astable multivibrators and monostable multivibrator
5. To understand basic functions of IC 555 timer and its use in astable and monostable multivibrator
6. To be able to design linear VCOs and adjustable duty cycle VCOs using timer 555 and IC op-amps
7. To understand the functioning of basic OTA-C linear circuits and to be able to design a current-tunable oscillator
8. To develop capability to design VCOs and waveform generators using IC Timer 555, IC op-amps, IC OTAs and combinations thereof as per the given specifications

COURSE CONTENT:

Linear Circuits using ideal op-amps: Realization of Controlled sources, inverting/non-inverting/unity gain amplifiers; integrators/differentiators; finite variable-gain difference amplifiers and instrumentation amplifiers; Op-amp RC filters; Op-amp RC Sinusoidal oscillators

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Log/Antilog Circuits using IC op-amps: Log amp, antilog amp, Log/antilog module

Applications of IC op-amps used as comparators: op-amp as comparator and zero crossing detector; Schmitt Trigger; astable and monostable multivibrators; Square/triangular wave form generators

Operational Transconductance amplifiers (OTA): differential pair, derivation of its transconductance; Simple and Wilson Current mirrors; IC OTA 3080, advantages and limitations of OTA-C circuits; Applications of the OTAs: examples of OTA-C realization of electronically-tunable resistors, inductors, filters and sinusoidal oscillators

IC op-amp architecture: various stages of an IC op-amp: input stage, active load, intermediate gain stage, output stage and level shifter

Effect of finite GBP of op-amps: Gain-bandwidth product of an IC op-amp (such as UA741); One-pole model of the op-amp gain; Determination of gain and bandwidth of inverting/non-inverting amplifiers; Magnitude and phase errors, examples of active compensated circuits; introduction to active-R design

Non ideal parameters of op-amps and their effects: input bias currents, gain-bandwidth product, effect of finite GBP, Stability considerations, origin of slew rate and limitations due to finite slew rate.

IC Timer 555 and its applications: block diagram, various modes of operation, power-on and power-off time-delays, astable and monostable multivibrators; miscellaneous application circuits

IC multipliers and their applications: Examples of Analog multiplier ICs; Major applications analog multipliers

Miscellaneous analog ICs: IC Voltage regulators, IC Function Generators, IC Phase locked loops (PLL) etc.

SUGGESTED READINGS:

1. S. Franco, ``Design with operational amplifiers and analog integrated circuits,'' Tata McGraw Hill
2. A. S. Sedra and K. C. Smith, ``Microelectronic Circuits,'' Oxford University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC11	Data Structures	3L-0T-2P	**None**

COURSE OUTCOMES (CO):

1. Candidate will be able to choose the appropriate data structure for a specified problem and determine the same in different scenarios of real world problems.
2. Become familiar with writing recursive methods and reducing larger problems recursively in smaller problems with applications to practical problems.
3. Be able to understand the abstract properties of various data structures such as stacks, queues, lists, trees and graphs and apply the same to real life problems of sorting, searching, traversals for skill enhancement in problem solving.
4. Be able to implement various data structures in more than one manner with the advantages and disadvantages of the different implementations for energy efficient by using efficient representation of problems.

COURSE CONTENT:

Introduction: Basic Terminology: Elementary Data Organization, Data Structure Operations, Algorithms Complexity and Time-Space Trade off.

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Arrays: Array Definition and Analysis, Representation of Linear Arrays in Memory, Traversing, Insertion And Deletion in Array, Single Dimensional Arrays, Two Dimensional Arrays, Bubble Sorting, Selection Sorting, Linear Search, Binary Search, Multidimensional Arrays, Function Associated with Arrays, Character String in C, Character String Operations, Arrays as parameters, Implementing One Dimensional Array.

Stacks and Queues: Introduction to Operations Associated with Stacks Push & Pop, Array representation of stacks, Operation associated with stacks: Create, Add, Delete, Application of stacks recursion polish expression and their compilation conversion of infix expression to prefix and postfix expression, Tower of Hanoi problem, Representation of Queues, Operations of queues: Create, Add, Delete, Front, Empty, Priority of Queues, Dequeue.

Recursion: Recursive thinking, Recursive Definition of Mathematical Formulae, Recursive Array Search, Recursive Data Structure, Problem Solving With Recursion, Back Tracking

Linked Lists: More operations on linked list, polynomial addition, Header nodes, doubly linked list, generalized list, circular linked lists.

Trees: Basic Terminology, Binary Trees and their representation, expression evaluation, Complete Binary trees, Extended binary trees, Traversing binary trees, Searching, Insertion and Deletion in binary search trees, Complexity of searching algorithm, Path length, Huffman's algorithm, General trees, AVL trees, Threaded trees, B trees.

Sorting: Insertion Sort, Quick sort, two-way Merge sort, Heap sort, sorting on different keys, External sorting.

Graphs: Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Sequential representation of graphs, Adjacency matrices, Traversal

New data structures: Trie, templates, containers.

Outline of Practical Work:

- programs based on sorting and searching, implementing stacks, queus , simple calculator using postfix expression, command line calculator changing infix to postfix, implementation of linked lists - a simple editor program, traversal of binary trees , binary search tree creation, insertion, deletion, traversal sorting. AVL tree creation and rotations, Traversal of graphs using BFS and DFS , implementation of topological sorting.

SUGGESTED READINGS:

1. Nell B Dale, `` C++ data structures, '' Jones and Bartlett Publishers.
2. Freetextbooks.com. Algorithms and data structures.
   Available :http://www.freetechbooks.com/algorithms-and-data-structures-f11.html
3. Robert Lafore, ``Data structures and Algorithms in Java,'' Pearson Publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC12	Transmission lines and Waveguides	3L-1T-0P	**None**
COURSE OUTCOMES (CO):			

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1. Understand the distribution of electromagnetic fields within various transmission line geometries.
2. Study of impedance matching using single and double stubs.
3. Use Smith chart to study transmission line applications for circuit elements and impedance matching.
4. Study the measurement of impedance using smith chart.
5. Ability to understand the behavior of strip lines and microstrip lines.
6. Ability to study the performance of Wave Guides.
7. Ability to study the performance of Resonators.
8. Ability to design the circuits of attenuators, filters and equalizers.

COURSE CONTENT:

Need for Transmission Lines, Types of Transmission lines, Characterization in terms of primary and secondary constants, Characteristic impedance, Propagation constant, general wave equation, and Lossless propagation. Wave reflection at discontinuities, Voltage standing wave ratio, Transmission line of finite length.

The Smith Chart, Smith Chart calculations for lossy lines, Impedance matching by Quarter wave transformer, Single and double stub matching, Transient analysis for resistive, inductive and capacitive loads.

General Wave behaviors along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates, TM and TE waves in Rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides, Rectangular and circular cavity Resonators, TEM, Quasi- TEM mode.

Image and iterative impedances, insertion loss, attenuators, impedance matching networks, low pass, high pass, band pass and band elimination filters, constant-K, m-derived filters and composite filters. Equalizers: inverse impedances, series & shunt equalizers, T- & bridged-T equalizers, lattice equalizers.

SUGGESTED READINGS:

1. John D. Ryder, "Networks lines and fields,'' Prentice Hall of India
2. David K Cheng, "Field and Wave Electromagnetics,'' Pearson Education Inc
3. M.N.O. Sadiku, "Principles of Electromagnetics,'' Oxford University Press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC13	Probability Theory and Communication	3L-0T-2P	**None**

COURSE OUTCOMES (CO):

1. Understood the concept of random variables and random processes, and can apply the various properties of random processes in context of the LTI systems.
2. Acquired the fundamentals of amplitude modulation and frequency modulation
3. Error performance of AM and FM signals in the presence of noise with both coherent and non-coherent receivers.
4. Understanding sampling and pulse analog modulation

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COURSE CONTENT:

Review of Fourier Series and Transforms. Hilbert Transforms, Bandpass Signal and System Representation. Random variables and random process, characterization of random variables and random process, linear systems and random signals. Random Processes, Stationarity, Power Spectral Density, Gaussian Process, Noise.

Amplitude Modulation, DSBSC, SSB, VSB: Signal Representation, Generation and Demodulation,

Frequency Modulation: Signal Representation, Generation and Demodulation.

Noise: in AM Receivers using Coherent Detection, in AM Receivers using Envelope Detection, in FM Receivers.

Sampling, Pulse analog modulation (PPM,PWM, PAM)

SUGGESTED READINGS:

1. Simon Haykins, ``Communication systems,'' Wiley Publication
2. Taub and Schilling, ``Communication systems,'' Tata McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC14	Control Systems	3L-1T-0P	**None**

COURSE OUTCOMES (CO):

1. To understand the open loop and closed loop (feedback) systems
2. To understand time domain and frequency domain analysis of control systems required for stability analysis.
3. To understand the compensation technique that can be used to stabilize control systems

COURSE CONTENT:

Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral Derivative (PID) control. State variable representation and solution of state equation of LTI control systems, Introduction to fuzzy control

SUGGESTED READINGS:

1. J.Nagrath and M.Gopal, ``Control System Engineering,'' New Age International Publishers
2. Benjamin.C.Kuo, "Automatic control systems,'' Prentice Hall of India.
3. John J.D'azzo & Constantine H.Houpis, ``Linear control system analysis and design,'' Tata Mc-Graw-Hill
4. Richard C. Dorf and Robert H. Bishop, `` Modern Control Systems,'' Addison – Wesley Publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC15	Digital Signal Processing	3L-0T-2P	None

COURSE OUTCOMES (CO):

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1. Possess basic background in digital signal processing area necessary for supporting subjects such as: communication principles, computer networks, speech processing, audio processing, image and video processing. 2. Possess necessary background for advance studies in DSP, especially for taking the subject Advanced Digital Signal Processing, or other multimedia signal processing subjects. 3. Analyze the basic of properties of signals and systems like time invariance, stability, causality, linearity etc. Compute the linear and circular convolutions of discrete time sequences. 4. Understand the basic theories behind DTFT/DFT/FFT for practical applications. 5. To be able to realize FIR/ IIR filter equations and implement the design using some simulation techniques. 6. Perform Matlab-based project(s) requiring some independent reading, programming, simulations, and technical writing.
COURSE CONTENT: Review of DTFT and z-transform, Discrete Fourier transform and FFT algorithms. High speed convolution and its application to digital filtering, Realization of digital Filters, Symmetric and anti-symmetric FIR filters and their Frequency response, Design of Linear-phase FIR filters using Windows and Frequency sampling method, IIR filter design by Impulse Invariance and bilinear transformation method. Frequency transformations in the digital domain, Analysis of finite word length effects.
SUGGESTED READINGS: 1. Alan V. Oppenheim and Ronald W.Schafer , ``Digital signal processing ,'' Prentice Hall of India. 2. S. K. Mitra, ``Digital Signal Processing- A Computer based approach, '', Tata McGraw-Hill 3. Andreas Antoniou, `` Digital Filters: Analysis, Design and Applications,'' McGraw-Hill Publication. 4. John G. Proakis, Dimitris G. Manolakis, `` Digital Signal Processing: Principles, Algorithms, And Applications, '' Pearson Education.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC16	Digital Communication	3L-0T-2P	None

COURSE OUTCOMES (CO): **1.** Acquired the knowledge about sampling, quantization and coding. **2.** Understood the various techniques of digital representation of analog waveforms, e.g. PCM, DPCM, DM etc. **3.** Studied the different digital modulation techniques and are able to evaluate the error performance of digital communication system in the presence of noise. **5.** Gained the fundamental knowledge about Information theoretical concepts of digital communications and can utilize these concepts for designing of various source coding algorithms.
COURSE CONTENT: Quantization, Pulse-Code Modulation. Noise Considerations in PCM, Time Division Multiplexing, Delta Modulation. Matched Filter, Error Rate due to Noise. Intersymbol Interference, Nyquist's Criterion,

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Duobinary Signaling. Optimum Linear Receiver. Geometric Representation of Signals. Coherent Detection of Signals in Noise, Probability of Error. Coherent Digital Modulation Schemes: MPSK, MFSK, MQAM; Error Analysis. Noncoherent FSK, Differential PSK. Comparison of Digital Modulation Schemes, Bandwidth Efficiency. Pseudo-Noise Sequences and Spread Spectrum. Information Theory, Entropy, and Source-Coding Introduction to OFDM
SUGGESTED READINGS: 1. Simon Haykins , `` Communication systems,'' Wiley Publication. 2. Simon Haykins, `` Digital Communication,'' Wiley Publication. 3. J. G. Proakis, `` Digital Communication,'' Tata Mc-Graw Hill Publication. 4. Taub & Schilling,`` Communication systems,'' Tata Mc-Graw Hill Publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC17	Microprocessor and its applications	3L-0T-2P	None

COURSE OUTCOMES (CO):

1. Understand the operation and architecture of a popular 8-bit microprocessor including Instruction Set Architecture, memory and port Interfacing, assembly language programming, timing and speed of operation.
2. Understand the motivation and need for peripheral operations circuits for digital data exchange, timer, serial communication, merits of direct memory access, interrupt controller and other circuits.
3. Comprehend various mechanisms for analog signal interfacing using ADC and DAC circuits.
4. Visualize optimal design of a computer for control and data acquisition applications based on available microprocessors, memory, interfacing logic circuits and other peripheral function circuits.
5. Learn the operation of circuits for user interaction through switches, keyboard and display devices.
6. Learn the basics of program simulation and emulation.
7. Develop the ability to compare, contrast and evaluate competing microprocessor architectures.
8. Learn the basics of 16-bit and 32-bit microprocessors.

COURSE CONTENT:

Introduction to Microcomputers & Microprocessor: Digital computing, Computer languages, From large chip computers to single chip Microcomputers, Microcomputers organization, and 4- bit Microprocessors.

Introduction to 8-bit Microprocessor Architecture: Microprocessor architecture & its operations, Memory, Input/Output, Interfacing devices MPU, 8085 based Microcomputer, Instruction classification, Instruction format, Instruction timings, and Overview of 8085 instruction set. Introduction to 8085 Basic Instructions: Data transfer instructions, Arithmetic operations, Logic operations, Branch operations, Programming techniques using looping counting & indexing, Dynamic debugging, Time delays, Counters, Stock, Subroutines, Conditional call, and return instructions, Advanced subroutine

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concepts.
Interrupts: The 8085 interrupts, Restart instructions, Additional I/O concepts & processes Parallel Input/Output And Interfacing Applications: Basic interfacing concepts, Interfacing output displays, Interfacing input keyboards, Memory mapped I/O, Interfacing memory, Interfacing D/A & A/D converter
General Purpose Programmable Peripheral Devices: Introduction to 8255, 8253 programmable interval timer, 8259 A programmable interrupt controller, SID & SOD lines, 8251 USART, 8257, 8279 etc. Introduction to 8086 architecture, programming & Interrupts

SUGGESTED READINGS:

1. Ramesh S Gaonkar,`` Microprocessor Architecture- Programming & Applications with 8085 / 8080A," Penram International Publishing (India) Pvt. Ltd.
2. Ram B, ``Introduction of Microprocessors & Microcomputers," Dhanpat Rai Publisher (P) Ltd.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC18	Antenna and Wave Propagation	3L-0T-2P	None

COURSE OUTCOMES (CO):

1. Helping the students to gain insight into the subject, to develop suitable hardware/software that addresses the industrial/social problems effectively.
2. To study, analyze and design various antenna types and their characteristics.
3. To evaluate and plot radiation field and patterns to analyze their utilization in specific applications.
4. Evaluate and draw the antenna array factor for linear uniform array
5. Understand how to steer antenna beam in a linear uniform array
6. To motivate the students towards professionalism

COURSE CONTENT:

Retarded Potential Functions & Electromagnetic Field, Current Elements, Radiation from Monopole & Half Wave Dipole, power radiated by current element, radiation resistance.
Reciprocity Theorems, Radiation Pattern, Antenna Parameters: Antenna Gain, Effective Area, Antenna Terminal Impedance, Antenna Temperature and Signal to Noise Ratio, HPBW, FNBW.
Two Element Array, N-Element Linear Array, Multiplication of patterns, Endfire, broadside array, non-uniform array, planar array. Feeding methods of antenna element, mutual coupling between two antennas.
Ground wave, sky wave propagation, Reflection and refraction, Virtual Height, MUF, Critical frequency, Skip Distance. Space wave Propagation, Line of sight, Troposcattering, Duct Propagation
Loop antenna, folded dipole, Rhombic Antenna, Parabolic, Helical, Horn Antenna, slot radiators, log periodic antenna, cylindrical antenna, lense antenna, and microstrip antenna.

SUGGESTED READINGS:

1. J. D. Kraus and R. J. Mashefka, `` Antennas: For All Applications," Tata McGraw Hill Publication.
2. Jordan Edwards C. and Balmain Keith G.,``Electromagnetic Waves and Radiating Systems," Prentice Hall

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(India) .
3. Balanis,``Antenna Theory analysis and design,'' Tata Mc-Graw Hill Publication..

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC19	Microwave Engineering	3L-0T-2P	None

COURSE OUTCOMES (CO):

1. Helping the students to gain insight into the subject, to develop suitable hardware/software that addresses the industrial/social problems effectively.
2. Knowledge about Microwave Solid State Devices.
3. Ability to identify and study the performance of Wave Guides and Resonators
4. Study the performance of various components used in microwave engineering.
5. Designing of Microwave filters
6. Knowledge about Microwave Measurements.
7. To motivate the students towards professionalism effective communication skills and team work.

COURSE CONTENT:

Overview of solid state and tube devices, two cavity klystron amplifier reflex klystron, TWT, cylindrical magnetron, Gunn Effect, Gunn diode, IMPATT diode, RF diodes

ABCD and S parameters, reciprocal and lossless networks, return loss, insertion loss and mismatch loss, S parameters of directional coupler, E plane, H-plane, and magic Tee, circulator, isolator, shift in reference plane of S –parameters.

Microstrip Lines, Characteristic Impedance of Microstrip Lines, Losses in Microstrip Lines, Quality Factor of Microstrip Lines, Power divider.

Single-section and multi-section Quarter wave transformer designs.

Periodic structures filter design by the image parameter and insertion loss methods. Filter transformations, Richard's transformation, kuroda's identities, impedance and admittance inverters, step impedance low pass filters, coupled line band pass filter and its design.

Measurement of frequency, wavelength, unknown impedance, VSWR, Coupling factor, insertion loss, and directivity, radiation pattern management isolation measurement of microwave components, network analyzer and spectrum analyzer.

Introduction to Microwave application in various fields.

SUGGESTED READINGS:

1. David M. Pozar,`` Microwave engineering ,'' Wiley India.
2. Samuel Y. Liao, `` Microwave devices and circuits,'' Prentice Hall India.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC20	VLSI	3L-0T-2P	None

COURSE OUTCOMES (CO):

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1. To be aware about the trends in semiconductor technology, and how it impacts scaling and performance.
2. Able to learn Layout, Stick diagrams, Fabrication steps, Static and Switching characteristics of inverters
3. Synthesis of digital VLSI systems from register-transfer or higher level descriptions in hardware design languages.
4. To understand MOS transistor as a switch and its capacitance
5. Student will be able to design digital systems using MOS circuits.

COURSE CONTENT:

Introduction: Basic principle of MOS transistor, Introduction to large signal MOS models (long channel) and advanced MOS modeling, BJT modeling, CS, CD and CG amplifiers. Current mirrors – active loads. High input impedance current mirrors. BJT gain stages.

CMOS operational amplifiers- compensation. Comparators. Sample and hold circuits MOS, CMOS and Bi CMOS S/H circuits. Switched capacitor filters, operation, analysis and applications. Nyquist rate. D/A converters. A/D converters. Over sampling techniques, filter design.

Introduction to CMOS circuits: MOS transistors, CMOS combinational logic gates, multiplexers, latches and flip-flops. CMOS fabrication and layout. VLSI design flow.

MOS transistor theory: Ideal I-V and C-V characteristics, non ideal I-V effects, DC transfer characteristics. Switch level RC delay models.

CMOS technologies. Layout design rules. CMOS process enhancement. Technology related issues.

Circuit characterization and performance estimation: Delay estimation. Logical effort and transistor sizing. Power dissipation. Interconnect design margin. Reliability. Scaling.

Circuit simulation: Device models, Device and circuit characterization. Interconnect simulation.

MOS device layout: Transistor layout, Inverter layout, CMOS digital circuit layout & simulation.

SUGGESTED READINGS:

1. D.A.John & K.Martin,`` Analog Integrated Circuit Design,” Wiley Publication.
2. Rabey, ``Digital Integrated Circuits Design,” Pearson Education.
3. N.H.E.Weste and D.Harris,`` CMOS VLSI Design,” Pearson Publication.
4. Kang & Leblebigi,`` CMOS Digital IC Circuit Analysis & Design,” McGraw Hill.
5. Weste and Eshraghian,`` Principles of CMOS VLSI design,” Addison-Wesley.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC21	Computer Networks	3L-1T-0P	None

COURSE OUTCOMES (CO):

1. To introduce the students the functions of different layers of networking
2. To introduce various networks.
3. To make students to get familiarized with different protocols and network components.

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COURSE CONTENT:

Introduction: Introduction, Network Topologies, Wired Vs wireless Networks, LAN, MAN, WAN, Internet, Intranet & Extranet, Connection-Oriented and Connectionless Services, Need of Protocols, TCP/IP reference Model, comparison of OSI & TCP/IP. Bridges, Hubs and Switches, Virtual LANs

Network Protocols: ALOHA, Carrier Sense Multiple Access Protocols, ARP, RARP, Framing, One-Bit Sliding Window Protocol, Protocol Using Go Back N, Protocol Using Selective Repeat, High-Level Data Link Control (HDLC)

Congestion Control in Data Networks: Congestion Prevention Policies, Congestion Control in Virtual-Circuit Subnets, Congestion Control in Datagram Subnets, Effects of Congestion, Load Shedding, Jitter Control, Congestion Control in Packet-Switching Networks

Routing Algorithms: The Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Routing for Mobile Hosts, Routing in Ad Hoc Networks, Node Lookup in Peer-to-Peer Networks Unit-V Internetwork Protocols Internet Protocol & IP Addresses, Principles of Internetworking, Internet Protocol Operation, IPv6, Virtual Private Networks and IP Security

SUGGESTED READINGS:

1. J. Kurose, K. W. Ross,`` Computer Networking: A Top-Down Approach Featuring the Internet," Addison-Wesley .
2. S. Keshav ,`` An engineering approach to computer networking : ATM networks, the internet, and the telephone network," Addison-Wesley.
3. L. L. Peterson and B. S. Davie,`` Computer networks: a systems approach," Morgan Kaufmann Publishers.
4. W. Stallings,`` Data and computer communications," Prentice Hall India.
5. A. S. Tanenbaum,`` Computer networks," Prentice Hall India.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC22	TRAINING		**None**

COURSE OUTCOMES (CO):

1. To motivate students to go and work with industry people to enhance knowledge.
2. Not a mere recipient of ideas, the student is a participant in discovery and inquiry.
3. To test the student's awareness of the latest developments and relate them to the knowledge acquired during the classroom teaching.

COURSE CONTENT:

None

SUGGESTED READINGS:

None

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Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC23	PROJECT-I	0L-0T-4P	**None**

COURSE OUTCOMES (CO):

1. To develop team work in students.
2. To make students implement the concepts studied in different subjects of engineering course.
3. To develop practical understanding, limitations and constraints of the theory they study.
4. To motivate and generate their interest in various areas of their field.
5. Manage complex Electronics Engineering based projects that are motivational, entrepreneurial, research and/or industry linked.
6. To motivate students to go and work with industry people to enhance knowledge.
7. Work autonomously and in teams within organizations or as a consultant.
8. Not a mere recipient of ideas, the student is a participant in discovery and inquiry.
9. To test the student's awareness of the latest developments and relate them to the knowledge acquired during the classroom teaching.
10. Pursue new and enriched understandings of the texts through sustained collaborative inquiry.
11. Apply knowledge in building their career in particular fields.

COURSE CONTENT:

None

SUGGESTED READINGS:

None

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECC24	PROJECT-II	0L-0T-4P	**None**

COURSE OUTCOMES (CO):

1. To develop team work in students.
2. To make students implement the concepts studied in different subjects of engineering course.
3. To develop practical understanding, limitations and constraints of the theory they study.
4. To motivate and generate their interest in various areas of their field.
5. Manage complex Electronics Engineering based projects that are motivational, entrepreneurial, research and/or industry linked.
6. To motivate students to go and work with industry people to enhance knowledge.
7. Work autonomously and in teams within organisations or as a consultant.
8. Not a mere recipient of ideas, the student is a participant in discovery and inquiry.
9. To test the student's awareness of the latest developments and relate them to the knowledge acquired during the classroom teaching.
10. Pursue new and enriched understandings of the texts through sustained collaborative inquiry.
11. Apply knowledge in building their career in particular fields.

COURSE CONTENT:

None

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SUGGESTED READINGS:
None

SYLLABUS OF FOUNDATION ELECTIVES

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE001	**Sports-I**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

To evolve a higher education system that is suitability blended with provision for knowledge values and skill practice where every student learns in without sacrificing his/her creativity.

COURSE CONTENT:

(Any Two out Of 4 Components)

A. INTRODUCTION TO PHYSICAL EDUCATION IN THE CONTEMPORARY CONTEXT (Any Two)

1. Learn and demonstrate the technique of Suryanamaskar.
2. Develop Physical Fitness through Calisthenics / Aerobics / Circuit-Training / Weight-Training and demonstrate the chosen activity.
3. Select any one game available in the college and learn different techniques involved in its play

B. CORE PHYSICAL EDUCATION-: FITNESS, WELLNESS AND NUTRITION (Any Two)

1. Measurement of Fitness Components – Leg-raise for Minimal Strength (Muscular Strength); Sit-ups Muscular Endurance); Harvard Step Test, Run and Walk Test (Cardiovascular Endurance); Sit and Reach Test (Flexibility)
2. Measuring height, weight, waist circumference and hip circumference, Calculation of BMI (Body Mass Index) and Waist-Hip Ratio
3. Engage in at least one wellness programme and write a report on it.

C. CORE PHYSICAL EDUCATION-: POSTURE, ATHLETIC CARE AND FIRST AID (Any Two)

1. Demonstrate Stretching and Strengthening Exercises for Kyphosis, Scoliosis, Lordosis, Knock Knees, Bow Legs, Flat Foot, Back Pain and Neck Pain

2. Illustration and Demonstration of Active and Passive Exercises

3. Asanas with Therapeutic Value (Any five asanas): Karnapeedasana, Padmasana, Dhanurasana, Sarvangasana, Paschimottanasana, Chakrasana, Halasana, Matsyasana, Ardhmatsyendrasana, Usthrasana, Mayurasana, Shirshasana, Vajrasana.

4. Practice P.R.I.C.E. in First Aid.

D. SPORTS ADMINISTRATION & MANAGEMENT (Any Two)

1. Demonstration of Supervision activities in Sports Management.

2. Demonstration of skills of Management.

3. Demonstration of fixtures of various kinds in sports competitions.

4. Demonstration of technical and non-technical purchase procedure.

SUGGESTED READINGS:

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1. Graham, G., ``Teaching Children Physical Education : Becoming a Master Teacher. Human Kinetics,'' Champaign, Illinois, USA.
2. Corbin, C. B., G. J. Welk, W. R Corbin, K. A. Welk, ``Concepts of Physical Fitness: Active Lifestyle for Wellness,'' McGraw Hill, New York, USA.
3. Anspaugh, D.J., G. Ezell and K.N. Goodman, `` Teaching Today Health,'' Mosby Publishers
4. Beotra, Alka, ``Drug Education Handbook on Drug Abuse in Sports,'' Applied Nutrition Sciences, Mumbai.
5. Ammon,R., Southall , R.M. and Blair, D.A., ``Sports Facility Management, ''West Virginia, USA: Fitness Information Technology Publishers.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE002	**Sports-II**	**0L-0T-4P**	**FE001**

COURSE OUTCOMES (CO):

To evolve a higher education system that is suitability blended with provision for knowledge values and skill practice where every student learns in without sacrificing his/her creativity.

