SCHEME AND SYLLABUS - B.E. COMPUTER ENGINEERING

UNIVERSITY OF DELHI

NETAJI SUBHAS INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM

SCHEME OF COURSES

FOR

B.E. COMPUTER ENGINEERING

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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

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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 Computer Engineering programme with following Programme Educational Objectives (PEO).

1. Graduates of the program will have successful technical and professional careers in industry, academia, govt. and entrepreneurship.

2. Graduates of the program will hold strong professional ethics with good team skills and communication

3. Graduates of the program will engage in lifelong learning to acquire new knowledge in an evolving technological landscape.

B. Types of Courses

Courses are the subjects that comprise the Computer Engineering programme.

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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. Computer 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:

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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 credit 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 skill.

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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.

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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, i.e.

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

Where S_i is the ith Semester, C_j is the number of credits of the jth course in that semester and G_j is the grade point scored by the student in the jth 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, i.e.

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

where $SPGA(S_i)$ is the SGPA of the ith 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

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1. The B.E. Computer 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. Computer 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. Computer 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**

1. **Program 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

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2. **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.   CECyy: Core Course

     ii.   CEDyy: Discipline-centric Elective Course

3. **Common Elective Course Codes:** There are common lists for courses offered under Compulsory Foundation (FC), Foundation Electives (FE) and Open Electives (EO). All disciplines 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.

     i.   FCyyy: Foundation Compulsory Course

     ii.   FEyyy: Foundation Elective Course

     iii.   EOyyy: Open Elective Course

4. **General Electives:** A student may take a course under the category of General Elective (EG) offered by any other Department of the Institute under the categories of Core Course (CC) and Discipline centric Electives (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 follows:

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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).

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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.

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4. 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 number of 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. Computer 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.

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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 computer 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) Heads of Departments

The Central Advisory 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

At the completion of the B.E. Computer Engineering Program, a student will achieve the following outcomes:

1. Gain an ability to apply the knowledge of mathematics, science, Engineering fundamentals and computer engineering in solving complex engineering problems.

2. Acquire the ability to survey the literature, conduct experiments, interpret data and analyze complex engineering problems.

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3. Acquire the ability to design a system, its components and processes to meet requirements with due regard to social, economic and environmental considerations.

4. Acquire the ability to apply research based knowledge and methods to investigate complex engineering problems with focus on computer engineering.

5. Acquire the ability to select existing tools, techniques and resources and create new ones to model complex engineering problems and activities.

6. Understand the responsibilities of an engineering profession towards society, economy, health, safety and legal issues.

7. Understand a computer engineer's role in enhancing sustainable development.

8. Demonstrate professional ethics and responsibilities with utmost integrity at all times

9. Acquire the ability to contribute effectively as members or leaders of diverse and multidisciplinary teams.

10. Communicate effectively among professional and with society through reports, presentations, documentations and instructions.

11. Engage in lifelong learning in ever evolving landscape of computer science and engineering.

SCHEME – SEMESTER WISE COURSE ALLOCATION

B.E. COMPUTER ENGINEERING-SEMESTER I									
Course Code	Type	Subject	L	T	P	Credits	Evaluation Scheme (Percentage weights)		Pre-requisites
							Theory	Practical	

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							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	25	25	50	-	-	None
FC005	FC	English-I	2	0	0	2	25	25	50	-	-	None
FExxx 1*	FE	Foundation Elective	-	-	-	2	-	-	-	-	-	–
			23/25 2*			20						subject

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)

							Evaluation Scheme (Percentage weights)					
B.E. COMPUTER ENGINEERING-SEMESTER II												
Course Code	Type	Subject	L	T	P	Credits	Theory			Practical		Pre-requisites
							CA	MS	ES	CA	ES	
FC006	FC	Mathematics-I I	3	1	0	4	25	25	50	-	-	None

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FC007	FC	English-II	2	0	0	2	25	25	50	-	-	None
CEC01	CC	Discrete Structures	3	1	0	4	25	25	50	-	-	None
CEC02	CC	Data Structures	3	0	2	4	15	15	40	15	15	None
CEC03	CC	Digital Logic Design	3	0	2	4	15	15	40	15	15	None
CEC04	CC	Analog and Digital Communication	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)