COURSE CONTENT:

(Any Two out Of 4 Components)

A. Sports for all (Any Two)

1. To participate in any intramural Tournaments (one team game and one Individual Game) of choice.
2. To participate/ attend at least 15 hours in Fitness training at Field or at Gymnasium.
3. Participate in at least one track and one field event on Annual Sports day.
4. To participate in Inter College Tournament

B. MEDIA AND CAREERS IN PHYSICAL EDUCATION (Any Two)

1. Organize an event / intramural / tournament in your college.
2. Prepare a News Report of an observed Sports competition.
3. Create a presentation on any topic from Physical Education using an audio-visual aid.
4. Demonstrate Warming-up / Conditioning / Cooling-down exercises.

C. MANAGEMENT OF AEROBICS & GROUP TRAINING (Any Two)

1. Measurement of Fitness Components – Leg-raise for Minimal Strength (Muscular Strength); Sit-ups (Muscular Endurance); Harvard Step Test or Run and Walk Test (Cardiovascular Endurance); Sit and Reach Test (Flexibility)

2. Measurement of Pulse Rate / Heart Rate at Radial Artery and Carotid Artery, Calculation of Target Heart Rate

3. Developing a 5-10 minute routine of aerobics with appropriate music for each component of health related physical fitness

D. SPORTS INDUSTRY & MARKETING (Any Two)

1. Identify an issue or a trend in the sports industry: o Players in professional or college sports o Ownership
2. Marketing Plan: Environmental Factors and Product Plan Draft, Paper bibliography/works cited.
3. Sponsorship proposal
4. Developing a budget plan for an event

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5. Athlete branding
SUGGESTED READINGS: 1. Covey, S. , `` 7 Habits of Highly Effective People, '' Covey Publications, USA 2. Magill, R.A., `` Motor Learning and Control: Concepts and Applications,'' McGraw Hill Publication. 3. Masteralexis, L.P., C. Barr and M. Humms, ``Principles and Practices of Sport Management,'' Jones and Bartlett Publisher 4. Bishop, J.G., ``Fitness through Aerobics,'' Benjamin Cummings USA. 5. Brown K.M., `` Physical Activity and Health: An Interactive Approach,'' Jones and Bartlett Publisher 6. Cornwell. T.B, `` Sponsorship in marketing: Effective communications through sports, arts and events, '' Routledge Publishers 7. DeGarris, L., ``Sports Marketing: A Practical Approach,'' Routledge Publishers, USA

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE003	**National Service Scheme (NSS)**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

1. Develop among them a sense of social and civic responsibility;
2. Utilize their knowledge in finding practical solution to individual and community problems;
3. Identify the needs and problems of the community and involve them in problem solving process;
4. Utilize their knowledge in finding practical solution to individual and community problems;
5. Develop capacity to meet emergencies and natural disasters

COURSE CONTENT:

Unit-I Introduction to NSS: Orientation and structure of NSS, History of Social Reforms in Modern India: Brahmo Samaj, Arya Samaj, Satya Shodhak Samaj: Principles and Functions

Unit-II Regular activities: Distribution of working hours- association between issues and programs- community project- urban rural activities, association- modes of activity evaluation

Unit-III concept of society- development of Indian society: Features- Division of labors and cast system in India; Features of Indian constitution; Provisions related to social integrity and development

Unit – IV N.S.S. Regular Activities

A) College campus activities

B) N.S.S.activities in Urban and Rural areas

C) Role of Non-Government Organisation (NGO) in social Reforms

i) Red Cross

ii) Rotary

SUGGESTED READINGS:

1. National Service Scheme Manual, Govt. of India
2. Training Programme on National Programme scheme, TISS.
3. Orientation Courses for N.S.S. programme officers, TISS.
4. Ram Ahuja, ``Social Problems in India,'' Rawat Publication.
5. History of Social Reforms in Maharashtra, Ed. J. Y. Bhosale, S. U. Kolhapur.

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Course No.	Title of the Course	Course Structure	Pre-Requisite
FE004	**National Cadet Corps (NCC)**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

1. Develop among them a sense of social and civic responsibility;
2. Utilize their knowledge in finding practical solution to individual and community problems;
3. Identify the needs and problems of the community and involve them in problem solving process;
4. Utilize their knowledge in finding practical solution to individual and community problems;
5. Develop capacity to meet emergencies and natural disasters;

COURSE CONTENT:

UNIT I: Introduction to NCC, National Integration & Awareness: Religions, Culture, Traditions and Customs of India, National Integration: Importance and Necessity, Freedom Struggle.

UNIT II: Adventure Training: – Obstacle course, Slithering, Trekking, Cycling, Rock Climbing, Para Sailing, gliding, Scuba Diving- methods and use.

UNIT III: Environment Awareness and Conservation: Natural Resources – Conservation and Management. Water Conservation and Rainwater Harvesting

UNIT IV: Personality Development and Leadership: Introduction to Personality Development, Factors Influencing /Shaping Personality: Physical, Social, Physiological, Philosophical and Psychological, Self Awareness Know yourself/ Insight, Change Your Mind Set, Communication Skills: Group Discussion / Lecturettes (Public Speaking), Leadership Traits, Types of Leadership

SUGGESTED READINGS:

1. Bhogle Anita & Bhogle Harsha, ``The Winning way, Learning from sports for managers,'' Westland Publications
2. Sharma Robin, `` The leader had no title, '' Simon and Schuster Ltd.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE005	**Corporate social responsibilities**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

1. The course will help students to understand corporate and emerging social responsibility for the corporate in reference to India and global situation
2. The course will support students to prepare themselves to work with corporate understanding collective aspiration of the society, individual and corporate social responsibility.

COURSE CONTENT:

UNIT I: Corporate social responsibility in Indian context and International: CSR – Definition, concepts, Approaches of CSR, overview of corporate social responsibility and corporate social accountability, SR Tools, National and International CSR activities, corporate philanthropy, drivers of CSR, difference

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between corporate governance, corporate philanthropy and CSR

UNIT II: Business ethics and corporate social responsibility: Concept of business ethics – meaning, Importance and factors influencing business ethics. Corporate Governance – meaning, significance, principles and dimensions. Ethical decision – making in different culture, consumer protection, environment protection, gender issues in multiculturalism, ethics and corruption, ethics and safety. Business benefits of CSR

UNIT III: Legislative measures of CSR: Corporate, labor, stake holders, Environmental and pollution. Social Accounting, Social Auditing, SA: 8000 and Corporate Social Reporting.

SUGGESTED READINGS:

1. Harsh Srivastava,`` The business of social responsibility,'' books for change
2. CV. Baxi and Ajit Prasad,`` Corporate social responsibility – concepts and cases," Excel Books
3. Dr. M. Mahmoudi,`` Global strategic management," Deep & Deep Publications Pvt. Ltd.
4. S K. Bhatia,`` International Human resource management – Global perspective," Deep & Deep Publications Pvt. Ltd.
5. J.P. Sharma, ``Governace, Ethics and Social responsibility of business, '' Ane books Ltd.
6. Kotler Philip and Lee Nancy, `` Corporate social responsibility; doing the most good for your company,'' John Wiley
7. Simpson, Justine and Taylor, John R, `` Corporate Governace Ethics and and CSR,'' Kogan Page Publishers

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE006	**Environmental Sciences**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

1. Recognize major concepts in environmental sciences and demonstrate in-depth understanding of the environment.
2. Develop analytical skills, critical thinking, and demonstrate problem-solving skills using scientific techniques.
3. Demonstrate the knowledge and training for entering graduate or professional schools, or the job market.

COURSE CONTENT:

UNIT I: Environmental Studies: Ecosystems, Bio-diversity and its Conservation

(i) The Multidisciplinary Nature of Environmental Studies Definition, scope and importance of Environmental Studies. Biotic and a biotic component of environment, need for environmental awareness.

(ii) Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and function of different ecosystem

(iii) Bio-diversity and its Conservation: Introduction to biodiversity —definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: Consumptive use,

productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity : Habitat loss, Poaching of wildlife, man wildlife conflicts, rare endangered and threatened species(RET) endemic species of India, method of biodiversity conservation: In-situ and ex-situ conservation.

UNIT II: Natural Resources: problems and prospects

(i) Renewable and Non-renewable Natural Resources

Concept and definition of Natural Resources and need for their management

• Forest resources: Use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and their effects on forests and tribal people.

• Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems, Water conservation, rain water harvesting, watershed management.

• Mineral resources: Uses are exploitation, environmental effects of extracting and using mineral resources, case studies.

• Food resources: World food problems, changes causes by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

• Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Urban problems related to energy, case studies.

• Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

UNIT III: Environmental Pollution Control: Environmental Pollution, Definition, types, causes, effects and control measures of (a) Air pollution, (b) Water pollution, (c) Soil pollution, (d) Marine pollution, (e) Noise pollution, (f) Thermal pollution. Nuclear hazards. Solid waste and its management: causes, effects and control measures of urban and industrial waste.

UNIT IV: Disaster Management, Social Issues, Human Population and the Environment. Social Issues, Human Population and the Environment, Sustainable development, Climate change, global warming, acid rain, ozone layer depletion, Environmental ethics: Issues and possible solutions, Consumerism and waste products, , Wasteland reclamation. Population growth, problems of urbanisation.

SUGGESTED READINGS:

1. E. Barucha,`` Textbook of Environmental Studies for Undergraduate Courses," Universities Press (India) Pvt. Ltd.
2 . S. Chawla,`` A Textbook of Environmental Studies," McGraw Hill Education Private Limited.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE007	**Environmental Development and Society**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

1. To sensitize the students regarding the relationship between human society and ecosystem.
2. To help students understand the various approaches to the study of environment and ecosystem.

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3. To create awareness among the students regarding environmental degradation and the importance of development and sustainable Development.
COURSE CONTENT: **UNIT I. Basic Issues and Approaches** a. Importance of the study of ecology and society b. The relation between Environment and Development c. Conceptual clarifications: social ecology; sustainable development; sustainability. d. Approaches: Realism, Appropriate Technology, Ecofeminism **UNIT II. People and Natural Resources:** Unequal Access and Shrinking Commons a. Water: depleting water resources & pollution; unequal distribution of water –(utilization of water for commercial crops, industrial use, power generation), the big dams debate. b. Forest: Colonial policy, diverting resources for mining and other commercial and industrial use, monoculture and loss of biodiversity, rights of forest dwelling communities. c. Land: modern technology, green revolution, biotechnology and impact on land, shrinking commons and its effects on rural poor. **UNIT III. Environmental issues and Problems.** a. Environmental Pollution: Air, Water, Noise, Land and Radioactive Pollution b. Problems of urban environment (pollution, health, industrial accidents (e.g. Bhopal), occupational hazards) c. Climate change/Global warming. **UNIT IV. Role of Environmental Movements and the State.** a. Environmental Movements in India – Chipko, Narmada Bachao Andolan, Chilka Lake Orissa, are some examples.
SUGGESTED READINGS: 1. Chandna R.C,`` Environmental Awareness," Kalyani Publishers. 2. Agarwal S.K,`` Environmental Issues and Themes," APH Publishing corporation. 3. Barry John,`` Environment and social theory," Routledge. 4. Gadigil, Madhav and Ramachandra Guha,`` Ecology and Equity: The use and Abuse of Nature in contemporary India," OUP. 5. Gole Prakash,`` Nature conservation and sustainable development in India," Rawat publications .

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE008	**Spoken Skills in English**	**2L-0T-0P**	**None**
COURSE OUTCOMES (CO): 1. This course will focus on oral & presentation skills of students with practice sessions in the language lab. 2. This course will develop confidence building in oral skills of learners. 3. It will seek to encourage the day to day conversations/dialogues and communicative needs of learners with ample practice in the lab.			

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4. The theory class will boost practice in ample language exercises to encourage oral skills.
5. This will also involve practice sessions in interview skills, group discussions & pair work.
6. Basics of communication

COURSE CONTENT:

- Practice on listening and reading comprehension
- Language lab practice for group discussion and interviews
- Definition and discussion on communication & the barriers in communication with practical training to use language as a tool for sharing, discussing, handling and convincing others.

SUGGESTED READINGS:

Everyday English I & II Cambridge University Press/Foundation books

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE009	**Financial Literacy**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

1. To provide in-depth knowledge of the banking and Principles of Investment, financial planning.
2. Help students in understanding stocks, sell strategy, mutual fund options, investing in education, planning for the future, purchasing your first home, taxes and tax planning, life insurance options, health insurance, property insurance, estate planning, and keeping money in perspective.

COURSE CONTENT:

UNIT I: Banking- Definition, Role of Bank in growth of saving and Investment, Types of banks , Services offered by banks, Deposits and Loans, Types of A/c, Opening a bank A/c, How to Transact with banks, KYC norms, (A/c opening form, Address Proof), How to read bank statement, Banking products and services, Calculating Interests – Saving, FD, Simple and Compound Interest, Power of compounding Loans, Types of loans, taking a home loan, Definition of EMI, Calculation of EMI, Post office-Account and transactions, Basic of foreign Exchange, Importance and Use of Foreign Exchange, Regulator Role of RBI, mutual funds.

UNIT II: Investment: Principles of Investment – Safety, Liquidity and Return, Investment plans, Hybrid plans-Ulip, SIP and VIP of mutual funds, index funds

UNIT III: Financial Planning- Meaning, Household financial health checkup, Important life stages, Medical and other Emergencies, ; Insurance, Meaning, Need and Wants, Loss protection, Life, non-life and health, Benefits of Insurance, Term plans, Social obligations Budgeting, Buying a house, Plan a vacation, Retirement planning, Price of procrastination, Market and financial instruments, Primary market, Secondary market, Financial Statement analysis,

UNIT IV: Scams, Fraud Schemes-Insider trading, Money laundering; Consumer protection and redressal mechanism, Rights of Consumers, Applicable to financial services, Filing a complaint, Complain to entity concerned, Regulators, Arbitration, Consumer courts, Govt. Websites-(PG Portals), Investor Associations, Taxes, Meaning, Need of Taxes, Types of taxes, How taxes impact income, Income, wealth and gift tax, Service tax, STT, Stamp Duty, Tax planning v/s tax evasion, Tax rates, Tax free bonds, Tax saving investment

SUGGESTED READINGS:

1. Braunstein, Sandra, and Carolyn Welch,`` Financial literacy: An overview of practice, research, and

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policy," Fed. Res. Bull.
2. Cole, Shawn A., and Gauri Kartini Shastry,`` Smart money: The effect of education, cognitive ability, and financial literacy on financial market participation,” Harvard Business School, 2009.
3. Study material of NSE.
4. Gitman, joehnk and Billingsley, ``Personal financial planning,'' Cengage Learning
5. Madura Jeff,`` Personal finance student edition,'' Prentice Hall PTR.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE010	**Introduction to Indian Society**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

To acquaint the students with the emergence and understanding of Indian Society, theoretical underpinnings of the complexity of society and also with the whole discourse contextualizing Sociology in India.

COURSE CONTENT:

1. **Unit –I Conceptualizing Indian Society:**

Hindu society and Diverse society (Regional, Linguistic, Religious diversities); Peoples of India- Groups and Communities ; Unity in diversity; Ethnicity and ethnic identities.

2. **Unit –II Theoretical perspectives I:**

Indological/ Textual (G.S. Ghurye, L. Dumont Structural – Functional M.N. Srinivas, S.C. Dube). Marxian (D.P. Mukherjee, A.R. Desai)

3. **Unit –III Theoretical perspectives II:**

Civilizational view (N.K. Bose, Surajit Sinha). Subaltern perspective (B.R. Ambedkar, David Hardiman).

SUGGESTED READINGS:

1. Robert W. Stern, `` Introduction: Change, the societies of India and Indian society'' Cambridge University Press
2. Dhanagare. D.N,`` Themes and perspectives in Indian sociology,” Rawat Publication.
3. Dube. S.C.`` The Indian Villages,” R and K Publication
4. Dumont. Louis Homo Hyerrchicus,`` The Caste System and its implications,” Vikas publications.
5. Hardiman, David,`` The coming of the Devi :Adivasi Assertion in western India,” Oxford University Press.
6. Marrott. Mckim,`` India through Hindu categories ,” Sage publication.
7. Momin. A. R,`` The legacy of G.S. Ghurye. A cemennial festschrift,” Popular prakashan.
8. Mukherjee. D.P,`` Diversities,” Peoples publication house.
9. Singh. Y,`` Indian Sociology social conditioning and emerging concerns,” Vistaar publication.
10. Singh. Y,`` Modernisation of Indian tradition,” Thomson press.
11. Singh. K.S.`` The Peoples of India. An introduction,” Seagull books.
12. Srinivas. M.N,`` India’s Villages,” Asia publishing house.

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13. Singh Y,`` Identity & Theory in Indian Sociology," Rawat Publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE011	**Soft Skills and Personality Development**	**1L-0T-2P**	**None**

COURSE OUTCOMES (CO):

Enable students to develop a basic English workplace vocabulary, comprehend sentences spoken or written in English and enables them to confidently converse in simple English.

COURSE CONTENT:

Unit 1: Conceptual Understanding of Communication; Cognition and Re-Cognition; Types of communication: Oral, Verbal, Non-verbal, Kinesics, Interpersonal, Group and Mass Communication, Communion, Barriers to communication; Values and Belief system.

Unit 2 : Spoken Communication; Art of debating, Elocution, Stage Anchoring, Group Discussion; Interviews; Quiz; Use of Jargon, Slangs and Vocabulary for effective Communication; Voice Modulation and Intonation; Clarity; Brevity; Articulation of thought and speech; Assertiveness; Affirmation.

Unit 3 : Written Communication, KISS rule; Resume writing; Letter writing; Taking notes; Recording minutes and preparing proceedings of meetings; Role of empathy and compassion.

Unit 4 : Self-assessment; Self awareness; Self-esteem, Self-confidence; Perception and observation skills; Benefits of Meditation and Self-Hypnosis, Goal setting and career planning.

Practical: Debate, Declamation; Presentation exercises and written communication exercises.

SUGGESTED READINGS:

1. Barker. A,`` Improve Your Communication Skills," Kogan Page India Pvt Ltd.
2. Adrian Doff and Christopher Jones,`` Language in Use (Upper-Intermediate)," Cambridge University.
3. John Seely,`` The Oxford Guide to Writing and Speaking," Oxford University Press.
4. Shiv Khera,`` You Can Win," Macmillan Books.
5. Stephen Covey,`` 7 Habits of Highly Effective People," Simon and Schuster
6. John Collin,`` Perfect Presentation ," Video Arts Marshal.
7. Jenny Rogers,`` Effective Interviews," Video arts Marshal.
8. Robert Heller,`` Effective Leadership: Essential Manager Series," DK Publishing.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE012	**Business Communication and**	**1L-0T-2P**	**None**

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	Presentation Skills		

COURSE OUTCOMES (CO):

To develop management communication skills in the students that will help the students to face future endeavors and will also help in their interviews.

COURSE CONTENT:

Unit-I:

Identity Management Communication:– Face to Face Impression Management & Mediated Communication (Self Introduction & Self-Promoting– Over Stating And Under Stating – Strategies to Overcome Communicative Inhibitions – Creating Positive Self-image through words - Appearance- Verbal and Non Verbal Manners) – Giving Polite Yet Assertive Responses – Responsive strategies to handle criticism - Accepting Failure and Declaring Success.

Unit-II

Business Presentations:– Oral and Power Point Presentations; Preparing Successful Presentations; Assessing Audience, Making Effective Use of Visual Aids, Delivering Presentation, Using Prompts, Handling With Questions and Interruptions, Mock Presentations.

Unit-III

Oratory Skills: – Group Discussion, Extempore, Mock Parliament and Mock Press.

Unit-IV

Interview Management: – Resume Preparation, Types of Interviews, Preparing For Interviews, Facing Interviews, Handling Tough & Tricky Questions, Reviewing Performance, Participating In Mock Interviews

SUGGESTED READINGS:

1. Lori Harvill Moore,`` Business Communication," Bookboon

2. John Thill, Courtland L. Bovee ,`` Excellence in Business Communication," Pearson Prentice Hall

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE013	**Theatre**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

Our goal is to nurture artist-scholars who are well read in dramatic literature, who understand the social and historical contexts of that literature, who appreciate contemporary performance and dance, who think critically, who master discipline-specific skills, and who make compelling artistic choices on stage.

COURSE CONTENT:

Unit 1 : Concept of Acting in Indian Classical theatre. Western styles of theatre acting.

Unit 2 : Basics of the following: Acting in Grotowski's Poor Theatre, Modern concept of Actor training with reference to Meyerhold, Bertold Brecht and ConstantinStanislavesky; Artaudian acting, Theatre of Cruelty; Theatre of Absurd.

Unit 3 : Acting for Camera –Knowledge of camera frames and movement within the confines of a frame, blocking, difference between theatre and Camera acting, Concentration.

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Unit 4 : Acting consistently for different takes, acting scenes out of order, Auditions, acting exercises. Art of Dubbing.
SUGGESTED READINGS: 1. Boleslavsky, Richard,`` Acting: the First Six Lessons," New York Theatre Arts. 2. Hagen, Uta,`` Respect for Acting," Macmillan Press. 3. Hodge, Alison,`` Twentieth Century Actor Training," London and New York. 4. Routledge ,Stanislavski, Konstantin,`` An Actor's Work: A Student's Diary," Trans. and ed. Jean 5. Jeremiah Comey ,`` The Art of Film Acting," Focal Press . 6. Philips B Zarrilli,`` Acting (Re) Considered," Routeledge . 7. Cathy Hassey,`` Acting for Film," Allworth Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE014	**Dance**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

This course will provide the student with the fundamentals necessary for advanced dance skills. Further, this course will develop student appreciation of dance as an art form and lifetime activity. Designed to familiarize students with technique, the student will also study vocabulary, different forms of dance, issues in dance and the history pertaining to the world of dance. The student will develop kinesthetic awareness, movement memory, creative abilities and aesthetic appreciation of various dance forms. The enhancement and the development and maintenance of physical fitness, self-confidence, self-discipline and independence with the body by providing informal showings during class are the goals expected to be achieved. Each student should leave this class having been encouraged, esteemed, and take with them a new appreciation of dance.

COURSE CONTENT:

- Basic workout
- Introduction to Hip Hop and B-Boying with a simple choreography
- Exercise like: Rolling, jumping, moving shoulders. Footwork, Floor steps, Beat knowledge.
- Freestyle combination along with House dance style.
- Expressions class: Body expressions, Face expressions.
- Introduction of Contemporary Dance. Basic exercise of Contemporary Dance. Exercise for flexibility, Floor steps, Spinning and Balancing.
- Introduction to Jazz. Basic exercise and proper routine practice.

SUGGESTED READINGS:

1. Jonathan Burrows, ``A Choreographer's Handbook,'' Routledge
2. Jacqueline M. Smith-Autard, ``Dance Composition: A Practical Guide to Creative Success in Dance Making,'' Routledge

Course No.	Title of the Course	Course Structure	Pre-Requisite

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FE015	Yoga	0L-0T-4P	None

COURSE OUTCOMES (CO):

Students will learn about the importance of yoga in their lives. They will be exposed various types of yoga, their health benefits.

COURSE CONTENT:

UNIT-I

Origin of Yoga & its brief development, Meaning of Yoga & its importance, Yoga as a Science of Art (Yoga Philosophy),Meaning of meditation and its types and principles.

UNIT- II

Classification of Yoga/Types of Yoga, Hatha Yoga , Raja Yoga, Laya Yoga, Bhakti Yoga, Gyan Yoga, Karma Yoga, Asthang Yoga.

UNIT –III

Principles of Yogic Practices, Meaning of Asana, its types and principles, Meaning of Pranayama, its types and principles, Meaning of Kriya its types and principles.

UNIT -IV

Yogic therapies and modern concept of Yoga, Naturopathy, Hydrotherapy, Electrotherapy, Messotherapy,Acupressure, acupuncture, Meaning and importance of prayer, Psychology of mantras, Different mudras during prayers.

SUGGESTED READINGS:

1. William Broad,`` The Science of Yoga: The Risks and the Rewards," Simon and Schuster
2. Swami Vishnu Devananda,`` The Complete Illustrated Book of Yoga," Harmony

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE016	Digital Film Making	0L-0T-4P	None

COURSE OUTCOMES (CO):

Students will learn about various technicalities involved in digital film making. They will also expose to history of cinema, preproduction etc.

COURSE CONTENT:

Unit 1 – History of Cinema, Research & Script

Early Cinema, Development of Classical Indian & Hollywood Cinema, History of Global Film including European Film (1930-present), Origin of Classical narrative cinema-Soundless film, Exploration of film and analysis of the three-part beginning, middle and end of story, **Research**(Finding and Collecting materials and facts related to your story. Where and How to find the materials related to your story. Things to consider before sketching down your story), **Script (Scriptwriting Process and its various phases), Film Grammar for Scriptwriting.**

Unit 2 – Pre-Production

Digital Video Cinematography: Introduction to Digital Video Cinematography

Cinematography, Interactivity and emotions through Cinematography,

Building blocks, Compositions, Lenses and Cameras, Types of lenses: Zoom Lens, Prime Lens, Types of

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Cameras: HD Cameras, Basics of Film Camera, Difference between, Film Camera and Digital Camera, DSLR and HDSLR Cameras, Lighting, Psychology of light, Visual Environment, Directional Effect of Light, Lighting design process, Three-point lighting, High-Key lighting, Low Key lighting, Construction of a Shot, Color, Contrast, Deep Focus, Shallow Focus, Depth of Filed, Exposure, Racking focus, Frame Rate, Telephoto shot, Zoom shot.

Unit 3- Digital Video Editing

Effective Editing, Principles of Video Editing, Non-Linear Editing (NLE) Concept, The Three-Point Edit, Non-Linear Editing (NLE) Techniques, Working in the Timeline, Transitions, Key framing, Applying Filters, Ingesting.

Unit-4Advanced Editing Techniques

NLE Compositing, Color Correction & Color Grading, Working on Audio, Titling

SUGGESTED READINGS:

1. Mark Brindle and Chris Jones, `` **The** Digital Filmmaking Handbook," Quercus

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE017	**Workshop (Electrical and Mechanical)**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

1. Student will be able to make various joints in the given object with the available work material.
2. The students will be able to understand various wiring connections

COURSE CONTENT:

Mechanical Workshop Experiments

1. BLACKSMITH
2. CARPENTRY
3. FITTING
4. FOUNDRY
5. WELDING

Electrical workshop Experiments

1. STUDY & PERFORMANCE OF DIFFERENT TYPES OF WIRE JOINTS
2. STUDY AND PERFORMANCE OF STAIRCASE WIRING
3. STUDY AND PERFORMANCE OF SERIES AND PARALLEL CONNECTION OF FLOURESCENT TUBE LIGHT
4. STUDY AND PERFORMANCE OF GODOWN WIRING
5. SERIES AND PARALLEL CONNECTION OF BULBS AND POWER SOCKETS BY SINGLE SWITCH AND MULTI SWITCHES.

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SUGGESTED READINGS:

1. Hajra Choudhury, Hazra Choudhary and Nirjhar Roy, ``Elements of Workshop Technology, vol. I, '' Media promoters and Publishers Pvt. Ltd.
2. W A J Chapman, Workshop Technology,`` Part -1, 1st South Asian Edition,'' Viva Book Pvt Ltd.
3. P.N. Rao, ``Manufacturing Technology, Vol.1,'' Tata McGraw Hill
4. Kaushish J.P., `` Manufacturing Processes, '' Prentice Hall

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE018	**Music**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

The student will be familiarized with the basic terms used in Indian classical music. Also it familiarizes with the life history of some dignitaries in the field of music. This course also throws some light on the ancient music and its origins in India.

COURSE CONTENT:

Unit 1 : Study of the following terms:- Mela (Thãt), ÃshrayRãga, Rãga, Lakshana, Shruti, Alankar, Gamak, Vadi-SamvãdiAnuvãdi-Vivãdi, VakraSwara, Varjit-Swara.

Unit 2 : Biographies & contributions of the following:- Jaidev, MansinghTomar, Abdul Karim Khan, Tyagaraja, Pt. Bhatkhande, Pt. Ravi Shankar

Unit 3 : Study of following Rãgas&TãlaRãga- Yaman, Jaunpuri, Khamaj. Tãla- Ektãl, Jhaptãl

Unit 4 :Genaral discussion and definition of the following:-

a. Khyãl, MaseetKhani – Razakhani gat, Dhrupad, Tarana, Meend, Soot, Murki, Kan, Khatka, Krintan, Harmony, Melody.

b. Writing of Bhatkhande Swarlipi Paddhati.

c. Writing of Tãlasand Compositions in Notation.

d. Detailed study of Rãgas (Rãga- Bihag, Malkauns, Vrindavani Sarang) and comparative study of Rãgas.

e. Essay, Shastriya Sangeet (Classical Music) & SugamSangeet(Light Music)

Unit 5 : Vedic Music – Samvedic Sangeet, Swara, Vadya, Bhakti, Vikãr .

General study of Natyashastra, SangeetRatnakar.

SUGGESTED READINGS:

1. Vasant and Laxmi Narayan Garg,`` Sangeet Visharad,'' Sangeet Karyalay
2. Sarat Chandra Pranjpayee and Chowbhamda ,`` BhartiyaSangeetkaItihas,'' Surbharti Prakashan
3. Bharat Muni,`` NatyaShastra,''
4. Sharangdeva ,`` SangeetRatnakar,''
5. Sharad Chandra Pranjpayee ,`` Sangeet Bodh,''
6. Thakur Jaidev Singh ,`` Indian Music,'' Sangeet research academy
7. V. N. Bhatkhande,`` Mallika Part II & III,'' KramikPustak.
8. V. N. Patwardhan,`` RaagVigyan,''
9. RaginiTrivedi,`` Ragvibodha Mishrabani, Vol. I & II,''

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Course No.	Title of the Course	Course Structure	Pre-Requisite
FE019	**Sociology of Development**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

The course introduces the students to the issues pertaining to development in the contemporary context. It familiarizes and discusses the theories and models of development and their alternatives and critiques. It also introduces the concept of social exclusion that has emerged in the development discourse in the era of globalization.

COURSE CONTENT:

1. Concepts Progress, Growth, Modernization and Development
2. Development Theory Adam Smith, Karl Marx, Talcott Parsons.
3. Development of Underdevelopment, Dependency and World Capitalist System- A.G.Frank, Paul Baran, Samir Amin, Immanuel Wallerstein
4. Critique and Alternative to Development
5. Gender and Development, Culture and Development, Environment and Development, Human Development Index, Gender Development Index
   Gandhi and Schumacher on Alternative development model Appropriate Technology, Sustainable Development
6. Understanding India's Development Debate on the Development Model in India: Nehru, Gandhi, Ambedkar,
7. New Economic Policy
8. Disparities in Development: Class, Caste, Gender, Tribe, Region and Religion
9. Social Exclusion in the era of Globalization
10. Social Exclusion: Minorities and the other Marginalized Development of the Marginalized: Perspectives and Challenges

SUGGESTED READINGS:

1. Debal K. Singha Roy,`` Social Development and the Empowerment of Marginalized Groups," Sage Publications
2. Desai, A.R.,`` Essays on Modernisation of Underdeveloped Societies Vol I and II," Thacker and Company Ltd.
3. Dereze Jean and SenAmartya,`` India Development and Participation," Oxford University Press.
4. Preston, P. W.,`` Development Theory An Introduction," Blackwell Publishers, Oxford.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE020	**Universal Human Values 1: Self and Family**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

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1. Sensitization of student towards issues in all dimensions of life

There are a whole range of issues which one faces in life towards which the young students are generally unfamiliar and therefore insensitive. Almost all the concerns - environmental, societal, familial or personal, are result of human action. Sensitization towards them therefore is an important step.

2. Inculcation of Self Reflection.

Human action is governed by various internal factors primarily the beliefs one holds, and therefore 'looking-in' becomes essential, to see what beliefs one is holding, whether they are really true or not, if they are not true, then what could be the process to get the "right" belief and then further validate it. Most of the young people are somehow trained to look only —outside . The motivation and the skill to look inside are missing. Inculcation of self reflection in students will result in them becoming more responsible, honest and trustworthy. Lack of such dualities in individuals is major concern of organizations, institutions and society in general.

3. Understanding (Clarity) of Human Relationships and Family.

It will try to show that relationships and material prosperity are the basic desire for a human being. Two global problems which we face today are war (including terrorism) and imbalance in nature (global warming). If we look at reasons for war, the fundamental cause is: Human Being is in opposition to other Human Being. Therefore one is willing (or gets compelled) to exploit others. This is due to lack of understanding of relationships.

4.Exposure to Issues in Society and nature (larger manmade systems and Nature).

- To show that the fundamental reasons for imbalance in nature are: pollution and resource depletion. Both these aspects are result of consumerist model of development.
- To show how harmony can be ensured at following levels of our living: Individual, human –human relationships, larger society, Various social systems like education system, economic system, political system and others, and rest of the nature.

5. Development of Commitment and Courage to Act.

If the understanding is right, then the actions become right. Commitment and courage to act are considered consequences of right understanding in an individual. In the course, an attempt will be made to build right understanding in the individual, and then further plan of actions will also be discussed in order to implement the understanding in various life situations in the right manner.

At the end of the course, students are expected to become more aware of their self and their relationships and would have better reflective and discerning ability. They would also become more sensitive to their surroundings including both people and nature, with commitment towards what they believe in (human values).

It is hoped that they would be able to apply what they have learnt to their own self in different ordinary day-to-day settings in real life with higher commitment and courage.

COURSE CONTENT:

1. Motivation and Objectives of Human Values Course.

Introduction to the objectives of the course. Content and process of the course including mode of conduct. Daily life as lab for the course. Activities in the course.

2. Purpose of Education How human being has a need for Knowledge, what should be the content of

knowledge, how the content should be discussed in education. Complimentarily of skills and values, how the current education system falls short.
3. Peers Pressure, Social Pressure In various dimensions of life, how do these things work. What is the way out? In the context of education, peer pressure etc. movie —TaareZameen Par can be used.
4. Concept of Competition and Excellence How competition leads to degradation of self and relationships. How excellence is the basic need of a human being. What is excellence? Movie —Fearless can be used to discuss the concept.
5. Time Management:
How does one deal with myriads of activities in college? Focus of the mind.
6. Concept of Preconditioning. How preconditioning affects our thinking, behavior, work, relationships, society and nature. How do we develop pre-conditioning?
What are the various sources of preconditioning? How do we evaluate our Preconditioning? How do we come out of it?
7. Concept of Natural Acceptance in Human Being. What is natural acceptance? How can the concept of natural acceptance be used to evaluate our preconditioning. Universal nature of natural acceptance. Are anger, jealousy, hatred natural? How do we feel when we experience them? Which feelings are natural for a human being and which are not?
8. Understanding Relationships.
a) Are relationships important? What is the role of relationships in our life? If relationships are important then why they are important? If they are important then why it is the case that we are not discussing them?
What are the notions/conditions and factors which stop us to explore more into relationships.
Relationships in family and extended family. Dealing with anger. Show film —Right Here, Right Now .
b) Basic expectations in relationships. Seven types of relations.
c) Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.
d) Nine universal values in human relationships. Trust as the founding value.
e) Concept of acceptance. Unconditional acceptance in relationships.
f) Our preconditioning affecting our relationships. Our relationships with subordinate staff, with people of opposite gender, caste, class, race. Movie —Dharm (set in Varanasi) can be used to show the conflict between reconditioning and relationships. How relationships have the power to force a person to change his preconditioning.
9. Concept of prosperity
Material goods and knowledge of one's physical needs is essential for feeling of prosperity. What role others have played in making material goods available to me: Identifying from one's own life.
10. Idea of Society. What is a society? What constitutes a society? What systems are needed for a society to work? What is the purpose of society and various systems which are working in it? How understanding of Human Nature is important in order to understand the purpose of Society and various social systems? And what happens when this understanding is lacking?
11. Idea of decentralization of politics, economics, education, justice etc. Its comparison with centralized

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systems. The idea of Swaraj. Various social initiatives by NGOs, social organizations and other people. (If time permits)

12. Balance in nature

a) Balance which already exists in nature.

b) How human beings are disturbing the balance. Resource depletion and pollution.

Our own role in wastage of electricity, water and in use of plastics. Waste management. (Show episode on city waste from SatyamevaJayate 2.)

c) Issues like global warming, animal extinction. Show —Story of Stuff documentary film. —Home film can also be used.

SUGGESTED READINGS:

1. Annie Leonard, `` The Story of Stuff,'' Free Press
2. Mohandas Karamchand Gandhi,`` The Story of My Experiments with Truth," Beacon Press
3. J Krishnamurthy,`` On Education," Official repository
4. Hermann Hesse ,`` Siddhartha," Bantam Books
5. ThichNhatHanh,`` Old Path White Clouds," Parallex Press
6. On Education - The Mother Aurobindo Ashram Publication
7. Anne Frank,`` Diaries of Anne Frank ,"
8. G S Banhatti`` Life and Philosophy of Swami Vivekananda," Atlantic
9. Swami Vivekanand`` Swami Vivekananda on Himself," Advaita Ashram
10. E. F Schumacher,`` Small is Beautiful: Economics as if people mattered,"Harper Pereinnial.
11. Cecile Andrews ,`` Slow is Beautiful," New society publishers
12. A.Nagaraj,`` JeevanVidya: EkParichaya," Jeevan Vidya Prakashan.
13. A.N. Tripathi,`` Human Values," New Age Intl. Publishers.
14. Dharampal,`` Rediscovering India," Other India Press
15. Mohandas K. Gandhi,`` Hind Swaraj or Indian Home Rule," Navjeevan publication house
16. Maulana Abdul Kalam Azad,`` India Wins Freedom," Stosius Inc
17. Ramakrishna kijeevani ,`` Romain Rolland
18 Romain Rolland , "Vivekananda" Advait ashram.
19. Romain Rolland , "Gandhi" Srishti Publishers & Distributors.
20. ParamhansaYogananda,`` Autobiography of a Yogi," ," Rider publication.
21. Sahasrabudhe, "Gandhi and Question of Science,"Other India Press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE021	**Universal Human Values 2: Self, Society and Nature**	**2L-0T-0P**	**FE020**

COURSE OUTCOMES (CO):

1. Sensitization of student towards issues in society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human

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relationships and resolved individuals.
3. Strengthening of self reflection.
4. Development of commitment and courage to act.

At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they believe in (humane values. humane r learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction relationships and humane society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

COURSE CONTENT:

In Universal Human Values 2 course, the focus is more on understanding society and nature on the basis of self and human relationships. and motivation for the course.-conditioning, and natural acceptance.
-existence of self and body. Identifying needs and satisfying needs of self and body. Self observations. Handling peer pressure family. Hostel and institute as extended family. Real life examples.
-student relationship. Shraddha. Guidance. Goal of education.
– material order, plant order, animal order and human order.
Salient features of each. Human being as cause of imbalance in nature. (Film “Home” can be used.)
– water, food, mineral resources.
Pollution. Role of technology. Mutual enrichment not just recycling.
on of needs of the self and
needs of the body. Right utilization of resources. Understanding the purpose they try to fulfil.
Recapitulation on society. Five major dimensions of human society. Fulfilment of the individual as major goal. Justice in society. Equality in human relationships as naturally acceptable. Establishment of society with abhaya (absence of fear). being through holistic education in just order.

SUGGESTED READINGS:

Text Book

1. R R Gaur, R Sangal, G P Bagaria, “Human Values and Professional Ethics “Excel Books, New Delhi, 2010

Reference Books

2 . A Nagaraj , “Jeevan Vidya: EkParichaya, “ Jeevan VidyaPrakashan, Amarkantak.
3 . A.N. Tripathi , “Human Values,” New Age Intl. Publishers, New Delhi, .
4. Annie Leonard, “The Story of Stuff” Simon and Schuster.
5. Mohandas Karamchand Gandhi, “ The Story of My Experiments with Truth “ Becon Press.
6. J Krishnamurthy, “ On Education “ Official repository.
7. Hermann Hesse, “Siddhartha “ Bantan press.
8. ThichNhatHanh, “ Old Path White Clouds “ parallax press.
9. On Education - The Mother Aurobindo Ashram Publication.
10 . Diaries of Anne Frank – Anne Frank
11. G.S Banhatti, “Life and Philosophy of Swami Vivekananda,” Atlantic publisher.

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12. Swami Vivekananda , “Swami Vivekananda on Himself,” Advait publication.
13. E. F Schumacher , “Small is Beautiful: Economics as if people mattered,”Harper Pereinnial.
14. Cecile Andrews , “Slow is Beautiful” New society publishers.
15. J C Kumarappa, “Economy of Permanence” Serve seva sangh prakashan.
16. Pandit Sunderlal , “Bharat Mein Angreji Raj”
17. Mahatma and the Rose plant
18 . M.Gandhi, “The Poet and the Charkha” Mani Bhavan
19. Dharampal, “Rediscovering India” other India press.
20 .Mohandas K. Gandhi , “Hind Swaraj or Indian Home Rule,” Navjeevan publication house.
21. Arvind Kejriwal , “Swaraj” Harper publication.
22 . Maulana Abdul Kalam Azad, “India Wins Freedom.”Stosius Inc.
23. Romain Rolland , “Ramakrishna kijeevani,”Advait Ashram.
24. Romain Rolland , “Vivekananda” Advait ashram.
25. Romain Rolland , “Gandhi” Srishti Publishers & Distributors.
26 . ParamhansaYogananda, “ Autobiography of a Yogi,” Rider publication.
27. Sahasrabudhe, “Gandhi and Question of Science,”Other India Press.

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SYLLABUS OF DISCIPLINE CENTRIC ELECTIVES

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 01	Statistical Signal Processing	3L-0T-2P	ECC15

COURSE OUTCOMES (CO):

CO-1: A basic understanding of the random signal theory, adaptive signal processing systems and their applications to a variety of practical problems such as interference and echo cancellation, system identification and channel equalization etc.

CO-2: A comprehensive understanding of MMSE & orthogonality principle, derivation of the Wiener filter for signals with known second order statistics and formulation of the Wiener filter as a constrained optimization problem.

CO-3: A comprehensive study and analysis of Lattice structures of FIR (AZ), and IIR (AP and PZ Lattice-Ladder) systems, their advantages.

CO-4: Study the Levinson-Durbin algorithm for the solution of Wiener-Hopf equations.

CO-5: A comprehensive understanding of derivation and application of the Steepest Descent and Newton's algorithm for iteratively estimating the Wiener filter weights.

CO-6: A comprehensive understanding of derivation and application of the LMS algorithm for iteratively estimating the Wiener filter weights.

CO-7: A comprehensive understanding of derivation and application of the RLS algorithm for iteratively estimating the Wiener filter weights.

COURSE CONTENT:

Basic concepts of Adaptive Filtering. Mathematical preliminaries, Review of Random signal theory, correlation matrix and some linear algebra, KL expansion, Mean-square error criterion, Wiener filters, principle of orthogonality, Gradient Search Algorithm (Newton), steepest descent algorithms, The LMS algorithm; convergence, misadjustment, Normalized LMS algorithm, Frequency domain LMS algorithm, Weighted Least squares algorithm, Recursive Least squares algorithm Properties, Kalman Filtering, Fundamentals of array signal processing.

SUGGESTED READINGS:

1. Tamal Bose, ``Digital Signal and Image Processing,'' WileyPublishing.
2. B. Widrow and S. D. Stearns, ``Adaptive Signal Processing, ' ' Pearson Education
3. B. Farhang-Boroujeny, ``Adaptive Filters Theory and Applications,'' WileyPublishing.
4. Tarun Kumar Rawat, ``Digital Signal Processing,'' Oxford University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 02	Speech Processing	3L-0T-2P	ECC15

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COURSE OUTCOMES (CO):

CO 1: Understand basic characteristics of speech signal in relation to production and hearing of speech by humans.

CO 2: Understand how the articulation mode of different classes of speech sounds determines their acoustic characteristics.

CO 3: Understand basic algorithms of speech analysis common to many applications in Time and frequency domain.

CO 4: Solve given problems regarding parameter estimation in source-filter production models and regarding speech analysis and synthesis using these models,

CO 5: Design a simple system for speech enhancement, end point detection, pitch period detection and its implementation into applications such as speech and speaker recognition, speech compression, speech enhancement etc.

CO 6: Perform Matlab-based project(s) requiring some independent reading, programming, simulations, and technical writing.

COURSE CONTENT:

The speech signal, classification, process of speech production, acoustic phonetics, articulatory phonetics, Pitch, formants, various applications. Digital Model of Speech Signal: The process of Speech production, Sound propagation, tonal/ non-tonal components, global threshold (MPEG- I), Uniform lossless tube model, digital model. Time dependent processing of Speech, Short time average energy, short time average magnitude, short time average zero crossing rate, speech Vs silence discrimination, pitch period estimation, short time auto correlation function.

Short time Fourier analysis: Fourier transform interpretation, Linear filtering Interpretation, filter bank summation method, overlap addition method, Homomorphic speech processing. Digital representation of Speech: Sampling, A law, mu law, scalar quantization, vector quantization, mp3 compression.

Coding theory (strategies and standards) : Introduction, algorithm objectives and requirements, coding strategies, waveform coding, voice coders, hybrid coders, CELP. Insight to Speech recognition: Basic building blocks, Hidden markov models

SUGGESTED READINGS:

1. Rabiner and Schaffer, ``Digital processing of Speech signals,'' Pearson Publication.
2. Douglas O' Shaugnessy, ``Speech Communication, Human and machine,'' Wiley IEEE Press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 03	Image Processing	3L-0T-2P	ECC15

COURSE OUTCOMES (CO):

CO 1: A comprehensive understanding of how images are formed, sampled, quantized and represented digitally, and how image are processed by discrete, linear, time-invariant systems.

CO 2: A comprehensive understanding of spatial filtering techniques, including linear and nonlinear methods.

CO 3: A comprehensive understanding of image enhancement algorithms such as histogram modification,

contrast manipulation, and edge detection. CO 4: A comprehensive understanding of the mathematical principles of image restoration. segmentation, feature detection and contour finding algorithms. CO 5: A comprehensive understanding of the mathematical principles of image segmentation, feature detection and contour finding algorithms. CO 6: A comprehensive understanding of Image transforms and compression schemes. CO 7: Demonstrated programming skills in digital image processing related problems.
COURSE CONTENT: Introduction to 2-D Signals and Systems. Image Digitization. Image Transforms. Image Data Compression: Transform Domain Coding, Predictive Coding, JPEG. Image Enhancement, Image Restoration: Inverse Filtering, Algebraic Approach to Restoration, Wiener (LMS) approach, Constrained Least Squares Restoration. Image Segmentation and Representation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Oriented Segmentation, Descriptors.
SUGGESTED READINGS: 1. R. C. Gonzales and R. E. Woods, ``Digital Image Processing,'' Prentice-Hall India 2. K. Jain, ``Fundamentals of Digital Image Processing,'' Prentice-Hall India. 3. Tamal Bose, ``Digital Signal and Image Processing, '' Wiley Publishing.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 04	Wireless Communication	3L-0T-2P	ECC16
COURSE OUTCOMES (CO): CO 1: apply the fundamental knowledge of wireless communication systems and principles. CO 2: describe the cellular concept and analyze various Techniques. CO 3: mathematically analyze mobile radio propagation mechanisms. CO 4: understand different diversity combining techniques. CO 5: examine the multiple access techniques and its application in real world. CO 6: compare and contrast the latest wireless technologies.			
COURSE CONTENT: Cellular Concept. Mobile Radio Propagation. Cochannel Interference. Modulation Techniques. Diversity. Channel Coding. Multiple Access. Cellular Coverage Planning. Wireless Networking. Wireless Systems and Standards.			
SUGGESTED READINGS: 1. T. S. Rappaport, ``Wireless Communication Principles,'' Pearson Publishing. 2. A. Goldsmith, ``Wireless Communications,'' Cambridge University Press .			

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 05	BICMOS AIC	3L-0T-2P	ECC10

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COURSE OUTCOMES (CO): CO 1 To understand the devices available for Bi-CMOS ICs and their modelling CO 2 To understand the basic building blocks their characteristics and their limitations CO 3 To understand the basic pitfalls of Bi-CMOS circuits CO 4 To appreciate the prevalent practices related to Bi-CMOS analog IC design
COURSE CONTENT: **DEVICES:** Silicon Conductivity, pn Junctions, Diode Current, Bipolar Transistors, MOS Transistors, DMOS Transistors, Zener Diodes, EpiFets **DEVICE MODELS**: Bipolar Transistors, MOS Transistors, Small Signal Models for Hand Calculations **CURRENT SOURCES**: Current Mirrors in Bipolar Technology, Current Mirrors in MOS Technology **VOLTAGE REFERENCES**: Simple Voltage References, VBE Multiplier, Zener Voltage Reference Temperature Characteristics of I_C and V_{BE}, Bandgap Voltage Reference **AMPLIFIERS**: The Common-Emitter Amplifier, The Common-Base Amplifier, Common-Collector Amplifiers, Two-Transistor Amplifiers, CC-CE and CC-CC Amplifiers, The Darlington Configuration, The CE-CB Amplifiers or Cascode, Emitter-Coupled Pairs; The MOS Case: The Common-Source Amplifier, The CMOS Inverter, The Common-Source Amplifier with Source Degeneration, The MOS Cascode Amplifier, The Common Drain (Source Follower) Amplifier, Source-Couple Pairs **COMPARATORS:** Comparator with V_{BE}-Dependent Hysteresis, The Bandgap Reference Comparator **Operational Amplifiers**: A Programmable Current Reference, A Triangle-Wave Oscillator, A Four-Bit Current Summing DAC, The MOS Case **AMPLIFIER OUTPUT STAGES**: The Emitter Follower: A Class A Output Stage, The Common-Emitter Configuration as a Class A Output Stage, The Class B (Push-Pull) Output, The Class AB, Output Stage, CMOS Output Stages, Overcurrent Protection **PITFALLS:** IR Drops, Lateral pnp, npn Transistors, Comparators, Latch-up, Floating Tubs, Parasitic MOS Transistors **DESIGN PRACTICES**: Matching, Electrostatic Discharge Protection (ESD), ESD Protection Circuit Analysis
SUGGESTED READINGS: James C Daly and Denis P. Galipeau, ``Analog BiCMOS Design: Practices and Pitfalls,'' CRC Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 06	Low Power VLSI Design	3L-0T-2P	ECC20
COURSE OUTCOMES (CO): CO 1 To understand the basic analog and digital circuits suitable for low power design CO 2 To understand low power architectures CO 3 To understand the basic issues related to low power circuit design CO 4 To understand low power memory design CO 5 To understand the use of miscellaneous CAD tools			
COURSE CONTENT: Introduction to IC Design: Basic circuits in analog/digital, Introduction to Layout design for Analog and			

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Digital, Design challenges in Nano-scale CMOS technology, Familiarity with VLSI CAD tools (CADENCE, HSPICE, Design Compiler etc.)

Overview of Low Power Design: CMOS Power Dissipation, Power and Performance Tradeoffs, Trends in IC Power Consumption

Low Power Architectures: Clock Gating and Clock Management, Pipelining to Reduce Supply Voltage, Parallelization to Reduce Supply Voltage

Low Power Circuit Design: Logic Power Estimation, Power Minimization in Static CMOS, Power Minimization in Dynamic CMOS, Multiple-Threshold CMOS (Multi-Vth), Variable Supply and Threshold Voltages, Managing Leakage (Leakage reduction techniques), Silicon-on-Insulator (SOI) Technologies, Energy Recovery, Interconnect Power Estimation and Management, Circuit design using new devices (beyond CMOS)

Low voltage Circuit Design: Low voltage digital circuit designs and challenges, Low voltage analog circuit (basic) design

Low Power Memory Design: Low-power memory design, Memory technology (SRAM, DRAM, Flash etc.), Low voltage memory design and challenges, Process variations in Memory design

Device/Circuit co-design : Speed, Power, Reliability

SUGGESTED READINGS:

1. Dimitrios Soudris, Chirstian Pignet, Costas Goutis, ``Designing CMOS Circuits for Low ower,''Kluwer
2. J.B.Kulo and J.H Lou, ``Low voltage CMOS VLSI Circuits,'' Wiley Publishing
3. A.P.Chandrasekaran and R.W.Broadersen, ``Low power digital CMOS design,'' Kluwer press
4. Gary Yeap, ``Practical low power digital VLSI design,'' Kluwer Press.
5. Abdelatif Belaouar, Mohamed.I.Elmasry, ``Low power digital VLSI design,'' Kluwer press.
6. Steven M.Rubin, ``Computer Aids for VLSI Design,'' Addison Wesley Publishing.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 07	Analog Filter Design	3L-0T-2P	ECC10

COURSE OUTCOMES (CO):

CO 1 To be able to design Butterworth, Chebyshev and other standard filtering functions corresponding to any given specification

CO 2 To be able to design passive RLC low pass, high pass, band pass, band stop and all pass filters and understand various transformations applicable to filters

CO 3 To be able to design a filter matching the given specs using standard biquads such as KHN, Tow-Thomas, Akerberg-Mossberg and others

CO 4 To be able to understand various methods of higher order filter designs using inductance simulation, FDNR, Leap frog and GIC-embedding techniques

CO 5 To be able to design high frequency analog filters using active-R and Active-C approaches

CO 6 To understand and be able to design current mode biquadratic filters using Current Conveyors and CFOAs

CO 7 To understand the design principles of second order and higher order OTA-C filters

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CO 8 To develop the capability of designing MOSFET-C and Switched-capacitor filters
COURSE CONTENT: **Transconductance – C Filters:** Transconductance Cells, Elementary Transconductor Building Blocks - resistors, integrators, amplifiers, summers, gyrators, First and second order filters, High order filters, Automatic Tuning. **Single Op- Amp Biquad:** Sallen-Key Circuits, Delyiannis-Friend Biquad **Multiple Op- Amp Biquad:** Basic low pass and band pass circuit, realization of the general Biquadratic Functions, summing of four Amplifier biquad, feed forward three amplifier biquad, Passive Ladder structures, Inductor Substitution using Gyrator, Transformation of elements using the FDNR. **Higher Order filter Design:** Cascade approach, Active filter by simulating inductor, FDNR approach, Leap – Frog Ladder filters **MOSFET – C Filters:** Introduction to MOS FET – C Filters, Second Order MOSFET C networks, **Switched - Capacitor Filters:** The MOS switch, The switched capacitor, first order building blocks, second order sections, sampled data operation, Switched capacitor first and second order filters, Bilinear transformation. **Approximation Theory:** Butterworth Approximation, Chebyshev Approximation, Inverse Chebyshev Approximation, Basic of sensitivity, Frequency transformation Introduction to digital filters
SUGGESTED READINGS: **1.** Rolf Schaumann and Mac. E. Van Valkenburg, `` Design of Analog Filters,'' Oxford University Press 2. Gobind Daryanani, ``Principles of active network synthesis and design,''John Wiley and Sons. 3. M.E. Van Valkenburg, ``Analog Filter Design,'' Holt Saunders International Edition

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 08	Embedded System Design	3L-0T-2P	ECC17
COURSE OUTCOMES (CO): CO-1 To introduce students to the embedded systems, its hardware and software. CO-2 Todevelop strong fundamentals related to computer platform and design analysis. CO-3 To comprehend the concept of real time operating systems and inter-task communication. CO-4 To gain an insight into hardware accelerators.			
COURSE CONTENT: Introduction to embedded computing: Complex systems and microprocessors – Design example: Model train controller – Embedded system design process – Formalism for system design – Instruction sets Preliminaries – ARM Processor – CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption. Computing platform and design analysis: CPU buses – Memory devices – I/O devices – Component interfacing – Design with microprocessors – Development and Debugging – Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Analysis and optimization of execution time, power, energy, program size – Program validation and testing.			