B.E. COMPUTER ENGINEERING- AUDIT COURSES (AC) AFTER II SEMESTER					Evaluation Scheme	
Course Code	Type	Subject	LTP	Credits	Theory CA-MS-ES	Practical CA-ES
ACxxx	Audit	Audit Courses can be floated during summer break after 2nd semesters on: (I) Courses for improvement:	-	Nil	The evaluation scheme and minimum grades for getting "Satisfactory" level, will be decided by	

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| | | These will not be shown on the degree.

(II) Courses on new themes: These will be shown on the degree. | | | the Department. Student has to achieve the minimum grades prescribed for getting "Satisfactory" level. |

B.E. COMPUTER ENGINEERING-SEMESTER III												
Course Code	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre Requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
CEC05	CC	Design and	3	0	2	4	15	15	40	15	15	None

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Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
		Analysis of Algorithms										
CEC06	CC	Database Management Systems	3	0	2	4	15	15	40	15	15	None
CEC07	CC	Object Orientation	3	0	2	4	15	15	40	15	15	None
CEC08	CC	Computer Architecture and Organization	3	1	0	4	25	25	50	-	-	None
CEC09	CC	Analog Electronics	3	0	2	4	15	15	40	15	15	None
FExxx 1*	FE	Elective Foundation	-	-	-	2	-	-	-	-	-	_
			26/28 2*			22						

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

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

B.E. COMPUTER ENGINEERING-SEMESTER IV												
Course Code	Type	Subject	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Pre-requisites
							Theory			Practical		
							CA	MS	ES	CA	ES	

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			L	T	P							
CEC10	CC	Micro-processors	3	0	2	4	15	15	40	15	15	None
CEC11	CC	Software Engineering	3	0	2	4	15	15	40	15	15	None
CEC12	CC	Computer Graphics	3	0	2	4	15	15	40	15	15	None
CEC13	CC	Computer Networking	3	0	2	4	15	15	40	15	15	None
CEC14	CC	Operating Systems	3	1	0	4	25	25	50	-	-	None
FExxx 1*	FE	Elective Foundation	-	-	-	2	-	-	-	-	-	–
			26/28 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).

B.E. COMPUTER ENGINEERING- AUDIT COURSES (AC) AFTER SEMESTER IV					Evaluation Scheme	
Course Code	Type	Subject	LTP	Credits	Theory CA-MS-ES	Practical CA-ES
ACxxx	**Audit**	Audit Courses can be floated during summer break after 4th semester	-	Nil	The evaluation scheme and minimum grades for

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		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.			getting "Satisfactory' level, will be decided by the Department. Student has to achieve the minimum grades prescribed for getting "Satisfactory" level.

B.E. COMPUTER ENGINEERING-SEMESTER V								
Course Code	Type	Subject	L	T	P	Credits	Evaluation Scheme (Percentage weights)	Pre-requisites

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| Course | Type | Subject | L | T | P | Credits | Theory | | | Practical | | Pre-requisites |
							CA	MS	ES	CA	ES	
CEC15	CC	Theory of Computation	3	1	0	4	25	25	50	0	0	None
CEC16	CC	High Performance Computing	3	0	2	4	15	15	40	15	15	None
CEC17	CC	Compiler Construction	3	0	2	4	15	15	40	15	15	None
CEC18	CC	Modeling and Simulation	3	0	2	4	15	15	40	15	15	None
1*	EO/EG/ED	Elective(s)	-	-	-	-	-	-	-	-	-	-
				2*		**16-28 3***						

1* : The LTP distribution, Evaluation Scheme and pre-requisite(s) for Elective courses are given in Tables 4, 5 and 6. The course code will depend upon the elective(s) chosen by the student.

3*: The weekly load will depend upon the electives chosen by the student from Tables 3, 4, 5 and 6.

4*: 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.