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Process and operating systems: Multiple tasks and multi processes – Processes – Context Switching – Operating Systems –Scheduling policies - Multiprocessor – Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes. Hardware accelerates & networks: Accelerators – Accelerated system design – Distributed Embedded Architecture –Networks for Embedded Systems – Network based design – Internet enabled systems. Case study: Hardware and software co-design - Data Compressor - Software Modem – Personal Digital Assistants – Set–Top–Box. – System-on-Silicon – FOSS Tools for embedded system development.
SUGGESTED READINGS: 1.Wayne Wolf, ``Computers as Components - Principles of Embedded Computer System Design,'' Morgan Kaufmann Publisher. 2. David E-Simon, ``An Embedded Software Primer,'' Pearson Education 3. K.V.K.K.Prasad, ``Embedded Real-Time Systems: Concepts, Design & Programming", Dreamtech press 4. Tim Wilmshurst, ``An Introduction to the Design of Small Scale Embedded Systems,'' Pal grave Publisher 5. Sriram V Iyer, Pankaj Gupta, ``Embedded Real Time Systems Programming,'' Tata Mc-Graw Hill 6. Tammy Noergaard, ``Embedded Systems Architecture,'' Elsevier publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 09	Computer Architecture and Digital Hardware Design	3L-0T-2P	ECC17
COURSE OUTCOMES (CO): CO 1 :To understand the fundamentals of computer system and underlying architecture. CO 2 :To learn the concepts related to instruction sets, pipelining and parallelism. CO 3 :To provide a broad coverage of memory organization and hierarchy in computer systems. CO 4 : Foster ability to understand the Input/Output Organization and Buses.			
COURSE CONTENT: Basics of Logic Design: Combinational logic, finite state machines Performance: metrics and calculations, performance equations, Amdahl's law Instruction Set Architecture: instruction set classifications, addressing modes, instruction encoding, impact of high-level language and compilers Computer Arithmetic: binary number systems, floating-point numbers, operations on binary numbers, implementations, ALU design, fast adder design CPU Design And Architecture: stages of execution, basic CPU organization, single-cycle and multiple-cycle designs, microprogramming vs. hardwired control, interrupts Pipelining: dependencies, data and control hazards, resolving hazards, forwarding, exceptions, multiple-functional-unit pipelines Advanced Pipelining and Instruction Level Parallelism: dynamic scheduling, branch prediction, superscalar issue, compiler and architectural support for ILP, register renaming Memory Hierarchy: caches and cache hierarchies, cache organizations, cache performance, compiler			

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support for cache performance, main memory organization, virtual memory, TLBs I/0 characteristics of UO devices.Buses (at the "big picture" level).Polling, interrupt-driven UO, DMA.
SUGGESTED READINGS: 1. Hennessy and Patterson, "Computer Architecture: A Quantitative Approach," Morgan Kaufmann Publishers 2. Patterson and Hennessy, "Computer Organization and Design: The Hardware/Software Interface," Morgan Kaufmann Publishers

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 10	Microstrip Circuit Design	3L-0T-2P	ECC12
COURSE OUTCOMES (CO): **CO 1**: Understand quasi-static analysis and dispersion in Microstrip lines. **CO 2**: Understand full wave analysis in Microstrip lines. **CO 3**: Understand the effect of discontinuities in Microstrip lines. **CO 4:** Understand coupled Microstrip lines.			
COURSE CONTENT: Microstrip line quasi-static analysis, dispersion model, fullwave analysis, microstip discontinuity quasi static analysis and characterization, coupled microstrip lines.			
SUGGESTED READINGS: 1**.** K C Gupta, Ramesh Garg, ``Microstrip lines and slotlines,'' Aartech house.			

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 11	Advanced Antenna Theory and Design	3L-0T-2P	ECC18
COURSE OUTCOMES (CO): **CO 1**: Design various antenna for different application. **CO 2**: Understand the application oriented antenna design **CO 3**: Understand the methods to improvement of performance of antennas. **CO 4:** Understand the method of controllability on antenna parameters.			
COURSE CONTENT: Antenna elements wire, aperture, reflector, frequency independent, leaky wave small, fractal structures, UWB Antennas, Reconfigurable Antennas, Smart Antennas and techniques related to antenna design.			
SUGGESTED READINGS:			

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1. C.A. Balanis, ``Modern antenna handbook,'' Wiley Publishing
2. Balanis, ``Antenna Theory: Analysis and Design,'' Wiley Interscience
3. Krauss, ``Antennas for all Applications,'' McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 12	RF and Microwave Circuit Design	3L-0T-2P	ECC19

COURSE OUTCOMES (CO):

CO 1: Understand microwave distributed circuit elements.
CO 2: Understand RF and Microwave circuit elements.
CO 3: Understand microwave circuit analysis techniques.
CO 4: Understand S-parameters and network characterization techniques.
CO 5: Apply the ZY Smith chart to design microwave matching networks.
CO 6: Apply stability circles, stability criteria to solve stable and potentially unstable networks.
CO 7: Design microwave small signal and power amplifiers.
CO 8: Design microwave oscillators.
CO 9: Design microwave detectors and mixers.

COURSE CONTENT:

RF and Microwave circuit elements, Microwave circuit analysis techniques, Circuit representation of two-port networks, RF transistor amplifier design and matching, microwave oscillator circuits, microwave passive components, microwave semiconductor devices, coupler, mixer circuits.

SUGGESTED READINGS:

1. Bahl and P. Bhartia, ``Microwave Solid State circuit Design," Wiley Publication
2. K. Chang, `` Microwave Solid-State Circuits and Applications,'' John Wiley & Sons
3. S. Y. Liao, ``Microwave Circuit Analysis and Amplifier Design,'' Prentice Hall
4. D. M. Pozar, ``Microwave Engineering,'' Wiley & Sons
5. Reinhold.Ludwig and Pavelbretshko, ``RF Circuit Design,'' Pearson Education.
6. Robert E. Colin, ``Foundations for Microwave Engineering,'' McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 13	Advanced DSP	3L-0T-2P	ECC15

COURSE OUTCOMES (CO):

CO 1: A comprehensive understanding of Multirate Signal Processing.
CO 2: A comprehensive understanding of analysis and design of linear-phase FIR digital filters used in decimation & interpolation, and their computationally efficient implementation techniques.
CO 3: A comprehensive understanding of MMSE & orthogonality principle and derivation of the Wiener

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filter for signals with known second order statistics.
CO 4: A comprehensive understanding of formulation of the Wiener filter as a constrained optimization problem.
CO 5: A comprehensive study and analysis of Lattice structures of FIR (AZ), and IIR (AP and PZ Lattice-Ladder) systems and their advantages.
CO 6: A comprehensive understanding of the quantization of numbers represented in fixed-point and floating-point format.
CO 7: A comprehensive understanding of the concept of finite word length effects in signal processing systems, e.g., DFT computation, FIR and IIR system structures, zero-input limit cycle.
CO 8: A basic understanding of two-dimensional signal processing and its application in image processing.

COURSE CONTENT:

Multirate signal processing: decimation and interpolation, Polyphase decomposition, QMF, Optimum linear filters, Lattice structures, Forward and backward linear prediction, The Levinson-Durbin algorithm, Power Spectrum Estimation: Nonparametric methods, Parametric methods, Eigenanalysis algorithms for spectrum estimation: PHD, Eigen-decomposition, MUSIC, ESPRIT algorithms.

SUGGESTED READINGS:

1. S.K. Mitra, ``Digital Signal Processing, A Computer Based approach,'' Tata Mc Graw Hill.
2. P.P. Vaidyanathan, Multirate, `` Systems & Filter Banks,'' Prentice Hall
3. Tarun Kumar Rawat, ``Digital Signal Processing,'' Oxford University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 14	Digital System design using VHDL/Verilog	3L-0T-2P	ECC03

COURSE OUTCOMES (CO):

CO-1: Foster ability to identify and code the module using different modeling styles.
CO-2: Foster ability to write test benches in VHDL.
CO-3: Acquired knowledge about FSM and how to code a FSM.
CO-4: Ability to develop synthesizable code in VHDL.

COURSE CONTENT:

Introduction to VHDL, design units, data objects, signal drivers, inertial and transport delays, delta delay, VHDL data types, concurrent and sequential statements. Subprograms – Functions, Procedures, attributes, generio, generate, package, IEEE standard logic library, file I/O, test bench, component declaration, instantiation, configuration. Combinational logic circuit design and VHDL implementation of following circuits – first adder, Subtractor, decoder, encoder, multiplexer, ALU, barrel shifter, 4X4 key board encoder, multiplier, divider, Hamming code encoder and correction circuits. Synchronous sequential circuits design – finite state machines, Mealy and Moore, state assignments, design and VHDL implementation of FSMs, Linear feedback shift register (Pseudorandom and CRC) Asynchronous sequential circuit design – primitive flow table, concept of race, critical race and hazards, design issues like metastability, synchronizers, clock skew and timing considerations. Introduction to place & route process, Introduction to ROM, PLA, PAL,

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Architecture of CPLD (Xilinx / Altera).
SUGGESTED READINGS: 1. Douglas Perry, `` VHDL,'' Tata McGraw Hill 2. Stephen Brown, ZvonkoVranesic, ``Fundamentals of Digital Logic with VHDL design,'' Tata McGraw Hill 3. Fletcher, ``An engineering approach to Digital Design Principles,'' Prentice Hall 4. J Bhasker, `` VHDL Synthesis,'' Pearson Education 5. J Bhasker, `` VHDL Primer,'' Pearson Education. 4. Chales H. Roth, ``Digital System Design Using VHDL,'' PWS Publishing Company 5. John Wakerley, `` Digital System Design,'' Pearson 6. Zainalabedin Navabbi, ``VHDL ,'' McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 15	Video Processing	3L-1T-0P	ECC15
COURSE OUTCOMES (CO): *CO-1:* A comprehensive understanding of basics of digital video processing. CO-2: A comprehensive understanding of motion estimation methods. CO-3: Understanding of depth perception and stereo imaging principle. *CO-4:* A comprehensive understanding of video coding and its international standards. *CO-5:* A comprehensive understanding of video compression techniques.			
COURSE CONTENT: Representation of digital video: Introduction and fundamentals, Time-varying image formation models: Motion models, Geometric image formation. Spatio-temporal sampling: Sampling of analog and digital video, Two-dimensional rectangular and periodic sampling, Sampling of 3-D structures, Reconstruction from samples, Sampling structure conversion: Sampling rate change, Sampling lattice conversion , Two-Dimensional Motion Estimation: Optical flow based methods, Block-based methods, Pel-recursive methods, Bayesian methods based on Gibbs Random Fields., Image Compression: Lossless compression, DPCM, Transform coding, JPEG, Vector Quantization, Subband Coding, Video compression: Interframe compression methods (3-d waveform and motion-compensated waveform coding), Video compression standards (H.261, MPEG-1, MPEG-2).			
SUGGESTED READINGS: 1. John W. Woods, ``Multidimensional Signal, Image, and Video Processing and Coding,'' Academic Press 2. M. Tekalp, ``Digital Video Processing,'' Prentice Hall 3. Alan C. Bovik, ``The Essential Guide to Video Processing','' Elsevier Science.			

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 16	Radar Signal Processing	3L-1T-0P	ECC15

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

COURSE OUTCOMES (CO):

CO1: get familiar with fundamentals of radar systems, Propagation of EM waves in space and time, Doppler shift, Range equation, system structure. Sampling complex bandpass signals, Sampling rates in range, angle, Doppler, space, Digital I/Q.

CO2: understand the concept of Signal Models, Radar cross section of targets and clutter, multipath statistical signal models, Swerling models, advanced statistical signal models for clutter, convolutional models in range and angle, frequency domain models.

CO3: understand the ambiguity function, Basic waveforms, Coded waveforms, Optimum waveforms for time delay, velocity, acceleration measurements, Measurement accuracy, Cramer-Rao bounds

CO4: know the theory of Matched filter, MTI, DFT/pulse Doppler approx to matched filter for known target velocity, Improvement factor, DPCA for airborne MTI

CO5: understand the concept of Optimal Detection**,** Neyman-Pearson detection and the likelihood ratio, threshold detection, targets in Gaussian noise, coherent and noncoherent integration; binary integration, Optimal detectors for non-Gaussian interference, CFAR

CO6: get acquainted with Synthetic Aperture Radar, the SAR principle from aperture, system issues, range migration, processor structure, SAR modes, Doppler beam sharpening, Inverse SAR.

CO7: Perform practicals based on radar processing and understand the use in practical applications.

CO8: Perform project works based on theoretical concepts using various simulation software and do hardware implementation.

COURSE CONTENT:

Fundamentals of radar systems, Propagating EM waves in space and time, Doppler shift, Range equation, system structure. Sampling complex bandpass signals, Sampling rates in range, angle, Doppler, space, I/Q imbalance and correction techniques, Digital I/Q, Signal Models, Radar cross section of targets and clutter, multipath statistical signal models, Swerling models, advanced (compound) statistical signal models for clutter, convolutional models in range and angle, frequency domain models. Basic waveforms: simple pulse, LFM, coherent pulse train, Coded waveforms: frequency, phase (biphase, Costas), MCW, step-freq, Optimum waveforms for time delay, velocity, acceleration measurements, Measurement accuracy, Cramer-Rao bounds, Doppler processing, Matched filter, MTI as approximation to matched filter for unknown target velocity, DFT/pulse Doppler approx to matched filter for known target velocity, Improvement factor, DPCA for airborne MTI, Neyman-Pearson detection and the likelihood ratio, threshold detection, targets in Gaussian noise, coherent and noncoherent integration; binary integration, Optimal detectors for non-Gaussian interference, CFAR, Synthetic Aperture Radar, The SAR principle from aperture, Doppler, chirp viewpoints, SAR overview: system issues, range migration, processor structure, SAR modes: strip map, spotlight, Doppler beam sharpening, Inverse SAR, Spotlight SAR and polar format data collection, Polar format processing, Range migration and chirp scaling algorithms for spotlight SAR , Autofocus: correlation, phase gradient algorithms, Interferometric 3D SAR

SUGGESTED READINGS:

1. I. Haykin, Simon S, ``Radar Adaptive signal processing,'' John Wiley & Sons.
2. Mark A Richards, ``Fundamentals of Radar signal processing,'' McGraw Hill.

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Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 17	Wavelets and Applications	3L-1T-0P	ECC15

COURSE OUTCOMES (CO):

CO 1: A comprehensive understanding of the Difference between Fourier and wavelet transform.
CO 2: Understanding of multiresolution analysis for different types of signals.
CO 3: A comprehensive understanding of data compression using wavelet transforms.
CO 4: Understanding of denoising of signals using wavelet transforms
CO 5: Implement and apply wavelet transform for various applications.

COURSE CONTENT:

Continuous-time wavelets, Definition of the CWT, Time-Frequency Resolution, Inverse CWT. Introduction to Discrete Wavelet Transform and Orthogonal Wavelet decomposition: Approximation of Vectors in Nested Linear Vector Subspaces. Orthonormal Wavelets, and their relationship to filter banks: MRA, construction of general orthonormal MRA, Digital filtering interpretation, examples of orthogonal basic generating wavelets, Data Compression: transform coding, DTWT for image compression, audio compression, and video coding using multiresolution techniques. Other application of wavelet transform: wavelet denoising speckles removal, edge detection and object isolation, image fusion, object detection by wavelet transform of projections.

SUGGESTED READINGS:

1. S. Mallat, ``A Wavelet Tour of Signal Processing,'' Academic Press
2. G. Strang and T. Q. Nguyen,`` Wavelets and Filter Banks,'' Wellesley-Cambridge Press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 18	Cryptography	3L-1T-0P	ECC15

COURSE OUTCOMES (CO):

CO 1: understand the principles of Cryptography and Network Security algorithms, public key cryptography. Also they should have a detailed knowledge about authentication techniques, hash functions and application level security mechanisms.
CO 2: Possess necessary background for OSI Security Architecture, Security mechanism and Security services, Steganography, Cipher Design Principles and Modes of Operation, Confusion and Diffusion.
CO 3: Understand the basic theory of Encryption techniques. DES, AES Encryption Standards. Shift Rows, MixColumns and AddRoundKey transformations, AES Key Expansion, Equivalent Inverse Cipher and Implementation Aspects.
CO 4: understand authentication functions and protocols, Message Authentication Codes, Hash Functions MD5 message Digest algorithm, Secure Hash Algorithm, HMAC Digital Signatures, and Digital Signature Standard.
CO 5: possess necessary background of

authentication Services, Electronic Mail Security, IP Security, Web Security.

CO 6: Understand the basic theories behind Intrusion detection, password management, Viruses and related Threats, Virus Counter measures, Firewall Design Principles.

CO 7: realize cryptography and network security techniques and implement the design using some simulation techniques.

CO 8: Perform project(s) requiring some independent reading, programming, simulations, and technical writing.

COURSE CONTENT:

Introduction to security attacks, services and mechanism, Classical encryption techniques substitution ciphers and transposition ciphers, cryptanalysis, steganography, Stream and block ciphers, Data encryption standard(DES), Introduction to group, field, finite field of the form GF(p), Advanced Encryption Standard (AES) encryption and decryption Fermat's and Euler's theorem, Primality testing, Chinese Remainder theorem, Discrete Logarithmic Problem, Principals of public key crypto systems, RSA algorithm, security of RSA, Message Authentication Codes,Digital Signatures: Digital Signatures, Elgamal Digital Signature Techniques, Digital signature standards (DSS), Key Management and distribution: Symmetric key distribution, Diffie-Hellman Key Exchange, Public key distribution, X.509 Certificates, Public key Infrastructure. Authentication Applications: Kerberos, IP Security,System Security

SUGGESTED READINGS:

1. William Stallings, ``Cryptography and Network Security – Principles and Practices,'' Pearson education,
2. Behrouz A. Foruzan, ``Cryptography and Network Security,''Tata McGraw-Hill
3. Bruce Schneier, ``Applied Cryptography,'' John Wiley & Sons Inc
4. Charles B. Pfleeger, Shari Lawrence Pfleeger, ``Security in Computing,'' Pearson education
5. Wade Trappe and Lawrence C. Washington, ``Introduction to Cryptography with coding theory,'' Pearson Education
6. Wenbo Mao, ``Modern Cryptography Theory and Practice,'' Pearson Education.
7. Thomas Calabrese, ``Information Security Intelligence : Cryptographic Principles and Applications,'' Thomson Delmar Learning.
8. Atul Kahate, ``Cryptography and Network Security,'' Tata McGraw-Hill.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 19	Pattern Recognition	3L-1T-0P	ECC15

COURSE OUTCOMES (CO):

CO 1: A comprehensive understanding of designing systems and algorithms for pattern recognition (signal classification), with focus on sequences of patterns that are analyzed using, e.g., hidden Markov models (HMM).

CO 2: A comprehensive understanding to analyze classification problems probabilistically and estimate classifier performance.

CO 3: Understand and analyze methods for automatic training of classification systems.

CO 4: Apply Maximum-likelihood parameter estimation in relatively complex probabilistic models, such as

mixture density models and hidden Markov models.
CO 5: Understand the principles of Bayesian parameter estimation and apply them in relatively simple probabilistic models.
CO 6: A comprehensive understanding of how to apply supervised learning methods (model-based maximum likelihood, k-nearest neighbors) to the classifier design.

COURSE CONTENT:

Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations: Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test. Statistical Patten Recognition: Bayesian Decision Theory, Classifiers, Normal density and discriminant function.Parameter estimation methods: Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models. Nonparametric Techniques: Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification.Unsupervised Learning & Clustering: Criterion functions for clustering, Clustering Techniques.

SUGGESTED READINGS:

1. C.M. Bishop, ``Pattern Recognition and Machine Learning,'' Springer publication.
2. Richard Duda, ``Peter Hart, and David Stork, Pattern Classification,'' John Wiley and Sons.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 20	VLSI Digital Signal Processing	3L-1T-0P	ECC15

COURSE OUTCOMES (CO):

CO 1: Understanding of VLSI design methodology for signal processing systems.
CO 2: A comprehensive understanding of VLSI algorithms and architectures for DSP.
CO 3: A comprehensive understanding of VLSI algorithm transforms including retiming, folding/unfolding, algebraic transforms.
CO 4: A comprehensive understanding of pipelining and parallel processing of FIR and IIR digital filters.
CO 5: A comprehensive understanding of systolic architectures for DSP.

COURSE CONTENT:

Introduction To DSP Systems: Introduction; representation of DSP algorithms: Block Diagram, signal flow graph, data flow graph, dependence graph. Iteration Bound: Data flow graph representations, loop bound and iteration bound, longest path matrix algorithm, iteration bound of Multirate data flow graphs. Pipelining and Parallel Processing: Pipelining and parallel processing of FIR digital filters, pipeline interleaving in digital filters: signal and multichannel interleaving. Retiming, Unfolding and Folding: retiming techniques; algorithm for unfolding, Folding transformation, systolic architecture design, systolic array design methodogy. Fast Convolution, Filters and Transforms: Cook-toom algorithm, modified cook-toom algorithm, winogard algorithm, iterated convolution Algorithm strength reduction in filters and transforms.

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SUGGESTED READINGS:
1. K. Parhi, ``VLSI Digital Signal Processing Systems,'' John Wiley & Sons. 2. U. Meyer-Baese, ``Digital Signal Processing with Field Programmable Gate Arrays,'' Springer-Verlag.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 21	Selected Topics in SP	3L-1T-0P	ECC15
COURSE OUTCOMES (CO): Select topics in signal processing; details will be decided by the instructor.			
COURSE CONTENT:			
SUGGESTED READINGS:			

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 22	Detection and Estimation Theory	3L-1T-0P	ECC16
COURSE OUTCOMES (CO): CO 1: A comprehensive understanding of how to cast a generic detection problem into a hypothesis testing framework and to find the optimal test for the given optimization criterion. CO 2: A comprehensive understanding of statistical decision theory used for signal detection and estimation (Classical and Bayesian Estimation Approaches). CO 3: A comprehensive understanding of finding optimal estimators for various signal parameters, derive their properties and assess their performance. CO 4: A comprehensive understanding of the detection of deterministic and random signals using statistical models. CO 5: Comprehend the elements and structure of nonparametric detection. CO 6: Examine the performance of signal parameters using optimal estimators.			
COURSE CONTENT: Detection theory: hypothesis testing, Bayes, minimax, and NeymanPearson criteria, signaling in additive Gaussian noise, receiver operating characteristic. M-ary hypothesis testing, MAP and ML decision rules. Estimation of random parameters, MMS and MAP estimates. Estimation of nonrandom parameters, Cramer-Rao inequality, consistent estimate. Bounds on estimation errors, composite hypotheses. Elements of sequential and non-parametric detection. Wiener-Hopf and Kalman filtering.			
SUGGESTED READINGS: 1. H. L. Vantrees, ``Detection, Estimation and Modulation theory Part I,'' Wiley Publication 2. H. V. Poor, ``An Introduction to Signal Detection and Estimation,'' Springer. 3. J. C. Hancock and P.A. Wintz, ``Signal Detection Theory,'' McGraw Hill			

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Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 23	Optical Fibre Networks	3L-1T-0P	ECC16
COURSE OUTCOMES (CO): CO 1: visualize the structures of Optical fiber and their types. CO 2: discuss the channel impairments like losses and dispersion. CO 3: analyze various coupling losses. CO 4: classify the Optical sources and detectors and to discuss their principle.			
COURSE CONTENT: Optical Fibers: Structure, Wave guiding, Step-index and graded index optical fibers. Modal analysis, Classification of modes, Single Mode Fibers. Pulse dispersion. Material and waveguide dispersion. Polarization Mode Dispersion. Absorption, scattering and bending losses. Dispersion Shifted Fibers, Dispersion Compensating Fibers. Optical Power Launching and Coupling. Lensing schemes for coupling improvement. 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.			
SUGGESTED READINGS: 1. G. Keiser, ``Optical Fiber Communications,'' McGraw Hill publication. 2. G. P. Agarwal, ``Fiber Optic Communication Systems,'', Wiley Publishing. 3. J. Gowar, ``Optical Communication Systems,'' Prentice Hall India.			

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 24	Selected Topics in Communication	3L-1T-0P	ECC16
COURSE OUTCOMES (CO):			
COURSE CONTENT: Selected topics in communication engineering; details will be decided by the instructor.			
SUGGESTED READINGS:			

Course No.	Title of the Course	Course Structure	Pre-Requisite

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ECD 25	Information Theory	3L-1T-0P	ECC16

COURSE OUTCOMES (CO):

CO 1: apply the concepts of entropy, mutual information for analyzing the information theoretic problems.

CO 2: conceptually understand the Shannon's law of capacity for AWGN channel.

CO 3: mathematically analyze the capacity for various channels.

CO 4: understand rate distortion techniques.

COURSE CONTENT:

Entropy, relative entropy, and mutual information. Asymptotic equipartition property. Entropy rates of a stochastic process, Markov chains. Data compression: Kraft inequality, Huffman codes. Channel capacity: symmetric channels, channel coding theorem, Fano's inequality, feedback capacity. Differential entropy. The Gaussian channel: bandlimited channels, channels with colored Gaussian noise, Gaussian channels with feedback. Rate distortion Electrical Engineering 180 theory: rate distortion function, strongly typical sequences, computation of channel capacity. Network information theory: Gaussian multiple user channels, the multiple access channel, encoding of correlated sources, the broadcast channel, the relay channel, source coding and rate distortion with side information, multi-terminal networks.

SUGGESTED READINGS:

1.Cover, T.M. and Thomas, J.A., ``Elements of Information Theory,'' Wiley Inter science
2.Bose, R., ``Information Theory, Coding and Cryptography,'' Tata McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 26	Satellite Communication	3L-1T-0P	ECC16

COURSE OUTCOMES (CO):

CO 1: understand how analog and digital technologies are used for satellite communication networks.

CO 2: understand the radio propagation channel for Earth station to satellite.

CO 3: learn the dynamics of the satellite

CO 4: learn the various modulation techniques used in satellite communication

CO 5: study the new techniques for designing the Earth stations and tracking of the satellites

COURSE CONTENT:

Satellite systems basics, satellite channel, earth station and satellite equipment, different modulation and access techniques, examples of different satellite systems.

SUGGESTED READINGS:

1. D.Roddy, ``Satellite Communication,'' McGraw Hill
2. T.Pratt and C.W.Bostain, ``Satellite Communication,'' Wiley Publishing

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 27	Optical Wireless Communication	3L-1T-0P	ECC16

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COURSE OUTCOMES (CO):

CO 1: gain the fundamental knowledge about the propagation of light beam in atmosphere

CO 2: discuss the various channel issues like atmospheric turbulence, absorption losses and scattering.

CO 3: analyze the performance of simple optical wireless communication systems.

CO 4: understand about the modulators and demodulators of optical signals.

COURSE CONTENT:

Introduction: Propagation of light in unguided media - laser beam characteristics -atmospheric effects on optical signals - coding for atmospheric optical propagation.

Light Sources: Modulators - photo detectors and receivers - optical amplification – optical signal to noise ratio - acquisition, pointing and tracking - adaptive and active optics – laser safety.

Performance analysis of various optical wireless systems, MIMO optical wireless communications, Cooperative FSO systems, Hybrid FSO and RF - FSO point to multipoint – FSO point to mobile.

FSO inherent security features; FSO Specific Applications: FSO networks for highway assisted communications - mesh FSO in disaster areas - visual light communication.

SUGGESTED READINGS:

1. Stamatios V. Kartalopoulos, ``Free Space Optical Networks for Ultra-Broad Band Services,'' IEEE Press, 2011.

2. Arun K. Majumdar and Jennifer C. Ricklin,``Free-Space Laser Communications: Principles and Advances,'' Springer

3. Olivier Bouchet, Herve Sizun, Christian Boisrobert and Frederique De Fornel, ``Free-Space Optics: Propagation and Communication,'' John Wiley and Sons

4. Heinz Willebrand and Baksheesh S. Ghuman, ``Free Space Optics: Enabling Optical Connectivity in Today's Networks,'' Sams Publishing

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 28	MIMO Communication	3L-1T-0P	ECC16

COURSE OUTCOMES (CO):

CO 1: understand the concepts of multiple antenna based communication systems.

CO 2: discuss the various types of diversity and their combining schemes.

CO 3: analyze the performance of MIMO communication systems in terms of error probability and channel capacity.

CO 4: understand the fundamentals of space time coding.

COURSE CONTENT:

Introduction to Diversity: Capacity of flat and frequency selective fading channels, Realization of independent fading paths, Receiver Diversity: selection combining, Threshold Combining, Maximal ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO

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Diversity Gain, Beamforming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC, STTC, Spatial Multiplexing and BLAST Architectures.
SUGGESTED READINGS: 1.E. G. Larsson and P. Stoica, ``Space-Time Block Coding for Wireless Communication,'' Cambridge University Press 2.H. Jafarkhani, ``Space-Time Coding: Theory & Practic,'' Cambridge University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD29	Coding Theory	3L-1T-0P	ECC16
COURSE OUTCOMES (CO): CO 1: explain the requirement of source coding, channel coding etc. CO 2: understand the structure of various error correcting codes. CO 3: compare different codes like block codes, cyclic codes, and convolution codes. CO 4: discuss the trellis codes and their importance in communication theory.			
COURSE CONTENT: Measure of information; Source coding; Communication channel models; Channel Capacity and coding; Block codes; Cyclic codes; BCH codes; Reed Solomon codes; Convolutional codes; Trellis coded modulation; Introduction to cryptography.			
SUGGESTED READINGS: 1.Lin, S. and Costello Jr., D.J., ``Error Control Coding,'' Pearson Prentice-Hall 2.Blahut, R.E., ``Algebraic Codes for Data Transmission,'' Cambridge University Press 3. McEliece, R., ``Theory of Information and Coding,'' Cambridge University Press 4.Huffman, W.C. and Pless, V., ``Fundamentals of Error Correcting Codes,'' Cambridge University Press 5. Moon, T.K., ``Error Correction Coding: Mathematical Methods and Algorithms,'' Wiley Inter science			

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 30	Telecommunication Switching	3L-1T-0P	ECC16
COURSE OUTCOMES (CO): CO 1: explain the working principle of switching systems involved in telecommunication switching CO 2: understand the need for voice digitization and T Carrier systems CO 3: compare and analyze Line coding techniques and examine its error performance CO 4: design multi stage switching structures involving time and space switching stages CO 5: analyze basic telecommunication traffic theory			
COURSE CONTENT: Basic line circuits, long haul circuits, signaling, switching exchanges, analysis of telecom switching networks, teletraffic engineering, management protocols, multi-service telecom protocols and networks.			

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SUGGESTED READINGS:

1. J .C. Bellamy, ``Digital Telephony,'' Wiley Publishing
2. J.E. Flood, ``Telecommunications Switching, Traffic and Networks,'' Pearson Publication
3. T. Viswanathan, ``Telecommunication Switching Systems and Networks,'' Prentice Hall India
4. E. Keiser and E. Strange, ``Digital Telephony and Network Integration,'' Springer

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 31	Wireless Sensor Networks	3L-1T-0P	ECC16

COURSE OUTCOMES (CO):

CO 1: analyze the challenges and constraints of wireless sensor network and its subsystems

CO 2 : examine the physical layer specification, modulation and transceiver design considerations

CO 3: analyze the protocols used at the MAC layer and scheduling mechanisms

CO 4: compare and contrast the types of routing protocols and data aggregation techniques

CO 5: identify the application areas and practical implementation issues.

COURSE CONTENT:

Motivation for a network of wireless sensor nodes-Definitions and background-challenges and constraints for wireless sensor networks-Applications. Node architecture-sensing subsystems, processing Subsystems, Communication interfaces, Prototypes.

Physical layer- Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management

Fundamentals of wireless MAC protocols, Characteristics of MAC protocol in wireless sensor networks contention-based protocols, Contention free MAC protocols. Hybrid MAC protocols

Routing metrics-Flooding and gossiping, Data centric routing, proactive routing, On demand routing, hierarchical routing, Location based routing, QOS based routing, Data Aggregation techniques.

SUGGESTED READINGS:

1. W. Dargie,C. Poellabauer, ``Fundamentals of Wireless sensor networks-Theory and Practice,'' John Wiley & Sons Publication
2. K. Sohraby, D.Minoli and T.Znati, ``Wireless Sensor Network Technology- Protocols and Applications,'' John Wiley & Sons
3. F.Zhao, L.Guibas, ``Wireless Sensor Networks: an information processing approach,'' Elsevier publication
4. C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, ``Wireless Sensor Networks,'' Springer publication
5. H. Karl , A.willig, "Protocol and Architecture for Wireless Sensor Networks,'' John Wiley publication

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Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 32	Cognitive Radio	3L-1T-0P	ECC16

COURSE OUTCOMES (CO):

CO 1: gain knowledge on software defined radio.

CO 2: develop the ability to analyze, design, and implement the cognitive radio based application.

CO 3: understand the signal processing concepts used for efficient OFDM based system design.

CO 4: understand the rapid advances in Cognitive radio technologies.

CO 5: explore the spectrum sensing techniques for cognitive radio systems.

COURSE CONTENT:

Introduction to software defined radio. Concept of Cognitive Radio, Benefits of Using SDR, Problems Faced by SDR, Cognitive Networks, Cognitive Radio Architecture. Cognitive Radio Design, Cognitive Engine Design.

A Basic OFDM System Model, OFDM based cognitive radio, Cognitive OFDM Systems, MIMO channel estimation, Multi-band OFDM, MIMO-OFDM synchronization and frequency offset estimation. Spectrum Sensing to detect Specific Primary System, Spectrum Sensing for Cognitive OFDMA Systems.

SUGGESTED READINGS:

1 .J. H. Reed, ``Software Radio,'' Pearson Publishing

2. H. Arslan ``Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems,'' Springer

3. K.C.Chen, R.Prasad , ``Cognitive Radio Networks,'' Wiley Publishing

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 33	Green Communication	3L-1T-0P	ECC16

COURSE OUTCOMES (CO):

CO 1: gain the fundamental knowledge about the green communication and its advantage.

CO 2: discuss the various energy harvesting techniques for communication.

CO 3: optimize the performance of a communication system in terms of the energy efficiency.

CO 4: summarize the base station power management techniques for green radio networks.

COURSE CONTENT:

Fundamental Tradeoffs on the Design of Green Radio Networks: Insight from Shannon's capacity formula - impact of practical constraints - latest research and directions; Algorithms for Energy Harvesting Wireless Networks: Energy harvesting technologies - PHY and MAC layer optimization for energy harvesting wireless networks.

Modulation: Green modulation and coding schemes in energy constrained wireless networks, Co-operative Techniques for Energy Efficient Wireless Communications, Energy efficiency metrics for wireless networks, optimizing the energy efficiency performance of co-operative networks.

Base Station Power Management Techniques for Green Radio Networks, energy saving techniques in

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cellular wireless base stations - power management for base stations in a smart grid environment, energy efficient relaying for cooperative cellular wireless networks
SUGGESTED READINGS: 1. Ekram Hossain, Vijay K. Bhargava and Gerhard P. Fettweis, ``Green Radio Communication Networks,'' Cambridge University Press 2. F. Richard Yu, Yu, Zhang and Victor C. M. Leung, ``Green Communications and Networking", CRC press 3. Mazin Al Noor, ``Green Radio Communication Networks Applying Radio-Over-Fibre Technology for Wireless Access,'' GRIN Verlag 4. Mohammad S. Obaidat, Alagan Anpalagan and Isaac Woungang, ``Handbook of Green Information and Communication Systems,'' Academic Press 5. Jinsong Wu, Sundeep Rangan and Honggang Zhang, ``Green Communications: Theoretical Fundamentals, Algorithms and Applications,'' CRC Press 6. Mazin Al Noor, ``WiMAX Improvements in Green Radio Communications Utilizing Radio-Over- Fiber,'' GRIN Verlag 7. Ramjee Prasad and Shingo Ohmori, Dina Simunic, ``Towards Green ICT,.''River Publishers

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 34	Analog CMOS Design	3L-1T-0P	ECC06
COURSE OUTCOMES (CO): CO 1 To understand fundamentals of CMOS logic, MOS amplifiers, BiCMOS inverters, frequency response, CMOS analog circuit design, VLSI design methodology , fundamentals of low power CMOS design . CO 2 To understand the use of CMOS circuits in basic analog components, such as single-stage and operational amplifiers and data converters CO 3 To understand the CMOS technology in specific layout rules in the placement and routing of transistors and interconnect. CO 4 To understand the BiCMOS operation and its applications CO 5 To understand the fundamentals of low power CMOS design and testing and verification of design.			

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COURSE CONTENT:

Basic MOS models, second order effects, CMOS logic and Design rules and layout, Latchup Transfer characteristics, Basic NMOS/CMOS gain stage, cascade and cascode circuits, and Frequency response, stabilty and noise issues in amplifiers

Basic current mirrors, Cascode current mirrors, Active current mirror, operational amplifiers-two stage MOS op-amps, Switched Capacitor Circuits and introduction to Switched Capacitor circuits-Sampling switches, Switched Capacitor Filters-basic operation and analysis

Introduction, BJT Structure & operation, Basic BiCMOS Circuit behavior, Switching Delay in BiCMOS Logic circuits, BiCMOS Applications

Structure Design, Strategy, Hierarchy, Regularity, Modularity, Locality. System on Chip Design options: Programmable logic and structures, Programmable interconnect, programmable gate arrays, Sea of gate and gate array design, standard cell design, full custom mask design

Introduction to Ideal D/A and A/D converters – quantization noise–performance limitations, Higher order sigma-delta A/D converters

SUGGESTED READINGS:

1. Gray, Meyer, Lewis, Hurst,`` Analysis and design of Analog IC's," Willey International.
2. Nandita Dasgupata, Amitava Dasgupta,`` Semiconductor Devices - Modelling and Technology," Prentice Hall of India .
3. Behzad Razavi,`` Principles of data conversion system design," S.Chand and Company Ltd.
4. Grebene,`` Bipolar and MOS Analog Integrated circuit design," John Wiley & Sons Inc.
5. Phillip E. Allen Douglas R. Holberg,`` CMOS Analog Circuit Design," Oxford University Press.
6. Baker, Li and Boyce,`` CMOS: Circuit Design, Layout and Simulation," Prentice Hall India.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 35	Mixed Signal Design	3L-1T-0P	ECC10

COURSE OUTCOMES (CO):

CO 1 To understand the basics of signals, sampling and filtering
CO 2 To understand analog filter design
CO 3 To understand digital filter design
CO 4 To understand the basic of data convertors

COURSE CONTENT:

Review of Signals, Filters: Sinusoidal signals, quadrature signals, Digital Comb filter, Digital differentiator, Digital integrator, Exponential Fourier series, Fourier transform;

Sampling: Sampling and aliasing, decimation, Sample and Hold, Track and Hold, Interpolation, Circuits, S/H with gain

Analog Filters: Active-RC integrators, effect of finite GBP; MOSFET-C Integrators, gm-C integrators, high frequency transconductors, Discrete time integrators; Filter topologies: Bilinear transfer function, Active RC implementation, transconductance-C implementation and Switched capacitor implementations, High Q

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considerations, Q-peaking and instability

Digital Filters: DACs and ADCs, number representations, addition and subtraction in 2's compliment format, counter, aliasing, Low pass Sinc filters, band pass and high pass sinc filters, Interpolation and decimation using sinc filters; FIR filters, stability and overflow; bilinear function, canonical forms of digital filters

Data Converters: Quantization noise, SNR, improving SNR; data converter design basics, passive noise shaping, Improving SNR and linearity; Noise shaping data converters, digital first order NS demodulator, second order noise shaping, noise shaping topologies

SUGGESTED READINGS:

1. R. Jacob Baker,`` CMOS Mixed-Signal Circuit Design," Wiley-IEEE Press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 36	IC Testing and Characterization	3L-1T-0P	ECC20

COURSE OUTCOMES (CO):

CO 1 To understand types of faults and also to study about fault detection

CO 2 To understand the concepts of the test generation methods.

CO 3 To understand Automatic test pattern generation concepts for combinational and sequential circuits

CO 4: To perform memory test, defect screening, SOC testing etc

COURSE CONTENT:

Introduction to testing, Faults and their manifestations. Fault models. Combinational logic and fault simulation.

Test generation basics. Structural and non-structural test generation techniques. Combinational ATPG. Current sensing based testing.

Classification of sequential ATPG methods. Fault collapsing and simulation Test generation for synchronous and asynchronous circuits. Test compaction.

Universal test. Pseudo-exhaustive and iterative logic array testing. Clocking schemes for delay fault testing. Testability classifications for path delay faults. Test generation and fault simulation for path and gate delay faults.

Design for testability: Scan design, use of scan chains, boundary scan. Built-in self test. Synthesis for testability.

SUGGESTED READINGS:

1. M.Abramovici, M.A.Breuer and A.D. Friedman,`` Digital systems and Testable Design," Jaico Publishing House.

2. M.L.Bushnell and V.D.Agrawal,`` Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits," Kluwer Academic Publishers.

3. A.L.Crouch,`` Design Test for Digital IC's and Embedded Core Systems," Prentice Hall International.

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Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 37	Electronic Design Automation	3L-1T-0P	ECC20

COURSE OUTCOMES (CO):

CO 1 To understand digital design methodologies
CO 2 To understand the basics of layout placement and partitioning
CO 3 To understand synthesis of logic circuits
CO 4 To understand basic of Analog /RF simulation

COURSE CONTENT:

Overview of digital design methodologies ; VLSI design automation tool requirements ; Computational complexity/ Tractable and Intractable problems; Layout compaction; Placement and partitioning; Floor planning; Routing; Simulation of VLSI circuits; Logic synthesis; Verification; Overview of Analog/RF simulation;
Simulation using direct/iterative methods

SUGGESTED READINGS:

1. D. Jansen et al,`` The Electronic Design Automation Handbook," Kluwer Publication
2. S. H. Gerez,`` Algorithms for VLSI Design Automation," Wiley Publication.
3. N. Sherwani,`` Algorithms for VLSI Physical Design Automation," Kluwer.
4. J. Rabaey,`` Digital Integrated Circuits," Prentice Hall India
5. J. Vlach and K. Singhal,`` Computer Methods for Circuit Analysis and Design," Van Nostrand Reinhold Publication
6. J. K. White and A. Sangiovanni-Vincetelli,`` Relaxation Techniques for the Simulation of VLSI Circuits," Kluwer Publication
7. K. S. Kundert, J. K. White and A. Sangiovanni-Vincetelli,`` Steady-State Methods for Simulating Analog and Microwave Circuits," Kluwer Publication

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 38	Optimization of CMOS Integrated Circuits Optimization of CMOS Integrated Circuits	3L-1T-0P	ECC20

COURSE OUTCOMES (CO):

CO-1 To understand the timing and power constraints and tradeoffs in digital CMOS Integrated circuits.
CO-2 To understand the gain and bandwidth related constraints and tradeoffs in analog CMOS integrated circuits.
CO-3 To determine the upper bounds on transistor sizes for optimization using relevant techniques for both digital and analog CMOS integrated circuits.
CO-4 To be able to understand the process corner analysis based on process, voltage and temperature variations.

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COURSE CONTENT:

Introduction to basic digital and analog CMOS integrated circuits such as transistor level realization of combinational (multiplexers, decoders etc.) and sequential circuits (flip-flops, counters, shift registers etc.), op-amps, comparators etc.

Timing characterization of digital CMOS integrated circuits, measurement of propagation delays, setup time, hold time, clock-to-output delay, data-to-output delay, clock skew, clock jitter etc. Power characterization in CMOS circuits including dynamic and leakage power dissipation.

Optimizing delays in digital CMOS circuits using logical effort theory, concept of logical effort, electrical effort, stage effort, delay optimization of multistage circuits. Technology calibration - deriving the relationship between transistor width and gate capacitance at a given process node. Process corners TT, SF, FS, FF, SS and PVT variations.

Tradeoffs and Optimization in Analog circuits, MOS design from weak through strong inversion, MOS design complexity compared to bipolar design, Bipolar transistor collector current and transconductance, MOS drain current and transconductance, MOS drain source conductance, Analog CMOS electronic design automation tools and design methods.

MOS performance versus drain current, inversion coefficient, and channel length, Advantages of selecting drain current, inversion coefficient, and channel length in analog CMOS design, Substrate factor and inversion coefficient, Temperature effects, sizing relationship, drain current and bias voltages, small signal parameters and intrinsic voltage gain, body effect transconductance and relationship to substrate factor, drain conductance, capacitances and bandwidth, noise,

Tradeoffs in MOS performance, and design of differential pairs and current mirrors,

Design of CMOS operational transconductance amplifiers optimized for DC, Balanced and AC Performance, Extending optimization methods to smaller geometry processes and future technologies.

SUGGESTED READINGS:

1. Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic,`` Digital Integrated Circuits,” Prentice-Hall.
2. N Weste and D. Harris,`` CMOS VLSI Design: Circuits and Systems Perspective,” Addison Wesley.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 39	Selected Topics in Analog Signal Processing	3L-1T-0P	ECC20

COURSE OUTCOMES (CO):

COURSE CONTENT:

Specific contents of this course would be devised by the Department taking due cognizance of the prevalent state-of-the-art of Analog Signal Processing at the time of offering the course to provide an exposure about the latest trends in Analog Signal Processing

SUGGESTED READINGS:

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Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 40	VLSI Technology and Design	3L-1T-0P	ECC20

COURSE OUTCOMES (CO):

CO-1To understand basics of MOS devices CMOS fabrication and basis building blocks
CO-2 To understand circuit design process
CO-3 To understand the various types and effects of scaling
CO-4 To understand CMOS logic structures
CO-5 To understand design for testability

COURSE CONTENT:

Review of Basic MOS Technology: Integrated circuits era, enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication, Thermal aspects of processing, BiCMOS technology, production of E-beam, MOS device design equations, the complementary CMOS inverter-DC characteristics, static load MOS inverters, the differential inverter, the transmission gate, tristate inverter.

Circuit Design Processes: MOS layers, stick diagrams, Design rules and layout- lambda-based design and other rules. Examples, layout diagrams, symbolic diagram, tutorial exercises.Basic physical design of simple logic gates.

CMOS Logic Structures: CMOS complementary logic, BiCMOS logic, Pseudo-nMOS logic, Dynamic CMOS logic, clocked CMOS logic, Pass transistor logic, CMOS domino logic cascaded voltage switch logic (CVSL).

Basic circuit concepts: Sheet resistance, area capacitances, capacitances calculations. The delay unit, inverter delays, driving capacitive loads, propagation delays, wiring capacitances.

Scaling of MOS circuits: Scaling models and factors, limits on scaling, limits due to current density and noise.

CMOS subsystem design: Architectural issues, switch logic, gate logic, design examples-combinational logic, clocked circuits. Other system considerations. Clocking strategies

CMOS subsystem design processes: General considerations, process illustration, ALU subsystem, adders, and multipliers.

Memory registers and clock, Timing considerations, memory elements, memory cell arrays.

Testability: Performance parameters, layout issues I/O pads, real estate, system delays, ground rules for design, test and testability.

SUGGESTED READINGS:

1. Douglas A. Pucknell & Kamran Eshraghian,`` Basic VLSI Design,” Prentice Hall India.
2. Neil H. E. Weste and K. Eshragian,`` Principles of CMOS VLSI Design: A System Perspective,” Pearson Education.

Course No.	Title of the Course	Course Structure	Pre-Requisite

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ECD 41	System on Chip	3L-1T-0P	ECC20

COURSE OUTCOMES (CO):

CO-1 To understand basic SoC design methodologies
CO-2 To understand HW/SW co-design
CO-3 To understand high level synthesis
CO-4 To understand SoC and IP integration

COURSE CONTENT:

1. System-level and SoC design methodologies and tools;
2. HW/SW co-design: analysis, partitioning, real-time scheduling, hardware acceleration;
3. Virtual platform models, co-simulation and FPGAs for prototyping of HW/SW systems;
4. Transaction-Level Modeling (TLM), Electronic System-Level (ESL) languages: System C;
5. High-Level Synthesis (HLS): allocation, scheduling, binding, resource sharing, pipelining;
6. SoC and IP integration, verification and test.

SUGGESTED READINGS:

1. Black, J. Donovan, ``SystemC: From the Ground Up,'' Springer
2. R. Zurawski, `` Embedded Systems Handbook,'' CRC Press
3. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, ``Embedded System Design: Modeling, Synthesis, Verification,'' Springer
4. P. Marwedel, ``Embedded System Design,'' Springer
5. De Micheli, ``Synthesis and Optimization of Digital Circuits'', McGraw-Hill
6. T. Noergaard, ``Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers,'' Newnes

Course No.	**Title of the Course**	**Course Structure**	**Pre-Requisite**
ECD 42	Deep sub-micron CMOS IC Design	3L-1T-0P	ECC20

COURSE OUTCOMES (CO):

CO-1 Apply the circuit models to investigate CMOS circuits.
CO-2 Able to design moderately sized CMOS circuits/ sub-systems and compute timing, power and parasitic for various CMOS Logic structures.
CO-3 Able to evaluate various micron, deep sub micron and nanometer-scale technologies.
CO-4 To understand the parasitic elements introduced by the deep submicron process

COURSE CONTENT:

Deep Submicron CMOS Circuit Fabrication accounting for process corners; Deep Submicron CMOS transistor theory, Strained Silicon Technology, Dual Damascene Process for Copper Wiring Resistance, Capacitance and Inductance Calculation, Deep Submicron Transistor Models Crosstalk and design margins VLSI economics, tools, design methodology, and design flows NP Dynamic and Zipper CMOS, Advanced Latches and Flip-Flops, pass transistor logic Dynamic logic and clocking Tree Adders , Carry Save Adders, Booth and Wallace Tree Multipliers and Dividers DRAM Design, CAM and ROM, Testing Wave Pipelining &

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case study, Synchronizers ,Arbiters, Power Distribution & Phase-Locked Loop Clocking, latch-up and reliability Design for Low Power, clocking, and analog VLSI design Silicon-on-Insulator Technology, Single-Electron Transistors, Carbon Nanotubes, Quantum Dots, Spintronics
SUGGESTED READINGS: 1. Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic, ``Digital Integrated Circuits,'' Prentice-Hall 2. Eric Brunvand, ``Digital VLSI Chip Design with Cadence and Synopsys CAD Tools, '' Addison Wesley 3. N Weste and D. Harris, `` CMOS VLSI Design: Circuits and Systems Perspective, '' Addison Wesley 4. Harry J. M. Veendrick, `` Deep-Submicron Cmos Ics: From Basics to Asics,'' Springer 5. W. Nebel, Jean P. Mermet, ``Low Power Design in Deep Submicron Electronics ,'' Springer 6. P.R.Van Der Meer, Arie van Staveren, Arthur H. M. van Roermund, ``Low-Power Deep Sub-Micron CMOS Logic Sub-threshold Current Reduction,'' Springer

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 43	Semiconductor Memory Design	3L-1T-0P	ECC20

COURSE OUTCOMES (CO):

CO-1 To understand various types of RAMs architectures
CO-2 To understand advanced Nonvolatile Memory designs
CO-3 To understand embedded memory designs
CO-4 To appreciate recent advancements in semi-conductor memories

COURSE CONTENT:

Static Random Access Memory technologies including advanced architectures, low voltage SRAMs, fast SRAMs, SOI SRAMs, and specialty SRAMs (multiport, FIFOs, CAMs)

High Performance Dynamic Random Access Memory-DDRs, synchronous DRAM/SGRAM features and architectures, EDRAM, CDRAM, Gigabit DRAM scaling issues and architectures, multilevel storage DRAMs, and SOI DRAMs

Applications-specific DRAM architectures and designs- VRAMs, DDR SGRAMs, RDRAMs, SLDRAMs, 3-D RAM

Advanced Nonvolatile Memory designs and technologies, including floating gate cell theory, EEPROM/flash memory cell design, and multilevel flash

FRAMs and reliability issues

Embedded memory designs and applications, including cache, merged processor, DRAM architectures, memory cards, and multimedia applications

Future memory directions with megabytes to terabytes storage capacities using RTDs, single electron memories, etc.

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SUGGESTED READINGS:
1. Ashok K Sharma,`` Advanced Semiconductor Memories: Architectures, Designs and Applications," Wiley-IEEE Press

Course No.	**Title of the Course**	**Course Structure**	**Pre-Requisite**
ECD 44	Device Modeling and Circuit Simulation	3L-1T-0P	ECC10
COURSE OUTCOMES (CO): CO-1 To understand basic ideas of semi-conductor device physics CO-2 To understand short channel effects and various parasitics in MOSFETs CO-3 To understand physical based modelling of electronc devices CO-4 To appreciate the role of device modelling in realistic circuit simulation			
COURSE CONTENT: Physical foundation of semiconductor devices; charge control; threshold voltage; sub-threshold phenomena; mobility; velocity saturation; Short-channel effects; parasitics; Physical-based modelling of common devices such as Si MOSFET (CMOS), GaAs MESFET, HEMT, and bipolar transistors; Strength and weaknesses of the models; Parameter extraction; Application of the models in SPICE-type circuit simulators.			
SUGGESTED READINGS: 1. C. Snowden, ``Introduction to Semiconductor Device Modeling," World Scientific. 2. Y. Tsividis and C. McAndrew,`` MOSFET modeling for Circuit Simulation," Oxford University Press. 3. B. G. Streetman and S. Banarjee, ``Solid State Electronic Devices," Prentice-Hall of India. 4. T. A. Fjeldly, T. Ytterdal and M. Shur, ``Introduction to Device Modeling and Circuit Simulation," John Wiley. 5. Y. Taur and T. H. Ning, ``Fundamentals of Modern VLSI Devices," Cambridge University Press.			