B.E. COMPUTER ENGINEERING-SEMESTER VI								
Course Code	Type	Subject	L	T	P	Credits	Evaluation Scheme (Percentage weights)	Pre-requisites

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Course	Type	Subject	L	T	P		Theory			Practical		Pre-requisite
							CA	MS	ES	CA	ES	
CEC19	CC	Computer Control Systems	3	1	0	4	25	25	50	-	-	None
CEC20	CC	IT Law and Ethics	2	0	0	2	25	25	50	-	-	None
CEC21	CC	Open Source Technologies	0	0	4	2	-	-	-	50	50	None
1*	EO/EG/ED	Elective(s)	-	-	-	-	-	-	-	-	-	-
				2*		**8-28** **3***						

1* : The course code, LTP distribution, Evaluation Scheme and pre-requisite(s) for Elective courses under EO, EG and ED will depend upon the electives chosen by the student as given in Tables 4, 5 and 6.

2*: The weekly load will depend upon the electives chosen by the student from Tables 4, 5 and 6.

3*: A student may register for courses leading to a minimum of 8 credits and a maximum of 28 credits. Normally a student registers for courses leading to 22 credits.

B.E. COMPUTER ENGINEERING - INDUSTRIAL TRAINING AFTER VI SEMESTER								
Course	**Type**	**Subject**	**L**	**T**	**P**		**Evaluation Scheme**	**Pre-**

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Code						Credits	(Percentage weights)					requisites
							Theory			Practical		
							CA	MS	ES	CA	ES	
CEC22 *1	CC	Training	-	-	-	2	-	-	-	40	60	None

*1: Students will undergo training in the industry / research organization / reputed Institute during the Summer vacation after sixth Semester. This will be evaluated as a seventh Semester subject during end-semester examination.

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

B.E. COMPUTER ENGINEERING-SEMESTER VII								
Course	Type	Subject	L	T	P	Credits	Evaluation Scheme	Pre-requisites

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Code							(Percentage weights)					
							Theory			Practical		
							CA	MS	ES	CA	ES	
CEC22 1*	CC	Training	-	-	-	2	-	-	-	40	60	None
CEC23 2*	CC	Project-I	0	0	4	4	0	0	0	40	60	None
3*	EO/EG/ED	Elective(s)	-	-	-	-	-	-	-	-	-	-
				4*		6-28 5*						

1*: The Training undertaken by students during the Summer vacation after VI 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 Course code, LTP allocation, Evaluation Scheme and Pre-requisites for Electives will depend on the electives chosen by the student as given in Tables 4, 5 and 6.

4*: The actual weekly load will depend upon the electives chosen by the student from Tables 4,5 and 6.

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.

B.E. COMPUTER ENGINEERING-SEMESTER VIII								
Course Code	Type	Subject	L	T	P	Credits	Evaluation Scheme (Percentage weights)	Pre-requisites

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							Theory			Practical		
							CA	MS	ES	CA	ES	
CEC24 1*	CC	Project-II	0	0	4	4	0	0	0	40	60	None
2*	EO/EG/ ED	Elective(s)	-	-	-	4	-	-	-	-	-	-
			3*			**4-28 4***						

1*: 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.

2* : The Course code, LTP allocation, Evaluation Scheme and Pre-requisites for Electives will depend on the electives chosen by the student as given in Tables 4, 5 and 6.

3*: The weekly load will depend upon the electives chosen by the student from Tables 4,5 and 6.

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.

TABLE 3: LIST OF FOUNDATION ELECTIVES					
Code	**Name of Foundation**	**L T P Allocation**	**Evaluation Scheme**		**Pre-Requisit**
			Theory	**Practical**	

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	Elective	L	T	P	CA	MS	ES	CA	MS	es
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

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FE013	Theatre	0	0	4	-	-	-	60	40	None
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

TABLE 4:   PART A: LIST OF DISCIPLINE SPECIFIC ELECTIVES WITH PRACTICAL

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LTP Allocation			Evaluation Scheme				
L	**T**	**P**	**CA**	**MS**	**ES**	**Int**	**ES**
3	**0**	**2**	**15**	**15**	**40**	**15**	**15**