Course No.	**Title of the Course**	**Course Structure**	**Pre-Requisite**
ECD 45	ASIC Design	3L-1T-0P	ECC20
COURSE OUTCOMES (CO): CO-1 To appreciate the current trends in IC design CO-2 To understand the basic design methodology of ASICs CO-3 To understand the basic steps of CMOS fabrication CO-4 To understand low power design methodologies CO-4 To understand the basic issues related to ASIC design			
COURSE CONTENT:			

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Integrated circuits trends, Digital integrated circuits implementation methodologies, MOS devices theory , SPICE simulation , CMOS fabrication ; Inverters and combinational circuits ; Sequential circuits ; Clocking and timing issues ; Interconnect issues ; Arithmetic and data path circuits ;Memories and array circuits ;Low power design ;Packaging, power and I/O issues ;Testing and design for testability ;Design methodologies and tools ;Full-custom IC design project
SUGGESTED READINGS: 1. N. H. E. Weste and D. Harris, ``CMOS VLSI Design: A Circuits and Systems Perspective,'' Addison-Wesley. 2. J. Rabaey, A. Chandrakasan, B. Nikolic, ``Digital Integrated Circuits: A Design Perspective,'' Prentice Hall. 3. W. Wolf, ``Modern VLSI Design: System-on-Chip Design,'' Prentice Hall.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 46	Pulse Digital Circuits	3L-1T-0P	ECC03

COURSE OUTCOMES (CO):

CO-1 To understand and analyse the difference between linear and non-linear wave shaping circuits.
CO-2To understand the utility of transistor as a switch in multivibrators.
CO-3To develop conceptual understanding of voltage and current sweep circuits.
CO-4To clearly know the implementation of digital circuits using various logic families and their relative advantages and disadvantages.

COURSE CONTENT:

Linear Wave Shaping: High Pass and Low Pass RC Circuits and their Response for Sinusoidal, Step Voltage, Pulse, Square Wave and Ramp Inputs. High Pass RC Circuit as a Differentiator. Low Pass RC Circuit as an Integrator. Attenuators and their Application as CRO Probe. RL and RLC Circuits and their response for step input. Ringing circuit.

Non-Linear Wave Shaping: Diode clippers. Transistor Clippers. Clipping at two independent levels. Comparator – Applications of voltage Comparators – Diode Comparator. Clamping Operation.Clamping Circuits using Diode with Different Inputs. Clamping Circuit Theorem.Practical Clamping circuits. Effect of diode Characteristics on Clamping Voltage.

Multivibrators: Transistor as a Switch – Switching times of a transistor. Astable, Monostable and bistableMultivibrators using Transistors.Resolution time of a Binary. Methods of improving Resolution time – Methods of Triggering a binary. Schmitt Trigger.

Sweep Circuits: Voltage sweep — Simple Exponential sweep Generator. Errors that define Deviation from linearity, UJT Relaxation Oscillator – Methods of linearising a Voltage Sweep – Bootstrap and Miller Circuits – Current Sweep – Linearising a current Sweep by Adjusting the driving Waveform.

Synchronization and Frequency Division: Principles of Synchronization – Synchronization of Astable Multivibrators. Synchronization of Sweep Circuits with Symmetrical Signals.

Logic Gates: IC Families, TTL, CMOS, ECL, FFs and Circuits.

Blocking Oscillator: Base Timing.Emitter Timing, and Astable Blocking Oscillator.

SUGGESTED READINGS:

1. Millman and Taub, ``Pulse, Digital and Switching Waveforms,'' McGraw Hill

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2. L. Strauss, ``Wave Generation and Shaping,” McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 47	Switching Theory and Automata	3L-1T-0P	ECC03

COURSE OUTCOMES (CO):

CO1: To understand the principles of switching theory and algebra.
CO2: To acquire knowledge and ability to analyze threshold gates sand their synthesis.
CO3: To be able to analyze and implement sequential machines: ASM and FSM.
CO4: To understand various fault tolerance and diagnosis techniques.

COURSE CONTENT:

Introduction to number system and codes: Radix conversion, Gray codes, Hamming codes for error detection and error correction.
Finite Automata: Deterministic accepters and transition graphs, Language and Dfa’s, Regular languages. Non-deterministic finite accepters, Definition of non-deterministic accepters, why non-determinism, Equivalence of deterministic and non-deterministic finite accepters, Reduction of the number of states in finite automata.
Combinatorial System: Switching algebra, switching functions. Isomorphic systems, Electronic gate networks, fundamental theorem of Boolean Algebra.
Minimization: Use of minimization techniques, minimal functions and their properties, Quine-McCluskey method for determination of prime implicants by tabulation procedure, the prime implicant chart.
Synthesis of switching functions: use of logic gates, logic design with integrated circuits, NAND and NOR circuits, Design of high speed adders, analysis and synthesis of contact networks.
Fault Diagnosis: Introduction, fault tolerance techniques, design for testability.
Sequential Machines: Introduction, flip-flops and excitation table. Design of counters.Synthesis of synchronous sequential machine, capabilities and limitations of Finite State machine.

SUGGESTED READINGS:

1. Z V I Kohavi, `` Switching and Finite Automata Theory,” Tata McGraw Hill .
2. Peter Linz, ``An Introduction to Finite Languages and Automata,” Narosa Publishing House.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 48	Robotics and Automation	3L-1T-0P	ECC17

COURSE OUTCOMES (CO):

CO-1 To understand the degrees of freedom in robotics along with the utility of sensors, actuators and grippers.
CO-2To study the various kinematics and inverse kinematics of robots.

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CO-3 To study Euler, Lagrangian formulation of Robot dynamics and comprehend trajectory planning for robots.
CO-4 To select appropriate sensors for a given automation application.
CO-5 To develop strong understanding of methodologies involved in controlling robots for specific applications.

COURSE CONTENT:

BASIC CONCEPTS: Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

POWER SOURCES AND SENSORS: Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

MANIPULATORS, ACTUATORS AND GRIPPERS: Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers –design considerations.

KINEMATICS AND PATH PLANNING: Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill climbing techniques – robot programming languages

CASE STUDIES: Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

SUGGESTED READINGS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., `` Industrial Robotics," McGraw-Hill.
2. Deb.S.R., `` Robotics technology and flexible Automation," John Wiley.
3. Asfahl C.R., ``Robots and manufacturing Automation," John Wiley.
4. Klafter R.D., Chimielewski T.A., Negin M., `` Robotic Engineering – An integrated approach," Prentice Hall of India.
5. Mc Kerrow P.J, `` Introduction to Robotics," Addison Wesley.
6. Issac Asimov I, `` Robot," Ballantine Books.
7. Ghosh, `` Control in Robotics and Automation: Sensor Based Integration," Allied Publishers.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 49	Computational Electromagnetics	3L-1T-0P	ECC 09

COURSE OUTCOMES (CO):

CO1: Introduce the subject of computational techniques and numerical methods.
CO2: Develop expertise in the field of computational electromagnetics in particular and numerical methods in general.
CO3: Build a background in numerical methods to be used in their research work and future studies and careers.
CO4: Understand the concept of modeling and the treatment of numerical solutions.

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CO5: Explore an ever-increasing area of research with state-of-the-art techniques and methods. CO6: Be exposed to the recent technological developments in the field of electromagnetics, especially in photonics and telecommunications.
COURSE CONTENT: Principles of Electromagnetic theory, analytical methods and orthogonal functions, Green function, Contour integration and conformal mapping, FDM, FDTD, FEM, MOM and varitional methods for electromagnetic problems.
SUGGESTED READINGS: 1. Ramesh Garg , ``Analytical and Computational Method in Electromagnetics,'' Artech house. 2. Collin, R.E., ``Field Theory of Guided Waves,'' Wiley-IEEE Press. 3. Peterson, A.F, Ray, S.L. and Mittra, R., ``Computational Methods for Electromagnetics,'' Wiley-IEEE Press. 4. Harrington, R.F., ``Field Computation by Moment Methods," Wiley- IEEE Press. 5. Sadiku, M.N.O., ``Numerical Techniques in Electromagnetics,'' CRC Press. 6. Volakis, J.L., Chatterjee, A. and Kempel, L.C., ``Finite Method for Electromagnetics," Wiley-IEEE Press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 50	Radar and Navigation	3L-1T-0P	ECC18
COURSE OUTCOMES (CO): **CO1**: Acquired knowledge about Radar and Radar Equations. **CO2**: Understanding the working principal of MTI and Pulse Doppler Radar. **CO3**: Foster ability to work using Detection of Signals in Noise and Radio Direction Finding. **CO4:** Foster ability to work using Instrument Landing System. **CO5**: Acquired knowledge about Navigation System.			
COURSE CONTENT: Principles of RADAR, RADAR equation, antenna for radar and navigation, CW and FM radar, MTI and Pulse Doppler radar, tracking and imaging radar, Navigation, radio direction finding, radio ranges, hyperbolic systems of navigation, Aids to approach landing, modern navigation.			
SUGGESTED READINGS: **1.** Skolnik, M, ``Introduction to Radar Systems,'' Tata McGraw-Hill, 3rd Edition, 2001. 2. N. S. Nagaraja, ``Elements of Electronic Navigation Systems,'' Tata McGraw-Hill.			

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 51	Phased Array Antennas	3L-1T-0P	ECC18
COURSE OUTCOMES (CO): **CO1**: Understand different array configuration.			

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CO2: Understand mutual coupling effect in antenna array **CO3**: Understand the beamforming of array. **CO4:** Understand smart array.
COURSE CONTENT: Antenna array basics, Array factor analysis, Linear and planar array factor synthesis, Array factors and element patterns, Nonplanar arrays, Adaptive array, Mutual coupling, Array beamforming network, Smart arrays.
SUGGESTED READINGS: 1. R. J. Mailloux, `` Phased array antenna handbook," Artech house. 2. Randy L. haupt, `` Antenna array a computational approach," IEEE press 3. R. C. Hansen, ``Phased array antennas," John Wiley and Sons. 4. H. J. Visser, ``Array and phased array antennas basics," John Wiley and Sons.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 52	Advanced Microwave Engineering	3L-1T-0P	ECC19
COURSE OUTCOMES (CO): **CO1**: Understand the noise in linear two-port network. **CO2**: Motivation to design small- and large-signal amplifier design. **CO3**: Motivation to design power amplifier. **CO4**: Motivation to design oscillator. **CO5**: Motivation to design microwave mixer.			
COURSE CONTENT: Two-port networks, noise in linear two-port, small- and large-signal amplifier design, power amplifier design, oscillator design, microwave mixer design.			
SUGGESTED READINGS: 1. George D. Vendelin, Anthony M. Pavio & Ulrich L. Rehde, ``Microwave circuit design," Wiley. 2. Matthew M. Radmanesh, ``Radio frequency and microwave electronics," Pearson Education Asia publication.			

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 53	Electromagnetic Interference and Compatibility	3L-1T-0P	ECC09
COURSE OUTCOMES (CO): CO1: To familiarize with the fundamentals that are essential for electronics industry in the field of EMI / EMC. CO2: To understand EMI sources and its measurements.			

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CO3: To understand the various techniques for electromagnetic compatibility.
CO4: Designing electronic systems that function without errors or problems related to electromagnetic compatibility
CO5: Diagnose and solve basic electromagnetic compatibility problems.

COURSE CONTENT:

History and concept of EMI, Definitions of EMI/EMC, Electromagnetic environment, Practical experiences and concerns, frequency spectrum conservation, mechanisms of EMI generation, EMI testing, Methods of elimination of EMI and Biological effects of EMI

Sources of Electromagnetic noise, modes of noise coupling, designing for EM compatibility, lightening discharge, electro static discharge (ESD), electromagnetic pulse (EMP). Electromagnetic emissions, noise form relays and switches, non-linearity in circuits, passive inter modulation, transients in power supply lines, EMI from power electronic equipment, EMI as combination of radiation and conduction.OATS measurements, measurement precautions.

Anechoic chamber, TEM cell, reverberating chamber, GTEM cell, comparison of test facilities. Characterization of conduction currents / voltages, conducted EM noise and power line, conducted EMI from equipment, immunity to conducted EMI, characteristics of EMI filters and
power line filter design.

Safety and signal grounds, grounding methods, grounding of amplifiers and cable shields, isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding, types of cables, mechanism of EMI emission / coupling in cables. effectiveness of shielding, near and far fields / impedances, methods of analysis, total loss due to absorption and reflection effects, composite absorption and reflection losses for electric fields / magnetic fields, magnetic materials as a shield, shield discontinuities, slots and holes, seams and joints, conductive gaskets, General Characteristics of good bonds.

Choice of capacitors, inductors, transformers and resistors, EMC design components National / International EMC standards, military and civilian standards.

SUGGESTED READINGS:

1. C.R. Pal, ``*Introduction to Electromagnetic Compatibility,"* John Wiley.
2. Kodali, V.P., ``Engineering Electromagnetic Compatibility: Principles, Measurement and Technologies," IEEE Press.
3. ``*Electromagnetic Interference and Compatibility,"* IMPACT series, IIT-Delhi, Modules 1-9.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 54	RF MEMS and their Applications	3L-1T-0P	---

COURSE OUTCOMES (CO):

CO1: Introduce the RF MEMS with their applications.
CO1: Introduce the MEMS switches.
CO3: Study the modeling of mechanical filters, micromachined filters, surface acoustic wave filters.

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CO4: Study the role and types of MEMS packages.
COURSE CONTENT: RF MEMS for microwave applications, MEMS technology and fabrication, mechanical modelling of MEMS devices, MEMS materials and fabrication techniques. Introduction to MEMS switches; Capacitive shunt and series switches: Physical description, circuit model and electromagnetic modelling; Techniques of MEMS switch fabrication and packaging; Design of MEMS switches. Modeling of mechanical filters, micromachined filters, surface acoustic wave filters, micromachined filters for millimeter wave frequencies; Various types of MEMS phase shifters; Ferroelectric phase shifters. Role of MEMS packages, types of MEMS packages, module packaging, packaging materials and reliability issues.
SUGGESTED READINGS: 1. Varadan, V.K., Vinoy, K.J. and Jose, K.J., ``RF MEMS and their Applications,", John Wiley & Sons. 2. Rebeiz, G.M., ``MEMS: Theory Design and Technology," John Wiley & Sons.

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 55	Quantum Mechanics	3L-1T-0P	-----
COURSE OUTCOMES (CO): CO1: Introduction to quantum mechanics. CO2: Study of Schroedinger's wave equation and getting "quantum" behavior. CO3: Study the Quantum mechanics of systems that change in time. CO4: Measurement in quantum mechanics. Co5: How to solve real problems.			
COURSE CONTENT: How quantum mechanics is important in the everyday world, the bizarre aspects and continuing evolution of quantum mechanics, and how we need it for engineering much of modern technology. Getting to Schroedinger's wave equation. Key ideas in using quantum mechanical waves — probability densities, linearity. The "two slit" experiment and its paradoxes. The "particle in a box", eigenvalues and eigenfunctions. Mathematics of quantum mechanical waves. Time variation by superposition of wave functions. The harmonic oscillator. Movement in quantum mechanics — wave packets, group velocity and particle current. Operators in quantum mechanics — the quantum-mechanical Hamiltonian. Measurement and its paradoxes — the Stern-Gerlach experiment. A simple general way of looking at the mathematics of quantum mechanics — functions, operators, matrices and Dirac notation. Operators and measurable quantities. The uncertainty principle. Angular momentum in quantum mechanics — atomic orbitals. Quantum mechanics with more than one particle. Approximation methods in quantum mechanics.			
SUGGESTED READINGS:			

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1. J. Griffiths, `` *Introduction to Quantum Mechanics,''* Prentice Hall .

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECD 56	Selected Topics in Microwave Engineering	3L-1T-0P	ECC19
COURSE OUTCOMES (CO): Selected topics in microwave engineering; details will be decided by the instructor.			
COURSE CONTENT:			
SUGGESTED READINGS:			

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SYLLABUS OF OPEN ELECTIVES

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO001	Technical Communication	3L-1T-0P	None

COURSE OUTCOMES (CO):

1. The course will improve writing and documentation skills of students with emphasis on the importance of effective communication with focus on choice of words, formation of proper sentence structures and writing styles.
2. This will enhance the students capability to prepare technical documents and correspondence.
3. The course will equip the student with good communications skills for placements, preparing SOPs and CVs.
4. The course will sensitize the students towards research ethics, copyright and plagiarism.

COURSE CONTENT:

- Definition of communication, meaning, importance & process of communication, objectives, types, C's of communication, barriers to communication
- human & non -human communication, distinctive features of human languages
- Business correspondence-definition, meaning and importance of business communication, business letters- purchase, enquiry, quotation, order, followup, acceptance-refusal
- Emphasis on (i) paragraph writing, its kinds, coherence & cohesion
  (ii)writing a paragraph/thesis: selection of topic and its development
  (iii) writing reports, manuals, notices, memos, agendas, minutes
  (iv)Interviews, speeches, presentations,
- research ethics, methodologies, copyright, plagiarism

SUGGESTED READINGS:

1. Martin Hewing, ``Advanced English Grammar,'' Cambridge University Press
2. Meenakshi Raman and Sangeeta Sharma, ``Technical Communication,'' Oxford University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO002	Disaster Management	3L-1T-0P	None

COURSE OUTCOMES (CO):

1. Demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning

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and programming in different countries, particularly their home country or the countries they work in.
COURSE CONTENT: **Unit -I: Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude. Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts. **Unit -II: Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics **Unit -III: Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness. **Unit -IV: Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival. **Unit -V: Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.
SUGGESTED READINGS: 1. R. Nishith, Singh AK,`` Disaster Management in India: Perspectives, issues and strategies,'' New Royal book Company 2. Sahni, Pardeep, ``Disaster Mitigation Experiences And Reflections,'' Prentice Hall Of India 3. Goel S. L., ``Disaster Adminastration And Management Text And Case Studies,'' Deep & Deep Publication

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO003	**Basics of Financial Management**	**3L-1T-0P**	**None**
COURSE OUTCOMES (CO): The course's objective is to provide a theoretical framework for considering corporate finance problems and issues and to apply these concepts in practice. In this course, you will enhance your knowledge and understanding of financial management. You will learn how managers should organize their financial transactions effectively and with integrity and how to give everybody the ability and confidence to tackle			

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common financial problems in practice. It will also provide adequate preparation for future finance classes.

COURSE CONTENT:

Unit I

Nature, scope and objectives of financial management, Time value of money, Risk and return (including Capital Asset Pricing Model).

Unit II

Long term investment decisions: The Capital Budgeting Process, Cash Flow Estimation, Payback Period Method, Accounting Rate of Return, Net Present Value (NPV), Net Terminal Value, Internal Rate of Return (IRR), Profitability Index.

Unit III

Financing Decisions: Sources of long-term financing, Estimation of components of cost of capital, Methods for calculating Cost of Equity, Cost of Retained Earnings, Cost of Debt and Cost of Preference Capital, Weighted Average Cost of Capital (WACC). Capital Structure- Theories of Capital Structure (Net Income, Net Operating Income, MM Hypothesis, Traditional Approach). Operating and Financial leverage. Determinants of capital structure

Unit IV

Dividend Decisions: Theories for Relevance and irrelevance of dividend decision for corporate valuation- Walter's Model, Gordon's Model, MM Approach, Cash and stock dividends. Dividend policies in practice.

Unit V

Working Capital Decisions: Concepts of Working Capital, Operating & Cash Cycles, sources of short term finance, working capital estimation, cash management, receivables management, inventory management.

SUGGESTED READINGS:

1. Khan, M.Y. and P.K. Jain,`` Financial Management: Text and Problems,'' Tata McGraw Hill
2. Srivastava, Rajiv, and Anil Mishra,`` Financial Management,'' Oxford University Press
3. Chandra, P., ``Financial Management-Theory and Practice,'' Tata McGraw Hill.
4. Horne, Van; James C., John Wachowicz, ``Fundamentals of Financial Management,'' Pearson Education.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO004	**Basics of Human Resource Management**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

This course is designed to provide students with an understanding of human resource management (HRM) functions within organizations, including an appreciation of the roles of both HRM specialists and line managers in designing and implementing effective HRM policies and practices.

COURSE CONTENT:

Unit - I

Evolution and growth of human resource management (with special reference to scientific management and Human relations approaches).Role of HR in strategic management.Nature.objectives, scope, and functions of HR management.

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Unit - II

Challenges of HR (the changing profile of the workforce - knowledge workers, employment opportunities in BPOs, IT and service industries, Flexi options), Workforce diversity (causes, paradox, resolution of diversity by management).

Unit III

HRD; Human resource management as a profession.Concepts of line-staff in the structure of human resource department and the role of human resource manager.

Unit - IV

Manpower planning -objectives, elements, advantages, process. Job design - (simplification, rotation, enlargement, enrichment and approaches}.Job analysis.Job evaluation.

Unit - V

Recruitment (factors affecting, sources, policy, evaluation). Selection(procedure, tests, interviews). Placement and Induction.

SUGGESTED READINGS:

1. Aswathappa K., ``Human Resource and Personnel Management,'' Tata McGraw-Hill
2. Chhabra T.N., ``Human Resource Management,'' Dhanpat Rai and Co.
3. Saiyadain S. Mirza, `` Human Resource Management,'' Tata Mc-Graw Hill
4.Chadha, N.K, ``Human Resource Management-issues, case studies, experiential exercises,'' Sri Sai Printographers

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO005	Project Management	3L-1T-0P	None

COURSE OUTCOMES (CO):

In this comprehensive course, student will learn the fundamentals of project management: how to initiate, plan, and execute a project that meets objectives and satisfies stakeholders. This course provides a step-by-step guide to planning and executing a project and to develop a manageable project schedule.

COURSE CONTENT:

Unit-I

Objectives of Project Planning, monitoring and control of investment projects. Relevance of social cost benefit analysis, identification of investment opportunities. Pre-feasibility studies.

Unit-II

Project Preparation: Technical feasibility, estimation of costs, demand analysis and commercial viability, risk analysis, collaboration arrangements; financial planning; Estimation of fund requirements, sources of funds.Loan syndication for the projects.Tax considerations in project preparation and the legal aspects.

Unit-III

Project appraisal: Business criterion of growth, liquidity and profitability, social cost benefit analysis in public and private sectors, investment criterion and choice of techniques. Estimation of shadow prices and social discount rate.

Unit-IV

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Project review/control-Evaluation of project. PERT/CPM.resource handling/leveling.

Unit-V

Cost and Time Management issues in Project planning and management , success criteria and success factors, risk management.

SUGGESTED READINGS:

1. Ravi Ravindran, `` Operations Research and Management Science Handbook,'' CRC Press
2. Harold Kerzner, ``Applied Project Management: Best Practices on Implementation,'' John Wiley & Sons
3. Goodpasture, J. C., ``Quantitative Methods in Project Management,'' J Ross Publishing
4. Meredith, J. R. and Mantel Jr., S. J., ``Project Management: A Managerial Approach,'' John Wiley
5. Clifford Gray, ``Project Management,'' Richard D. Irwin

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO006	Basics of Corporate Law	3L-1T-0P	None

COURSE OUTCOMES (CO):

The objective of this Course is to provide in-depth knowledge of the Corporate laws and process related to integrate these aspects of management studies in decision making within an organization; analyze and interpret management information; make decisions based on the information available; communicate information effectively; understand and apply the theoretical aspects of accounting methods used for collecting, recording and reporting financial information; explain and appraise the taxation laws which govern corporations and individuals.

COURSE CONTENT:

Unit I: Introduction : Administration of Company Law, characteristics of a company; common seal; lifting of corporate veil; types of companies including private and public company, government company, foreign company, one person company, small company, associate company, dormant company, producer company; association not for profit; illegal association; formation of company, promoters and their legal position, pre incorporation contract and provisional contracts; on-line registration of a company.

Unit II: Documents: Memorandum of association and its alteration, articles of association and its alteration, doctrine of constructive notice and indoor management, prospectus, shelf prospectus and red herring prospectus, misstatement in a prospectus; GDR; book building; issue, allotment and forfeiture of shares, calls on shares; public offer and private placement; issue of sweat capital; employee stock options; issue of bonus shares; transmission of shares, buyback and provisions regarding buyback; share certificate; D-Mat system; membership of a company.

Unit III: Management and Meetings: Classification of directors, additional, alternate and adhoc director; women directors, independent director, small shareholders' director; director identity number (DIN); appointment, who can appoint a director, disqualifications, removal of directors; legal position, powers and duties; key managerial personnel, managing director, manager; meetings of shareholders and board; types of meeting, convening and conduct of meetings, requisites of a valid meeting; postal ballot, meeting through video conferencing, e-voting; committees of board of directors – audit committee, nomination and remuneration committee, stakeholders relationship committee, corporate social responsibility committee;

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prohibition of insider trading.
SUGGESTED READINGS: 1. Hicks, Andrew & Goo S.H., ``Cases and Material on Company Law,'' Oxford University Press 2. Gowar, LCB, ``Principles of Modern Company Law,'' Stevens & Sons, London. 3. Majumdar, A.K., and G.K. Kapoor, ``Company Law and Practice,'' Taxmann 4. Hanningan, Brenda, ``Company Law,'' Oxford University Press 5. Sharma, J.P., ``An Easy Approach to Corporate Laws,'' Ane Books Pvt. Ltd 9. Ramaiya, ``A Guide to Companies Act,'' Lexis Nexis Buttersworth wadhwa 6. Kannal, S., and V.S. Sowrirajan, ``Company Law Procedure,'' Taxman's Allied Services (P) Ltd.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO007	**Biological Computing**	**3L-1T-0P**	**None**
COURSE OUTCOMES (CO): 1. To understand computing in context of biological systems 2. To understand computing languages needed to solve biological problems 3. To acquire computational skills for analysis of biological processes through grid computing 4. To gain knowledge of different biological databases and their usage 5. To gain innovative insight into DNA computing			
COURSE CONTENT: **Introduction**, Orientation and UNIX, **Python:** Introduction to Variables and Control flow, Python II - Parsing In and Output, Python III - Scripting and Functions, Python IV- Number Crunching and Plotting, **Grid computing**, Biogrid, R basics and Visualization, Unix for fast text processing, SQL, Database **Biological databases**, R for speed, R for fun, Local BLAST, Unit Testing and Code Correctness **DNA computing**,			
SUGGESTED READINGS: 1. H. Bolouri, R. Paton, `` Computations in cells & tissues,'' Springer **2.** Haubold**,** Bernhard**,** Wiehe, Thomas, `` Introduction to Computational Biology: An Evolutionary Approach,'' Springer			

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO008	**Basics of Social Sciences**	**3L-1T-0P**	**None**
COURSE OUTCOMES (CO): **Social science** is a major category of academic disciplines, concerned with society and the relationships among individuals within a society. It in turn has many branches, each of which is considered a "social science".			
COURSE CONTENT: **Unit I:** Economics, political science, human geography, demography and sociology.			

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Unit II: Humanities, anthropology, archaeology, jurisprudence, psychology, history, and linguistic. **Unit III:** Political science, economics, sociology, international politics and scientific methodology.
SUGGESTED READINGS: 1. A.C. Kapoor, "Principles of Political Science,'' S. Chand Publications 2. A.K. Sharma, "Issues in Social Demography,'' Mittal Publications 3. Kathy S. Stolley, "The Basics of Sociology,'' Greenwood Press. 4. Paul M. Muchinsky ,"Psychology Applied to Work,'' Thomson Learning Inc

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO009	**Entrepreneurship**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

This Course Aims at Instituting Entrepreneurial skills in the students by giving an overview of who the entrepreneurs are and what competences are needed to become an entrepreneur.

COURSE CONTENT:

Unit I-Introduction:

Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmes; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.

Unit II- Creating Entrepreneurial Venture:

Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Challenges in managing innovation; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership- components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection- Patents Trademarks and Copyrights – importance for startups, Legal Acts Governing Business in India.

Unit III-Functional plans:

Marketing plan– for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, pro forma cash budget, funds Flow and Cash flow statements; Pro forma balance sheet; Break Even Analysis; Ratio Analysis.

Unit IV- Entrepreneurial Finance:

Debt or equity financing, Sources of Finance- Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India.

Unit V- Enterprise Management:

Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations,

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Joint ventures, Mergers & acquisitions.
SUGGESTED READINGS: 1. Kumar, Arya,`` Entrepreneurship: Creating and Leading an Entrepreneurial Organization'', Pearson 2. Hishrich., Peters, ``Entrepreneurship: Starting, Developing and Managing a New Enterprise,'' Irwin 3. Taneja, ``Entrepreneurship,'' Galgotia Publishers. 4. Barringer, Brace R., and R. Duane, ``Entrepreneurship,'' Pearson Prentice Hall 5. Hisrich, Robert D., Michael Peters and Dean Shephered, ``Entrepreneurship,'' Tata McGraw Hill 6. Lall, Madhurima, and Shikha Sahai, ``Entrepreneurship,'' Excel Books 7. Charantimath, Poornima, ``Entrepreneurship Development and Small Business Enterprises,'' Pearson Education

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO010	**Social work**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

In this course students will learn about various methods of social work, about community organization, social welfare administration, Problems pertaining to Marriage, Family and caste

COURSE CONTENT:

Unit 1.Social work

Philosophy and Methods. Social work: Meaning, Objectives, Scope, Assumptions & Values; History of Social work in U.K. U.S.A.and India, philosophy of Social Work. Democratic (Equality, Justice Liberty & Fraternity) and Humanitarian (Human Rights) Matrix.Social works as a profession.

Unit 2. Methods of Social work

Meaning, Scope Principles, Processes (Psychosocial study, Assessments, treatment-goal formulation and techniques), Evaluation, Follow-up and Rehabilitation. Social Groups work: Meaning,Objective, Principles, Skills, Processes (Study, Diagnosis, treatment and evaluation), Programme, Planningand Development, Role of Social group worker, Leadership Development.

Unit 3 Community organization

Meaning, Objective, Principles, Approaches, Roles of Community Organization Worker.

Unit 4 Social Welfare Administration

Meaning Scope, Auspices-Private and Public, Principles, Basic Administrative Processes and Practice decision making communication, planning.organisation, budgeting and finacial control, reporting. Social work Research: Meaning objectives, types, scope, scientific method, Selection and formulation of the problem Research Design Sampling, Sources and Methods of Data Collection, Processing of Data, analysing and interpretation, Report writing. Social Action: Meaning,Scope, approaches (Sarvodays, Antyodaya etc.) and Strategies.

Unit 5 Work in India Problem pertaining to Marriage, Family and caste

Dowry- child Marriage, Divorce, Families with working couples, Disorganised Families, Families with Emigrant Heads of the Households, Gender Inequality, Authoritarian Family structure, Major Changes in Caste systems and problem of casteism. Problems Pertaining of Weaker Sections. Problems of Children,

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Women Aged. Handicapped and Backward Classes (SCs, STs, and other Backward Classes). Problems of Deviance: Truancy Vagrancy and Juvenile Delinquency, Crime, White Colla Crime, Organized Crime,Collective Violence, Terrorism, Prostitution and Sex Related Crimes. Social Vices: Alcohilism. Drug Addiction, Beggary, Corruption and communalism. Problems of Social Structure : Poverty, Unemployment, Bonded Labour, Child Labour. Fields of Soclal work India : Child Development, Development of Youth, Women's Empowerment, Welfare of aged, Welfare of Physically. Mentally and Social Handicapped, Welfare of backward Classes (Scs, STs and Other Backward Classes) Rural Development Urban Community Development, Medical And Psychiatric Social work, Industrial Social work, Social Security offender Reforms.

SUGGESTED READINGS:

1. Rajni Bedi, ``Social Work: An Introductory Text Book,'' Regal Publication
2. Sanjay Bhattacharya, ``Social Work: An Integrated Approach,'' Deep and Deep Publication
3. Nitesh Dhawan, ``Social work perspective Philosophy and Methods,'' Bharat Book Center
4. P. R. Gautam, ``Social Work: Methods Practices And Perspectives,'' Centrum Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO011	**Intellectual Property and Patenting**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

The objective of this Course is to provide in-depth knowledge of the laws and process related to Trademarks, Copyrights and other forms of IPs with focus on Patents, the Indian and International Patent filing procedure, drafting patent application and conducting prior art searches. Students will be exposed to the technical, management and legal aspects of IP and Patents.

COURSE CONTENT:

UNIT I: Introduction: Historical and philosophical background of patents and other intellectual property, Patent System: the Constitution, Congress, Patent Office (PTO), and courts; Analyzing and understanding judicial opinions

UNIT II: Comparative overview of patents, copyrights, trade secrets, and trademarks: Legal fundamentals of patent protection for useful inventions**,** Design and plant patents, Legal fundamentals of copyright protection, Similarity and access, Expression vs. ideas and information, merger, Fair use of copyrighted works (e.g., for classroom use), Contributory copyright infringement, Critical differences between patent and copyright protection, Copyright infringement distinguished from plagiarism, Legal fundamentals of trade-secret protection, Legal fundamentals of trademark protection

UNIT III: Requirements and limitations of patentability: New and useful: (A) The legal requirement of novelty (B) First to invent vs. first inventor to file, The legal requirement of non-obviousness.

UNIT IV: The process of applying for a patent ("patent prosecution"): Anatomy of a patent application, Adequate disclosure, The art of drafting patent claims, Patent searching: (A) Purposes and techniques, Actions for patent infringement, Interpretation of claims, Doctrine of equivalents, Product testing as a possibly infringing use, Doctrine of exhaustion

SUGGESTED READINGS:

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1. Robert H. Rines, ``Create or Perish: The Case for Inventions and Patents,'' Acropolis.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO012	**Supply Chain Management-Planning and Logistics**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

Supply chain management consist of all parties (including manufacturer, marketer, suppliers, transporters, warehouses, retailers and even customers) directly or indirectly involved in fulfillment of a customer. The main objective is to acquaint the students with the concepts and tools of supply chain management and logistics as relevant for a business firm.

COURSE CONTENT:

Unit I

Introduction: Concept of supply chain management (SCM) and trade logistics; Scope of logistics; Logistic activities – an Overview; Contribution of logistics at macro and micro levels; SCM and trade logistics; Business view of SCM; Concept, span and process of integrated SCM; Demand management – methods of forecasting; Supply chain metrics (KPIs), performance measurement and continuous improvement; Product development Process and SCM; Strategic role of purchasing in the supply chain and total customer satisfaction; Types of purchases; Purchasing cycle.

Unit II

Managing Relationship: Role of Relationship marketing in SCM; Managing relationships with suppliers and customers; Captive buyers and suppliers; Strategic partnerships; Supplier-retailer collaboration and alliances.

Unit III

Focus Areas of Logistics and Supply Chain management: Transportation-Importance of effective transportation system; Service choices and their characteristics; inter-modal services; Transport cost characteristics and rate fixation; In-company management vs. out-sourcing; World sea borne trade; International shipping- characteristics and structure; Liner and tramp operations; Liner freighting; Chartering-Types, principles and practices; Development in sea transportation-Unitization, containerisation, inter and multimodal transport; CFC and ICD. Air transport: Set up for air transport and freight rates; Carriage of Goods by sea -Role and types of cargo intermediaries. Warehousing and inventory management: Reasons for warehousing; Warehousing evaluation and requirements; Warehousing location strategies; Inventory management principles and approaches; Inventory categories -EOQ, LT, ICC; Material management systems and techniques – JIT purchasing, manufacturing and in-bound logistics; Packing and marking; Control and communication.

Unit IV

IT Enabling Logistics and Supply Chain: Technology in logistics – EDI, bar Coding, RFID etc., data warehousing, electronic payment transfers; Business management systems; TRADITIONAL ERP, SPECIAL ERP, MR, DRP, PDM, EIP, CPFR, WMS, TMS; Re-engineering the supply chain- Future directions.

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Unit V **Trends and Challenges in logistics and supply chain management:** Third party logistic outsourcing – challenges and future directions.
SUGGESTED READINGS: 1. M. Christopher, ``Logistics and Supply Chain Management,'' Prentice Hall. 2. Handfield and Nicholas, Jr, `` Introduction to Supply Chain Management,'' Prentice Hall. 3. Jhon J Coyle, C. Jhon and Langley, Brian J Gibs, ``Logistics approach to Supply Chain Management,'' Cengage Learning.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO013	**Organization Development**	**3L-1T-0P**	**None**
COURSE OUTCOMES (CO): Organisation Development is a growing field of Human Resource Management. It has its foundations in a number of behavioural and social sciences .			
COURSE CONTENT: 1. Organizational Systems and Human Behaviour - Developing a basic knowledge of how organizattons and groups function as systems; introducing and discussing various theoretical approaches and issues. 2. Interpersonal and Consulting Skills - Increasing effectiveness as a change agent by providing a variety of opportunities in order to increase self-awareness, practice alternative ways of approaching personal and interpersonal problem-solving and develop basic consulting and interviewing skills. 3. Introduction to Organization Development - Introducing some basic theories, models and methods in the field of organization development, especially those relating to the role of consultant and strategies for change. 4. Intervention and Change in Organizations - Consolidating and further developing consulting skills and strategies 5. Action Research Project - Carrying out a change activity in an organization, while also researching the effects and/or the process. This provides participants with an opportunity to consolidate and demonstrate skills and knowledge gained in other units of the course			
SUGGESTED READINGS: 1. Wendell L. French, Cecil H. Bell Jr., Veena Bohra, "Organization development," Pearson Prentice Hall. 2. Donald L. Anderson, "Organization Development: The process of leading organizational change,'' Sage Publications, Inc. 3. W. Warner Burke, Debra A. Noumair, "Organization Development: A process of learning and changing,'' Pearson Education Ltd.			

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO014	**Industrial Organization**	**3L-1T-0P**	**None**

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	and Managerial Economics		

COURSE OUTCOMES (CO):
This course help students in understanding the basics of management and Industrial organization

COURSE CONTENT:
Unit I: Principles of management, General idea, various functions, scope of engineering. Organisation structure, Types, merits and demerits.
Unit II: Plant location and layout, Factors effecting location, types of layout. Production planning and control, Sequence of planning and control of production. Scheduling , routing, despatching., Methods Study, Methods analysis, time study methods of rating.
Unit III: General idea of personnel management, Industrial psychology, job evaluation and monitoring. Business decision making and forward planning. Demand and demand forcasting of production analysis-prices and pricing decision-profit and capital, management. Analysis of inter-industry relation, macro-economics and business.

SUGGESTED READINGS:

1. Lawrence L. Bethel ,"Industrial organization and management" McGraw-Hill
2. Ralph Currier Davis,"Industrial organization and management" Harper & Row
3. James L. Riggs, Lawrence L. Bethel,"Industrial organization and management" McGraw-Hill
4. Richard Hines Lansburgh, William Robert Spriegel, "Industrial management" John Wiley
5. Harold T. Amrine, John A Ritchey, Colin L. Moodie, Joseph F. Kmec, "Manufacturing Organization and Management" Pearson Education India

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO015	**Global Strategies and Technology**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):
Course Objectives
This subject focuses on the specifics of strategy and organization of the multinational company, and provides a framework for formulating successful and adaptive strategies in an increasingly complex world economy.

COURSE CONTENT:
Globalization of industries, the continuing role of country factors in competition, organization of multinational enterprises, and building global networks
Analysis of competitive situations from the general management point of view, including fit between key environmental forces and the firm's resources, and changes in these over time. Formulating and implementing strategy based on that analysis. Developing and leveraging a firm's core competencies to gain long-term sustainable advantage.

SUGGESTED READINGS:

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1. Kazuyuki Motohashi ,"Global Business Strategy" Springer
2. M. Pinedo, I. Walter, "Global Asset Management: Strategies, Risks, Processes, and Technologies" SimCorp, strategylab
3. Frank McDonald and Richard Thorpe, " Organizational Strategy and Technological Adaptation to Global Change" Macmillan Business
4. Prashant Palvia, Shailendra C. Jain Palvia, Albert L. Harris ," Managing Global Information Technology : Strategies and Challenges
5. McDonald, Frank, Thorpe, Richard, "Organizational Strategy and Technological Adaptation to Global Change" Macmillan Business

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO016	**Engineering System analysis and Design**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

The students will learn about system definitions and role of system analyst. They will learn about system modeling and design. They will be exposed to System Implementation and Maintenance issues.

COURSE CONTENT:

Unit 1

System definition and concepts: Characteristics and types of system, Manual and automated systems

Real-life Business sub-systems: Production, Marketing, Personal, Material, finance Systems models types of models: Systems environment and boundaries, Real time and distributed systems, Basic principles of successful systems

Unit 2

Systems analyst: Role and need of systems analyst, Qualifications and responsibilities, Systems Analyst, agent of change.

Various phases of systems development life cycle: Analysis, Design, Development, Implementation, Maintenance

Unit3

Systems Design and modeling:Process modeling, Logical and physical design, Design representation, Systems flowcharts and structured charts, Data flow diagrams, Common diagramming conventions and guidelines using DFD and ERD diagrams. Data Modeling and systems analysis, designing the internals: Program and Process design, Designing Distributed Systems

Unit 4

User Interfaces – Relational Analysis – Database design – program design– structure chart – HIPO – SSADM – Alternate Life cycles – Prototypes.

Unit 5

System Implementation and Maintenance:Planning considerations, Conversion methods, producers and controls, System acceptance Criteria, System evaluation and performance, Testing and validation, Systems qualify Control and assurance, Maintenance activities and issues.

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SUGGESTED READINGS:

1) Haryszkiewycz, ``Introduction to Systems Analysis and Design,'' Prentice Hall India
2) James A Senn , ``Analysis and Design of Information Systems,'' McGraw Hill

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO017	**Biology For Engineers**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

1. General understanding of organization in biological systems
2. Conceptual knowledge of functioning in biological systems
3. Clarity about relevance of Biology to engineering graduates
4. Understanding human body as a study-model for engineering students
5. Understanding electrical, chemical and magnetic forces, and communication networks in human body

COURSE CONTENT:

Unit I: Principles of Biology: Form and Function, Modularity and Incremental Changes, Genetic Basis, Competition and Selection, Biological Hierarchies, Biological complexity vs simplicity

Unit II: Biological Responses: Need for Water, Oxygen, Food, Nutrients, Heat Sources and Sinks, Adaptation to their Environments, Waste tolerance, Response to Chemical and Mechanical Stresses, Optimization to Save Energy and Nutrient Resources, **Allometric Relationships from Evolutionary Pressure**

Biology for Engineering Solutions: Systems Approach, Relationships between Engineering and Biology, The Completed Design

Biological Systems and Dynamics: Basic principles, Qualitative and quantitative description of Human Body, Modeling of Human Body: Compartments, Fluid streams, Production sources, The Hemodynamic System, Cheyne-Stokes Respiration,

Neural system: Action Potentials and Ion Channels, Ficks Law, Ohms Law and the Einstein Relation, Cellular Equilibrium: Nernst and Goldman, Equivalent Circuits, Dendrites; **Mathematical Neurodynamics:** Hodgkin, Huxley and the Squid Giant Axon FitzHugh-Nagumo Model, Fixed Points and Stability of a One-Dimensional Differential Equation, Nullclines and Phase Plane, Pitchfork and Hopf Bifurcations in Two Dimensions Excitability

Bioelectric and biomagnetic phenomena and their measurements

SUGGESTED READINGS:

1. T. Johnson,`` Biology for Engineers,'' CRC Press
2. Michael Small, `` Dynamics of Biological system,'' CRC Press
3. Johnny T. Ottesen, MS Olufsen, JK Larsen, ``Applied Mathematical Models and Human Physiology,'' Society for Industrial and Applied Mathematics

Course No.	Title of the Course	Course Structure	Pre-Requisite

SCHEME OF COURSES - B.E. Electronics and Communication Engineering

EO018	Energy, Environment and Society	3L-1T-0P	None

COURSE OUTCOMES (CO):

The objective is to aware students about various renewable resources, Basics of energy, environmental Impact of Energy sources. Students will also learn about the role of appropriate Technology in Transformation of Society

COURSE CONTENT:

Unit 1 Technology and Development

Introduction to Technology, Appropriate Technology, Role of Appropriate Technology in Transformation of Society, Importance of Technology Transfer, Impact of technology on Society.

Unit 2 Energy Basics

Importance of Energy in achieving Maslow's hierarchy of Needs, Human Development Index and Energy Consumption, Current Energy Trends, Demand and Supply of Energy in World and Nepal, Introduction to Global warming, Clean Development Mechanism, and Sustainability Issues, Conventional and Non-Conventional/Renewable Energy Sources,. Conventional Energy Sources: Fossil fuel, Nuclear Energy

Unit 3 Renewable Energy Sources

Solar radiation, Solar thermal energy, Solar Cell (Photovoltaic Technology), Hydropower Water sources and power , Water turbines and hydroelectric plants, Hydro Power Plant Classification (pico, micro, small, medium, large), Wind Energy , Availability of Wind Energy sources, Wind turbines, wind parks and power control, Geothermal Energy, Sources of Geothermal Energy, Uses of Geothermal Energy, .Bio-mass and Bio-energy, Synthetic fuels from the biomass ,Thermo-chemical, physio-chemical and bio-chemical conversion, Bio-fuel cells , Hydrogen Energy and Fuel Cell , Basics of electrochemistry, Polymer membrane electrolyte (PEM) fuel cells, Solid oxide fuel cells (SOFCs) , Hydrogen production and storage.

Unit 4 Environmental Impact of Energy sources : Emission hazard, Battery hazard, Nuclear hazard

Unit 5 Energy Storage

Forms of energy storage, Hybrid vehicles, Smart grid systems, Batteries, Super-capacitors

SUGGESTED READINGS:

1) A. B. Saxena, ``A Textbook of Energy, Environment, Ecology and Society,'' New Age Publication

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO019	Public Policy and Governance	3L-1T-0P	None

COURSE OUTCOMES (CO):

Students will be introduced to Public Policy and Administrative governance. They will also learn about Administrative Governance.

COURSE CONTENT:

Unit 1 Introduction to Public Policy and Administrative Governance: Introduction to public policy, econometrics for policy research, policy analysis, economics for public decision making.

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Unit 2 Public Bureaucracy in Theory and Practice: Benefit cost analysis, public budgeting, revenue and expenditures, managing and leading public service organisations.

Unit 3 Administrative Governance: The Challenge of Policy Implementation, public and non-profit programme evaluation.

Unit 4 Non-state Actors in Policy-making and Administrative Governance: governance in twenty-first century, Social Diversity and the Question of "Difference" in Policy-making and administrative Governance

SUGGESTED READINGS:

1. John Shields and B. Mitchell Evans., `` Shrinking the State: Globalization and Public administration reform,'' Halifax: Fernwood

2. Beryl Radin, Beyond Machiavelli, `` Policy Analysis Reaches Midlife,'' Georgetown University Press

3. Frank R. Baumgartner, Jeffrey M. Berry, Marie Hojnacki, and David C. Kimball, ``Lobbying and Policy Change: Who Wins, Who Loses, and Why,'' University of Chicago Press.

4. Timothy Conlan, Paul Posner, and David Beam, ``Pathways of Power: The dynamics of National Policymaking,'' Georgetown University press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO020	**Numerical Methods**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

1. Write program and solve algebraic & transcendental equations and system of equations.
2. Analyze data through interpolation and able to write programs for Numerical Integration.
3. Write programs to solve Ordinary Differential Equations and Partial Differential Equations.

COURSE CONTENT:

Solution of Algebraic and Transcendental Equations: Bisection method, Regula Falsi method, Secant methods, Newton's method, Rate of convergence, Fixed-point iteration method.

System of Linear Algebraic Equations: Gauss elimination method, Gauss-Jordan method, Crout's method, Jacobi's method, Gauss-Seidel method, Relaxation method.

Interpolation: Finite difference operators, Interpolating polynomials using finite difference (Newton forward, Newton backward, Stirling and Bessels). Lagrange polynomials, divided difference

Numerical Differentiation and Integration: Derivatives from differences tables, Higher order derivatives, Newton-Cotes integration formula, Trapezoidal rule, Simpson's rules and error estimation, Romberg's Integration.

Numerical Solution of Ordinary Differential Equations: Taylor series method, Euler and Modified Euler method, Runge-Kutta methods, Milne's method.

Numerical Solution of Partial Differential Equations: Finite difference approximations of partial derivatives, Solution of Laplace equation and Poisson's method (Standard 5-point formula only), One-dimensional heat equation (Schmidt method, Crank-Nicolson method) and Wave equation.

Practical:

Based on the above methods using C / C++

SUGGESTED READINGS:

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1 Curtis F. Gerald and Patrick G. Wheatley, ``Applied Numerical Analysis,'' Pearson, Education Ltd.
2 E. Balagurusamy, ``Numerical Method,'' Tata McGraw Hill
3 M. K. Jain, S. R. K. Iyenger and R. K. Jain, ``Numerical Methods for Scientific and Engg. Computations,'' Wiley Eastern Ltd.
4. S. S. Sastry, ``Introductory Methods of Numerical Analysis,'' Prentice hall India

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO021	**Mathematical Statistics**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

1. Collect and analyze the data using statistical techniques.
2. Describe sampling distributions of sample means and sample proportions
3. Estimate unknown parameters of the population from a sample.
4. Construct confidence intervals for mean difference of means and proportions; and perform hypothesis tests for means.

COURSE CONTENT:

Random Variable, Moments, Rectangular distribution, Exponential distribution, Beta distribution of first and second kind, Gamma distribution, Marginal and Conditional probabilities, Tchebycheff's and Markov's inequalities, Important theoretical Distributions: Binomial, Poisson, Normal and Multinomial distributions and their properties, Fitting of Normal Distribution by Method of ordinates and Method of areas, Dirichlet distribution, Moment Generating Functions and Cumulants, Weak Law of Large Numbers, Central Limit Theorem.

Method of least square: Fitting a straight line, Parabola and Exponential Curves.

Bivariate distribution: Correlation and Regression, Probable Error, Rank Correlation.

Simple sampling of Attributes: Large samples, Mean and S.D. in simple sampling of attributes, Test of significance for large samples, Standard error, Null Hypothesis, Confidence Limits, Chi-Square Distribution, Degree of Freedom, m. g. f. of Chi square distribution, Level of Significance, Test of Goodness of Fit, Test of Independence, Coefficient of Contingency, Yate's Correction for Continuity.

Sampling of Variables: Small samples, t-Distribution, Test of significance of the mean of random sample from Normal population, F-Distribution, ANOVA: Analysis of variance, meaning and definition, Variance within and between classes, One criterion of Classification and problems based on it.

SUGGESTED READINGS:

1. Walpole, ``Probability and Statistics for Engineers and Scientists,'' Prentice Hall
2. S. M. Ross, `` Introduction to Probability and Statistics for Engineers and Scientists,'' Academic Press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO022	**Abstract and Linear**	**3L-1T-0P**	**None**

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	Algebra		

COURSE OUTCOMES (CO):

1. Know the concepts of Group theory and its applications
2. Know the concept of Rings
3. Know the concepts of Vector Spaces and Linear Transformations

COURSE CONTENT:

GROUPS: Binary operation, Group, Finite and Infinite Groups, Order of a Group, Additive and Multiplicative groups of integers (mod m). Composition table, Subgroup, Permutation group, Cyclic permutation, even and odd permutations, Cayley's Theorem, Isomorphism, Automorphism, homomorphism, Lagrange's Theorem, Quotient Group, Cyclic Group, Normal Subgroup, Centre of a group, Normalizer, Homomorphism, Isomorphism.

RINGS: Rings, Integral domain, Field, Theorems on Rings, Integral domain and Fields, Subrings, Left and Right Ideals, Quotient Ring, Homomorphism, Isomorphism, Kernel of a homomorphism.

VECTOR SPACES: Vector space and its examples, Subspaces, Linear combinations, Linear spaces, Linear dependence and Linear Independence, Cauchy–Schwarz's inequality, Minkowski inequality, Basis, Dimension and simple examples. Linear Transformation, Isomorphism, Nullity and Rank, Linear functional, Linear operators, Dual Space, Dual Basis, Annihilator, Transpose of a Linear map.

SUGGESTED READINGS:

1. I. N. Herstein, ``Topics in Algebra, '' Wiley Publishing
2. J. B. Fraleigh, ``A First Course in Algebra,'' Narosa Publication

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO023	**Optimization Techniques**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

1. Know the concepts of Linear Programming
2. Know the concept of Non-linear Programming
3. Know the concepts of Dynamite Programming

COURSE CONTENT:

Linear programming, Duality Theory, dual Simplex method, Revised Simplex method, Sensitive analysis.
Integer Programming, Cutting plane algorithm.
Branch and bound technique, travelling salesman problem.
Nonlinear Programming, Kuhn-Tucker conditions, quadratic programming, Wolfe's algorithm.
Dynamite programming, Deterministic and stochastic examples. Advanced queuing Models, Finite source queues, Balking and Reneging, Priority queue disciplines.

SUGGESTED READINGS:

1. Hamdy Taha, ``Operations Research, An Introduction,'' Pearson Education
2. J R Fletcher, ``Practical Methods of Optimization,'' Wiley Publishing

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Course No.	Title of the Course	Course Structure	Pre-Requisite
EO024	**Introduction to Mathematical Software and Programming Languages**	**2L-0T-4P**	**None**

COURSE OUTCOMES (CO):

1. Know using different Mathematical Software to solve Engineering Problems.
2. Know preparing Texts/ Reports / Dissertation and presentations using Latex

COURSE CONTENT:

Use of MATHEMATICA, MATLAB, MATHCAD, MAPLE, STASTITICA, LATEX, and other application software packages to study models of simultaneous equations, eigenvalues and eigenvectors, system of linear and non-linear differential equations, stability analysis, numerical integration, regression analysis, etc.

SUGGESTED READINGS:

1. Online Manuals of the related Software.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO025	**Mathematical Finance**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

Mathematical Methods for Finance covers topics from calculus and linear algebra that are fundamental for the study of mathematical finance. Students successfully completing this course will be mathematically well prepared to study quantitative finance at the graduate level.

COURSE CONTENT:

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR. Bonds, bond prices and yields, Macaulay and modified duration, term structure of interest rates: spot and forward rates, explanations of term structure, running present value, floating-rate bonds, immunization, convexity, putable and callable bonds.

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints), Two fund theorem, risk free assets, One fund theorem, capital market line, Sharpe index. Capital Asset Pricing Model (CAPM), betas of stocks and portfolios, security market line, use of CAPM in investment analysis and as a pricing formula, Jensen's index. Forwards and futures, marking to market, value of a forward/futures contract, replicating portfolios, futures on assets with known income or dividend yield, currency futures, hedging (short, long, cross, rolling), optimal hedge ratio, hedging with stock index futures, interest rate futures, swaps. Lognormal

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distribution, Log-normal model / Geometric Brownian Motion for stock prices, Binomial Tree model for stock prices, parameter estimation, comparison of the models. Options, Types of options: put / call, European / American, pay off of an option, factors affecting option prices, put call parity.
SUGGESTED READINGS: 1. David G. Luenberger , ``Investment Science, '' Oxford University Press 2. John C. Hull, ``Options, Futures and Other Derivatives,'' Prentice Hall India 3. Sheldon Ross, `` An Elementary Introduction to Mathematical Finance,'' Cambridge University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO026	**Quantum Electronics**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in semiconductor, laser, maser and optical fibre communication using quantum mechanics as fundamental tool. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies. This course is very useful in designing electronic and optical communication devices for using in optical communications, medicine, environment, industries and related fields.

COURSE CONTENT:

1. Semiconductor Laser

Homojunction laser: Population inversion at a junction; Emission spectra; The basic semiconductor laser; Heterojunction: Formation of ideal heterojunctions between (a) a p-type wide band-gap semiconductor and an n-type narrower band-gap semiconductor, (b) an n-type wide band-gap semiconductor and a p-type narrower band-gap semiconductor, (c) wide and lightly doped narrower band gap n-type semiconductors; Anderson's model of ideal heterojunction. Heterojunction laser: Single and double heterojunction laser; Analysis of carrier confinement in a single heterojunction laser.