Code	Name of Elective	Pre-Requisites
CED01	Embedded Systems Design	CEC08,CEC10
CED02	Big Data and Analytics	CEC02, CEC06
CED03	Software Testing	CEC11
CED04	Mobile Ad-hoc Networks	CEC08, CEC13
CED05	Advanced Data Structures	CEC01, CEC02
CED06	Natural Language Processing	CEC02, CEC05
CED07	Information and Network Security	CEC13, CEC14
CED08	Mobile Computing	CEC05, CEC13, CEC14
CED09	Advanced Networks	CEC08, CEC13
CED10	Logic Programming	CEC02, CEC15
CED11	Internet and Web Technology	CEC08, CEC13
CED12	Emerging Programming Paradigms	CEC07
CED13	Wireless Technologies	CEC09, CEC13
CED14	Advanced algorithms	CEC01, CEC02, CEC05

TABLE 5 - PART B: LIST OF DISCIPLINE SPECIFIC ELECTIVES

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WITH TUTORIAL							
LTP Allocation			**Evaluation Scheme**				
L	**T**	**P**	**CA**	**MS**	**ES**	**CA**	**ES**
3	**1**	**0**	**25**	**25**	**50**	**-**	**-**
Code	**Name of Elective**		**Pre-Requisites**				
CED15	Fault Tolerant Computing		CEC03, CEC08				
CED16	Artificial Intelligence		CEC02, CEC05				
CED17	Machine Learning		CEC02, CEC05				
CED18	Computer Vision		CEC02, CEC05,CEC12				
CED19	Semantic Web		CEC02, CEC05				
CED20	Advanced databases		CEC02, CEC06				
CED21	Internet of Things		CEC13, CEC10				
CED22	Software Quality		CEC11				
CED23	Requirements Engineering		CEC11				
CED24	Digital Watermarking and Steganography		CEC02, CEC05				
CED25	Service Oriented Architectures		CEC13, CEC14				
CED26	Real Time Systems		CEC08, CEC14				
CED27	Ethical Hacking		CEC13, CEC14				
CED28	Digital Forensic		CEC02, CEC05, CEC13				
CED29	CAD of VLSI		CEC02, CEC03, CEC05				

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CED30	Middleware technologies	CEC13, CEC14
CED31	Multimedia Applications	CEC12
CED32	Human Computer Interfacing	CEC03, CEC12
CED33	Emerging Applications of Computing	CEC02, CEC05
CED34	Cryptography	CEC01
CED35	Information Theory and coding	CEC01
CED36	Rough Set Theory	CEC01
CED37	Cloud Computing	CEC13, CEC14
CED38	Soft Computing	CEC02, CEC05
CED39	Distributed Computing	CEC08, CEC13, CEC14
CED40	Design and Architectural Patterns	CEC07
CED41	Rule based Computing	CEC02, CEC15

TABLE 5 – GENERIC ELECTIVES (EG)
A Student may take any course offered by any department of the Institute under the

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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.

TABLE 6 :   LIST OF OPEN ELECTIVES
Evaluation Scheme

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CA	MS	ES			Int	Ext
25	25	50			-	-
Course Code	Name of Elective	L	T	P	Pre-Requisites	
EO001	Technical Communication	3	1	0	None	
EO002	Disaster Management	3	1	0	None	
EO003	Basics of Finance Management	3	1	0	None	
EO004	Basics of Human Resources Management	3	1	0	None	
EO005	Project Management	3	1	0	None	
EO006	Basics of Corporate Law	3	1	0	None	
EO007	Biological computing	3	1	0	None	
EO008	Basic of social science	3	1	0	None	
EO009	Entrepreneurship	3	1	0	None	
EO010	Social work	3	1	0	None	
EO011	IP and Patenting	3	1	0	None	
EO012	Supply Chain Management-Planning and logistics	3	1	0	None	
EO013	Organization Development	3	1	0	None	
EO014	Industrial Organisation and Managerial Economics	3	1	0	None	
EO015	Global Strategy and Technology	3	1	0	None	