2. Electrons in quantum structures

Energy level and wave functions for quantum well, quantum wire and quantum dot; Density of states for quantum well, quantum wire and quantum dot; Modulation | doped quantum well; Multiple quantum well; Coupling between quantum wells. Super lattice: The concept of a super lattice; Kronig-Penney model of a super lattice | zone folding, Tight binding approximation for a super lattice.

3. Quantum Semiconductor Laser

Light amplification in quantum well; Modulation bandwidth; Strained quantum well laser; Quantum wire laser; Blue quantum well laser.

4. Electro-optic effect in quantum structures

Franz-Keldysh effect in Semiconductor; Electro-optic effect in quantum wells; Electro-optic effect in super lattice.

5. Parallel and Perpendicular Transport in Quantum Structures

High field electron transport|Hot electrons in quantum structures; Double barrier resonant-tunneling structures; Super lattices and ballistic injection devices.

6. Quantum Transistor

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Resonant-tunneling unipolar and bipolar transistor; Velocity modulation and quantum interference transistor.

7. Guided wave optics

(a) Waveguide modes, Modes characteristics for a planar waveguide, Step index planar waveguide, Maxwell equations in inhomogeneous media: TE modes and TM modes, Radiation modes, Guided modes, Leaky modes, Quasi modes.

(b) Propagation in optical fibre, Numerical aperture, Pulse dispersion in fibres, Scalar wave equation and modes of the fibre, Modal analysis for a step index fibre.

8. Masers

Ammonia beam maser, Energy levels, Methods for population inversion, Maser operation.

9. Coherent interactions of a radiation field and an atomic system

(a) Induced resonant transitions, Inclusions of decay phenomena, Rotating wave approximation, Exact Rabi Solution in the strong field, Rabi flopping, Dressed state picture.

(b) Density matrix, Rate equation for density matrix, Optical Bloch equations, Vector model of density matrix, The Bloch sphere.

10. Semiclassical laser theory

Electromagnetic field equations, Expansion in normal modes of a cavity, Lambs self-consistency equations, Density matrix equations, Polarization of the medium, Single mode operation, Non-linear effect in polarization, Hole burning, Steady state power, Frequency pulling and pushing.

SUGGESTED READINGS:

1. Mitin, Kochelap and Stroscio, `` Quantum Heterostructures: Microelectronics and Optoelectronics,'' Cambridge University Press
2. Martinez-Duart, Martin-Palma, Agullo-Rueda, ``Nanotechnology for Microelectronics and Optoelectronics,'' Elsevier Science
3. A. Yariv, ``Quantum Electronics,'' John Wiley
4. A.K. Ghatak and K. Thyagarajan, ``Optical Electronics,'' Cambridge University Press
5. O. Svelto, ``Principles of Lasers,'' Springer
6. P. Bhattacharyya, ``Semiconductor Optoelectronics Devices,'' Prentice Hall
7. R. W. Boyd, ``Nonlinear Optics,'' Academic Press
8. B. G. Streetman and S. Banerjee, ``Solid State Electronic Devices,'' Prentice Hall India
9. T. Suhara, ``Semiconductor laser fundamentals,'' CRC Press
10. S. M. Sze, ``Physics of Semiconductor Devices,'' Wiley Publishing
11. J. Orton, ``The Story of Semiconductors,'' Oxford University Press
12. Rogers, Pennathur, Adams, ``Nanotechnology: Understanding Small Systems,'' CRC Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO027	**Laser Systems and Applications**	**3L-0T-2P**	**None**
COURSE OUTCOMES (CO):			

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The concept and understanding of laser action are helpful in designing and developing new devices used in optical communications, medicine, environment, industries and related physics. It also gives value addition in the students' understanding of the basic principles involved. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D in the related field.

COURSE CONTENT:

Introduction: Review of elementary quantum physics, Schrodinger equation, concept of coherence, absorption, spontaneous emission and stimulated emission processes, relation between Einstein's A and B coefficients, population inversion, pumping, gain, optical cavities.

Lasers & Laser Systems: Main components of Laser, principle of Laser action, introduction to general lasers and their types. Three & four level Lasers, CW & Pulsed Lasers, atomic, ionic, molecular, excimer, liquid and solid state Lasers and systems, short pulse generation and Measurement.

Applications: Laser applications in medicine and surgery, materials processing, optical communication, metrology and LIDAR and holography(recording and reconstruction).

SUGGESTED READINGS:

1. K.R. Nambiar, "Laser Principles, Types and Application," New Age International.
2. S. A. Ahmad, "Laser concepts and Applications," New Age International.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO028	**Optoelectronics and Photonics**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in semiconductor laser, photonics and optical fibre communication. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies. This course is very useful in designing opto-electronic and optical communication devices for using in optical communications, medicine, environment, industries and related fields.

COURSE CONTENT:

Semiconductor lasers for optical fiber communications, Fabry-Perot cavity, heterostructure semiconductor lasers, single frequency semiconductor lasers, semiconductor lasers for coherent systems. Distributed feedback in Ga-As-P lasers. Device structure and fabrication, photodetectors for fiber optics, reverse bias photo-detectors, dark current, quantum efficiency, signal to notice ratio, types of detectors. Receivers for digital fiber optic communication systems: basic
components, detectors for digital fiber optic receivers, PIN diode, Avalanche photodiode, Fronts ends for digital fiber optic receivers, equalizer for optical communication, receivers, PIN-FET receivers for longer wavelength communication systems. Coherent optical fiber transmission systems, coherent detection principles, comparison of direct and coherent performance, homodyne and heterodyne systems. Non linear process in optical fibers, phase matching in
waveguide, phase matched harmonic generation in waveguides. Second harmonic generation (SHG) in integrated optics, Cerenkov configuration SHG. Optical fiber sensor and devices, intensity modulation

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through light interruption, distributed sensing with fiber optics. Basic principles of interferometric optical fiber sensor, signal processing in mono mode fiber optic sensor, photonic band gap materials.
SUGGESTED READINGS: 1. G. Keiser, ``Optical fiber communication,'' McGraw-Hill. 2. J. Senior, `` Optical fiber Communication,'' Prentice- Hall International 3. S.O. Kasap, `` Optoelectronics and Photonics: Principles and Practices,'' Pearson Education

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO029	**Electromagnetic Theory and Waveguides**	**3L-0T-2P**	**None**
COURSE OUTCOMES (CO): This course imparts understanding of various mechanisms in the propagation of electromagnetic waves through space and wave guides. The understanding of various electromagnetic laws are helpful in designing and developing new devices used in optical communications, industries and related field. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies.			
COURSE CONTENT: Electrostatics; Boundary value problems Dielectrics, Steady currents, Magnetostatics; Time varying fields, Maxwell's equations, Lorentz force equation and motion of charges, Plane electromagnetic waves. Waveguides and resonant cavities, fields at the surface of and within a conductor, cylindrical cavities and waveguides, modes in a rectangular waveguide, energy flow and attenuation in waveguides, perturbation of boundary conditions, resonant cavities, power losses in a cavity, Earth and ionosphere as resonant cavity, dielectric waveguide.			
SUGGESTED READINGS: 1. Griffiths D. J., ``Introduction to Electrodynamics,'' Prentice- Hall Pvt.Ltd. 2. J. D. Kraus, ``Electromagnetics,'' Tata McGraw Hill.			

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO030	**Polymer Science & Technology**	**3L-0T-2P**	**None**
COURSE OUTCOMES (CO): 1. To know about polymer science and technology. 2. To have an understanding of nanotechnology in polymers.			
COURSE CONTENT: Polymer Chemistry, Polymer Physics, Polymer Technology, Polymer Characterization, Polymer Engineering and Rheology, Polymer Processing, Polymer Testing and properties, Polymer Composites, Polymer Blends and Alloys, Rubber Technology, Polymer Processing, Polymers in Packaging, Nanotechnology in Polymers,			

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Engineering Plastics and Specialty Polymers, New innovations in Polymers. Practical related to above theory.
SUGGESTED READINGS: 1) P. J. Flory, ``Introduction to polymer Chemistry, '' Asian Books 2) Miles & Briston, ``Polymer Technology,'' J. G. Chemical Publishing Company 3) R. T. Fenner , ``Principle of Polymer Processing, '' Maxwell McMillan International Edn 4) Stephen L. Rosen, ``Fundamental principles of polymer materials practices for engineers, Plastics Materials,'' Barnes & Noble 5) Joel Frados, Van Nostrand, ``Plastics Engineering Handbook,'' Reinhold, New York 6) Morton & Jones, ``Polymer Processing,'' Chapman & Hall.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO031	**Semiconductor Physics and Devices**	**3L-0T-2P**	**None**
COURSE OUTCOMES (CO): This course is very helpful in understanding the various phenomena/mechanisms which are very useful in designing electronic devices, energy storage devices and other transistor based devices used in all sphere of life. It prepares students to take advanced courses in the related fields and finally equips them to take up R&D and higher studies.			
COURSE CONTENT: Semiconductor Physics; Semiconductor, Bonds in Semiconductors, Energy band, Effect of temperatures on Semiconductor, Hole currents, Intrinsic & extrinsic semiconductor, Majority and minority carriers, p-n junction, Volt- ampere characteristics of p-n junction. Semiconductor Diode: Semiconductor diode, Crystal diode rectifiers, Half wave rectifiers, Efficiency of half wave rectifier, Full wave rectifier, Centre tap full wave rectifier, Ripple factor, Filter Circuits, Voltage stabilization, Zener diode, Zener diode as Voltage stabilizer. Transistors: Transistors, Transistors connections, Common base connection, Common emitter connection, common collector connection, Comparison of transistor connections, Transistor as an amplifier in CE arrangement, Transistor load line analysis, Operating point, Cut off and saturation points, Applications of Common base amplifier, Bipolar junction Transistors, Hybrid Parameters, Field effect Transistor: JFET/MESFET, MOSFET, Unipolar Devices.			
SUGGESTED READINGS: 1. Joseph Lindmayer and Charles Y. Wrigly, ``Fundamentals of Semiconductor Devices,'' Litton Educational Publishing Inc. 2. S. M. Sze, ``Physics of Semiconductor Devices,'' John Wily & Sons. 3. A. K. Sharma, ``Semiconductor Electronics,'' New Age International (P) Limited Publisher.			

Course No.	Title of the Course	Course Structure	Pre-Requisite

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EO032	Elements of Fiber Optics	3L-0T-2P	None

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in optical fibre communication. Concepts of Optical Fiber waveguides are helpful in designing and developing new devices used in optical communications, medicine, environment, industries and related physics. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies.

COURSE CONTENT:

Over view of optical fiber communications, the evolution of fiber optics systems, elements of an optical fiber transmission links. Electromagnetic analysis of optical waveguides, classification of modes for a planner waveguide, TE and TM modes in a symmetric step index planner waveguide, power associated with a mode, excitation of guided modes, Maxwell equations in inhomogeneous media: TE and TM modes in planner waveguide. Leaky modes, leakage of power from the core, bending loss in optical waveguides. Optical fiber waveguides, optical fiber types, numerical aperture, pulse dispersion in step index fibers, scalar wave equations and modes of a fiber, Modal analysis for a step index fiber and graded-index fiber. Linearly polarized modes, power flow, multi mode fibers with optimum profiles, single mode fiber, propagation modes in single mode fibers, fiber materials, fiber fabrication. Vapor-deposition methods, Fiber optic cables, optical fiber connections, joints and couplers, signal degradation in optical fiber, absorption loss, radiation loss, attenuation, signal distortion in optical waveguides, pulse broadening, mode coupling.

SUGGESTED READINGS:

1. G. Keiser and J. Seniar, ``Optical fiber communication'' McGraw Hill
2. A. K. Ghatak, ``Introduction to Optical fiber,'' Cambridge University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO033	Material Physics	3L-0T-2P	None

1. COURSE OUTCOMES (CO):
2. Given a type of material, be able to qualitatively describe the bonding scheme and its general physical properties, as well as possible applications.
3. Given a type of bond, be able to describe its physical origin, as well as strength. Be able to qualitatively derive a material's Young's modulus from a potential energy curve.
4. Given the structure of a metal, be able to describe resultant elastic properties in terms of its 1D and 2D defects.
5. Given a simple set of diffraction data, be able to index the peaks and infer the structure.
6. Be able to describe a polymer's elastic behavior above and below the glass transition.
7. Be able to do simple diffusion problems.

COURSE CONTENT:

1. Overview of materials

Crystalline and amorphous materials, glasses, semiconductors, compound semiconductors, solar energy materials, luminescent and optolectronic materials, polymer, liquid crystals, ceramics, classification

according to bonding | Pauling and Philips theories.

2. Synthesis and preparation of materials

Single crystal growth, zone refining, doping techniques of elemental and compound semiconductors, fabrication and control of thin films, PVD and CVD processes, principles of polymer processing, preparation of ceramics powders | mechanical and chemical methods.

3. Characterization of materials

Defects and microstructures; Diffraction techniques: X-ray diffraction | structure determination from XRD data; Neutron diffraction; Thermal methods: DTA, TGA, DSC; Microscopy: TEM, SEM; Optical spectroscopy: UV and IR; Nuclear techniques: NMR, ESR, Mossbauer and Positron annihilation. Heat treatments, quenching and annealing; Radiation damage.

4. Phase transition in materials

Thermodynamics and phase diagrams, statistical theories of phase transitions, critical phenomena, calculation of critical exponents for van der Waals gas and ferromagnets; Diffusion in solids, variation of diffusion constant with temperature.

5. Mechanical properties

Deformation and fracture, Deformation at low and high temperature, Intrinsically hard materials.

6. Spinodal decomposition

Spinodal curve, Free energy of composition fluctuations, Kinetics of Spinodal decomposition.

7. Electrical properties of alloys, ceramics, and conducting polymer

Resistivity variation of metals at low and high temperature, Kondo effect; Effect of pressure on resistivity, resistivity variation in ceramics and conducting polymer; Ferroelectricity, Landau-Ginzburg theory of ferroelectricity; Piezoelectricity.

8. Magnetic properties of different materials

Antiferromagnetism, ferrimagnetism, magnons, thermal properties of magnons, magnetic storage, applications as capacitors, transducers, sensors, memories, displays; Quantum Hall effect.

9. Glasses

Definitions, properties of glass transition, tunnelling states, calculation of specifc heat from tunneling states and from a model two level system having random energy gap, theories for glass transition.

10. Non-crystalline semiconductors

Classifcations, electrical properties, temperature variation of dc conductivity, ac conductivity, magnetoresistance, Colossal magnetoresistance (CMR).

11. Exotic solids

Structure and symmetries of liquids, liquid crystals, amorphous solids; Aperiodic solids and quasicrystals; Fibonacci sequence; Penrose lattices and their extensions in 3 dimensions; Special carbon solids, fullerenes and tubules, formation and characterization of fullerenes and tubules, single wall and multiwall carbon tubules; Electronic properties of tubules; Carbon nanotubule based electronic devices, Defnition and properties of nanostructured materials. methods of synthesis of nano-structured materials; Special experimental techniques for characterization of materials; Quantum size effect and its applications.

SUGGESTED READINGS:

1. C. Kittel, ``Introduction to Solid State Physics'' Wiley

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2. R. Zallen, ``The Physics of Amorphous Solids'' Wiley Classic
3. N. F. Mott and E.A. Davies, ``Electronic Processes in Non-crystalline Materials'' Oxford Classic
4. C. N. R. Rao and B. Raveau, ``Colossal Magnetoresistance, Charge Density and Related Properties of Manganese oxides,'' World Scientific
5. J. M. Yeomans, ``Statistical Mechanics of Phase Transitions'' Claredon Press
6. R. E. Prange and S. M. Girvin (editors), ``The Quantum Hall Effect'' Springer
7. H. P. Klug and L. E. Alexander, `` X-ray Diffraction Procedures'' Wiley

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO034	**Advanced Electromagnetic Theory and Special Relativity**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in the propagation of electromagnetic waves through space and wave guides. The understanding of various electromagnetic laws are helpful in designing and developing new devices used in optical communications, industries and related field. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies.

COURSE CONTENT:

Maxwell's equations, wave equations in scalar and vector potential, solutions of scalar and vector wave equations by Fourier analysis. Relativistic motion in electromagnetism, postulates of special theory of relativity, Lorenz transformation, relativistic mechanics, contraction of length, dilation of time, magnetism as relativistic effect, four vector, co-variance of Maxwell's equations, Lienard-Wiechert potentials and the field of a uniformly moving electron, radiation from an accelerated charge, cyclotron synchrotron, Brensstrahlung and Cerenkov radiations. Scattering and absorption of electromagnetic waves, antenna, radiated power and angular distribution of radiation, electric dipole radiation.

SUGGESTED READINGS:

1. R. Resnik, ``Introduction to Special Relativity,'' Wiley Eastern Ltd.
2. J. D. Jackson , ``Classical Electrodynamics'' John Wiley & Sons

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO035	**Fiber and Integrated Optics**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in optical fibre communication. Concepts of Optical Fiber waveguides are helpful in designing and developing new devices used in optical communications, medicine, environment, industries and related physics. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies.

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COURSE CONTENT:

Modes in an asymmetric planer waveguides. Ray analysis of planer waveguide, W. K. B. analysis of inhomogeneous planer waveguide, strip waveguides, periodic waveguide-coupled mode analysis, and rectangular core waveguides metal clad waveguides. Anisotropic polarizer, leaky modes in a planer structure. Polarization maintaining fibers and their applications different types of polarization maintaining fibers, high birefringent fibers, single polarization single mode fibers. Integrated optic devices: electro-optic effect, phase modulator, polarization modulators and wavelength filters. The Mach Zhender Interferometric modulator, logic operations, optical directional coupler, leaky mode, metal clad polarizer.

SUGGESTED READINGS:

1. A. W. Snyder and J. D. Love, ``Optical Wave guide Theory'' Chapmann and Hall.
2. A. K. Ghatak, `` Introduction to optical fiber'', Cambridge University Press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO036	**Condensed Matter Physics**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course aims to establish fundamental concepts in condensed matter physics, and applies the physics you have learned previously (in particular quantum mechanics, classical mechanics, electromagnetism and statistical mechanics) to these real-world materials. The structure and properties of solids including thermal and electrical properties are described.

COURSE CONTENT:

1. Symmetry in crystals

Concepts of point group; Point groups and Bravais lattices; Crystal symmetry | space groups; Symmetry and degeneracy | crystal _eld splitting; Kramer's degeneracy; Quasicrystals: general idea, approximate translational and rotational symmetry of two-dimensional Penrose tiling, Frank-Casper phase in metallic glass.

2. Lattice dynamics

Classical theory of lattice vibrations in 3-dimensions under harmonic approximation; Dispersion relation: accoustical and optical, transverse and longitudinal modes; Lattice vibrations in a monatomic simple cubic lattice; Frequency distribution function; Normal coordinates and phonons; Occupation number representation of the lattice Hamiltonian; Thermodynamics of phonons; The long wavelength limits of the acoustical and optical branches; Neutron diffraction by lattice vibrations; Debye-Waller factor; Atomic displacement and melting point; Phonon-phonon interaction, interaction Hamiltonian in occupation number representation; Thermal conductivity in insulators.

3. Density Functional Theory

Basics of DFT, Comparison with conventional wave function approach, Hohenberg-Kohn Theorem; Kohn-Sham Equation; Thomas-Fermi approximation and beyond; Practical DFT in a many body calculation and its reliability.

4. Electronic properties: I

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The Boltzmann transport equation and relaxation time; Electrical conductivity of metals | impurity scattering, ideal resistance at high and low temperatures, U-processes; Thermo-electric effects; Thermal conductivity; The Wiedemann-Franz law.

5. Electronic properties: II

Electronic properties in a magnetic field; Classical theory of magneto-resistance; Hall effect and magneto-resistance in two-band model; K-space analysis of electron motion in a uniform magnetic field; Idea of closed, open and extended orbits, cyclotron resonance; Azbel-Kaner resonance; Energy levels and density of states in a magnetic field; Landau diamagnetism; de Haas-van Alphen effect; Quantum Hall effect.

6. Optical properties of solids

The dielectric function: the dielectric function for a harmonic oscillator, dielectric losses of electrons, Kramers-Kronig relations; Interaction of phonons and electrons with photons; Interband transition | direct and indirect transition; Absorption in insulators; Polaritons; One-phonon absorption; Optical properties of metals, skin effect and anomalous skin effect.

SUGGESTED READINGS:

1. M. Tinkham, ``Group Theory and Quantum Mechanics,'' Dover Publications
2. M. Sachs, ``Solid State Theory'' McGraw Hill
3. A. O. E. Animalu, ``Intermediate Quantum Theory of Crystalline Solids'' Prentice Hall
4. N. W. Ashcroft and N. D. Mermin, ``Solid State Physics'' Brooks
5. J. M. Ziman, ``Principles of the Theory of Solids'' Cambridge University Press
6. C. Kittel, ``Introduction to Solid State Physics,'' Wiley

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO037	**Microwave**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

1. Helping the students to gain insight into the subject, to develop suitable hardware/software that addresses the industrial/social problems effectively.
2. Knowledge about Microwave Solid State Devices.
3. Ability to identify and study the performance of Wave Guides and Resonators
4. Study the performance of various components used in microwave engineering.
5. Designing of Microwave filters
6. Knowledge about Microwave Measurements.
7. To motivate the students towards professionalism effective communication skills and team work.

COURSE CONTENT:

1. Transmission line and waveguide

Interpretation of wave equations; Rectangular wave guide | TE and TM modes, power transmission, excitation of modes; Circular waveguide | TE, TM and TEM modes, power transmission, excitation of modes. Microstrip lines | characteristic impedance, loss and Q of microstrip lines, coplanar strip lines and shielded strip lines.

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2. Component
Scattering parameter and scattering matrix, properties of S-parameter; Quality factor and Q-value of a cavity resonator, Q-value of a coupled cavity; Wave guide tees, magic tee, hybrid ring, couplers; Ferrites and Faraday's rotation, gyrator, circulator, isolator and terminator; λ/4 section filter, tuner and sliding short.
3. Measurement
Smith chart, single stub and double stub matching; Microwave bridge, measurement of frequency, attenuation and phase; Measurement of dielectric parameters of amorphous solids | dielectric constant, ac conductivity, resistivity, insertion loss, return loss, shielding coefficient. Measurement of microstrip line parameters.
4. Source
Conventional sources & their limitations.
(a) Vacuum tube sources | Klystron, reex klystron, travelling wave tubes and switching tubes;
Magnetrons, FWCFA and Gyrotrons.
(b) Microwave transistors and FETs, Gunn, IMPATT, TRAPATT and parametric devices.
(c) Laser | Laser processes, Pockels-Cell; Laser modulators, infrared radiation and sources.
5. Antenna
Transmitting and receiving antennas, antenna gain, resistance and bandwidth; Antenna dipoles, straight, folded and broadband dipoles; Beam width and polarisation; Antenna coupling.
6. Microwave integrated circuit
Materials and fabrication technique; MOSFET fabrication, memory construction, thin film formation, planar resistor, planar inductor and planar capacitor formation; Hybrid integrated circuit formation.

SUGGESTED READINGS:

1. Samyel Y. Liao, ``Microwave Devices and Circuits'' Prentice hall publication,
2. Herbert J. Reich, ``Microwave Principles,'' Van Nostrand
3. K. C. Gupta, ``Microwaves,'' New Age publisher.
4. M. L. Sisodia and G. S. Raghubanshi, ``Microwave Circuits and Passive Device'' New Age publisher.
5. N. Mercuvitz, ``Waveguide Handbook'' IET
6. S. M. Sze, ``Physics of Semiconductor Devices'' John Wiley publisher.
7. R. E. Collins, ``Foundations of Microwave Engineering'' Wiley publication.
8. J. D. Ryder, ``Network Lines and Fields'' Prentice Hall publication.
9. Royal Signals, ``Handbook of Line Communication'' The War Office
10. W. Frazer, ``Telecommunications'' Macdonald
11. J. D. Kraus, ``Antenna'' Tata Mc Graw Hill publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO038	**Fundamentals of Instrumentation and experimental**	**3L-0T-2P**	**None**

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	techniques in Physics		

COURSE OUTCOMES (CO):

The knowledge of various measurement instruments and techniques are very helpful in the scientific laboratories, organizations and industries for faithful measurements, characterizations and interpretation of data with high accuracy. It also gives value addition in the students' understanding of the basic principles involved. It prepares students to take advanced courses in the related fields and finally equips students to take up higher studies and R&D in the related field

COURSE CONTENT:

Physical Measurement: Sources of uncertainty and experimental error, Systematic and random error, Analysis of repeated measurements, Distribution functions, Propagation of error, Analysis of data. Optical measurements and the electromagnetic spectrum, Temperature transducers and linear position sensors.

Signal to noise considerations: Fluctuations and noise measurement systems, Noise in frequency domain, Signal to Noise and experimental design, Frequency and bandwidth considerations, Signal to noise enhancement, Digital and auto correlation methods.

Vacuum techniques: Characteristics and applications of vacuum, Vacuum systems-pumps and gauges, pumping speed, Thin film techniques, Film thickness monitors and measurements.

Optical Instruments: Spectroscopic Instrumentation, visible and infrared spectroscopy, Spectrometer design- lenses and refractive optics, Dispersive elements. Lasers and fibre optics.

X-ray Measurement: X-ray Fluorescence- line spectra, fine structure, Absorption and emission processes, X-ray production, X-ray diffraction and crystallography- powder diffraction spectra, information available from spectra.

Analytical Instrumentation: Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Environmental Scanning Electron Microscope (ESEM), Surface Analytical Methods-Auger Electron spectroscopy, X-ray photo electron spectroscopy (XPS) and secondary ion mass spectrometer (SIMS). X-ray fluorescence, Tunneling scanning microscope.

Occupational Health and Safety : Occupational health and safety, Chemical substances- Storage and Disposal, Work hazardous materials information system(WHMIS). Safety from electromagnetic radiation, General Electrical and testing standards- CSA approval, General laboratory and workshop practice.

SUGGESTED READINGS:

1. Michael Sayer and Abhai Mansingh, ``Measurement, Instrumentation and Experiment Design in Physics and Engineering'' Prentice-Hall India

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO039	**Lasers and Photonics**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

The understanding of Laser, Photonics and Optical Fiber are helpful in designing and developing new devices used in optical communications, solar energy devices, medicine, environment, industries and related physics. It also gives value addition in the students' understanding of the basic principles involved. It prepares students to take advanced courses in the related fields and finally equips students to take up

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higher studies and R&D in the related field
COURSE CONTENT: Properties of Lasers, Absorption**,** Spontaneous emission and stimulated emission processes, relation between Einstein's A and B coefficients, population inversion, pumping, gain, Working principle of laser, Optical cavities. Ruby Laser, Helium Neon Laser, Semiconductor Laser. Three & four level Lasers, CW & Pulsed Lasers, atomic, ionic, molecular, excimer, liquid and solid state Lasers and systems, short pulse generation and Measurement. Laser applications in medicine and surgery, materials processing, optical communication, metrology and LIDAR and holography(recording and reconstruction) Photonics : Basics of Solid state lighting- LED- Photodetectors, photovoltaic cell, Junction & avalanche photodiodes, photo transistors, thermal detectors, Solar cells- I-V characteristics, Optic fibre- principle of propagation, numerical aperture, optical communication system. Industrial, medical and technological applications of optical fibre. Fibre optic sensors- basics of Intensity modulated and phase modulated sensors.
SUGGESTED READINGS: 1. K.R. Nambiar, "Laser Principles, Types and Application" New Age International 2. G.Keiser, ``Optical fiber communication,'' McGraw-Hill.