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EO016	Engineering System Analysis and Design	3	1	0	None
EO017	Biology for Engineers	3	1	0	None
EO018	Energy, Environment and Society	3	1	0	None
EO019	Public Policy and Governance	3	1	0	None
EO020	Numerical Methods	3	0	2	None
EO021	Mathematical Statistics	3	1	0	None
EO022	Abstract and Linear Algebra	3	1	0	None
EO023	Optimization Techniques	3	1	0	None
EO024	Introduction to Mathematical Software and Programming Languages	2	0	4	None
EO025	Mathematical Finance	3	1	0	None
EO026	Quantum Electronics	3	0	2	None
EO027	Laser Systems and Applications	3	0	2	None
EO028	Optoelectronics and Photonics	3	0	2	None
EO029	Electromagnetic Theory and Waveguide	3	0	2	None
EO030	Polymer Science and Technology	3	0	2	None
EO031	Semiconductor Physics and Devices	3	0	2	None

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EO032	Elements of Fibre Optics	3	0	2	None
EO033	Material Physics	3	0	2	N one
EO034	Advanced Electromagnetic Theory and Relativity	3	0	2	None
EO035	Fibre and Integrated Optics	3	0	2	None
EO036	Condensed Matter Physics	3	0	2	None
EO037	Microwave	3	0	2	None
EO038	Fundamentals of Instrumentation and experimental techniques in Physics	3	0	2	None
EO039	Lasers and Photonics	3	0	2	None

SYLLABI OF COMPULSORY FOUNDATION COURSES

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Course Code	Type	Subject	L	T	P	Credits	Theory			Practical		Pre-requisites
							CA	MS	ES	CA	ES	
FC001	FC	Mathematics-I	3	1	0	4	25	25	50	-	-	None

(Table header: B.E. COMPUTER ENGINEERING - SEMESTER I; Evaluation Scheme (Percentage weights))

COURSE OUTCOMES

1. By the end of this course, the student will be able to :
2. Analyze and test infinite series for its convergence.
3. Find Taylor's series expansion, maxima & minima of functions of one and more variables.
4. Calculate length, area, radius of curvature, surface of revolution and volume of revolution.
5. 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,

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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.
3 Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley.
4 Michael Greenberg, "Advanced Engineering Mathematics", Pearson Education.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-Requisites
FC002	FC	Computer Programming	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

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

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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.
Emerging Trends: Kinds of programming languages.

Guidelines for practical work:

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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.

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.
2. Herbert Schildt and Tata McGraw Hill ,"The Complete Reference",.
3. Yashwant Kanitkar, "Let us C", BPB Publication
4. Byron Gottfried, Schaum Series, Tata McGraw Hill,"Schaum's Outline of Programming with C",
5. Addison Wesley, "Object Oriented Programming", Budd.
6. D Samantha, "Object oriented Programming in C++ and Java ", PHI. Stroustrup,"Programming in C++", Special Edition, Addison Wesley.

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Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-Requisites
FC003	FC	Electrical and Electronics Engineering	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

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.

Bipolar junction transistor: Introduction, Transistor, construction, transistor operations, BIP characteristics, load line, operating point, leakage currents, saturation

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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 l_{co} V_{BE} & β, Stabilization factors, thermal stability.

SUGGESTED READINGS

(1) Vincent Del Toro , "Electrical Engineering Fundamentals,"
(2) Basic Electrical Engineering: Mittle and Mittal, TMH
(3) Electronic Devices and Circuit Theory: Boylestad and Nashelsky, 10th Edition, Pearson.
(4) Microelectronics: Millman & Grabel. TMH.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-Requisites
FC004	FC	Physics	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

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.

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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. 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,

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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," McGraw Hill
2. Serwey , Moses, Moyer, "Modern Physics," Cengage Learning
3. S Chand & co., "Mechanics", D S Mathur
4. Jenkins and White, "Fundamentals of Optics", McGraw Hill
5. N. Subramaniam and Brij Lal (S Chand), "A Text Book of Optics"
6. Indu Prakash, "A Text Book of Practical Physics, Volume-1", Kitab Mahal Publication.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
FC005	**FC**	**English-I**	**2**	**0**	**0**	**2**	**25**	**25**	**50**	**-**	**-**	**None**

COURSE OUTCOMES

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.

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COURSE CONTENT

1. Practice in dictation, punctuation and spellings, listening and reading comprehension.
2. Practice with well formed sentences with stress on remedial grammar.
3. Exercises in unseen comprehension, paraphrasing, paragraph writing & summarizing.
4. Reinforcement in letter writing, preparing CVs, writing book reviews.
5. 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.
6. 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

    1. Margaret M Maison, *"Examine Your English"*

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							Evaluation Scheme (Percentage weights)					Pre-requisites

B.E. COMPUTER ENGINEERING-SEMESTER II

Course Code	Type	Subject	L	T	P	Credits	Theory			Practical		Pre-requisites
							CA	MS	ES	CA	ES	
FC006	FC	**Mathematics-II**	3	1	0	4	25	25	50	-	-	**None**

COURSE OUTCOMES

1. By the end of this course, the student will be able to 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 functions. Laplace transforms solution of IVP and simultaneous linear differential equations, unit step function, Dirac-Delta function.

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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.
3. Erwin Kreyszig, "Advanced engineering mathematics," Wiley.
4. Michael Greenberg, "Advanced engineering mathematics", Pearson Education.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
FC007	FC	English-II	2	0	0	2	25	25	50	-	-	None

COURSE OUTCOMES

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

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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":
2. Meenakshi Raman & Sangeeta Sharma, "Technical Communication"
3. Renu Gupta, "A Course in Academic Writing"

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	**SYLLABI OF CORE COURSES**
**SEMESTER II**
Course Code	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**CA**	**MS**	**ES**	**CA**	**ES**	**Pre-requisites**
CEC01	**CC**	**Discrete Structures**	3	1	0	4	25	25	50	-	-	**None**

COURSE OUTCOMES

1. To be able to analyze and compute time and space complexity of various computing problems.
2. To be able to design algorithms for solving various problems using the concepts of discrete mathematics.
3. To apply the concepts and algorithms learnt in developing large scale applications and modify them.

COURSE CONTENT

Preliminaries: Mathematical Logic, Propositions, Truth Tables, and Logical inferences, Predicates and quantifiers, Methods of Proof.

Set Theory, Relations and Functions: Elements of Set Theory, Primitives of set theory, binary Relation and its Representation, type of Binary Relations, Equivalence relations and partitions. Functions, Types of functions, Inverses and composition of Functions, Pigeon hole principle. Posets, Hasse Diagram, Lattices: Definition, Properties of lattices – Bounded, Complemented, Modular and Complete lattice, Boolean Algebra.

Number Theory: Infinity and Natural numbers, Integers, Divisibility and Euclidean algorithm, Prime numbers, Congruence, Modular arithmetic, Euler ϕ function, Public key cryptosystems and RSA.

Counting: Counting and analysis of algorithms, Permutations, Combinations,

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Asymptotic behavior of algorithms, Recurrence relation, generating functions

Principles of Counting: Principles of inclusion-exclusion, Pigeon hole principle, Permutations, Combinations.

Mathematical induction: proof by induction, Groups & rings, Recursion, Recurrence relation, Characteristic Polynomial. Generating Functions.

Logic: Propositional Logic, Logical Inference, First order logic, applications

Graphs: Graph isomorphism, Paths and Cycles, Graph coloring, Critical Path, Eulerian paths and circuits, Hamiltonian paths and circuits, Bipartite Graphs, Digraphs, Multigraphs.

Probability: Overview of probability theory , Discrete distributions.

SUGGESTED READINGS
1. Keneth H. Rosen, "Discrete Mathematics and Its Applications", TMH.
2. C.L. Liu, "Elements of Discrete Mathematics", TMH.
3. Kolman, Busby & Ross, "Discrete Mathematical Structures", PHI.
4. Narsingh Deo, "Graph Theory With Application to Engineering and Computer Science", PHI.
5. Charles S. Grimmstead, J. Laurie Snell "Introduction to Probability".
6. Kai Lai Chung, "A Course in probability theory".

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC02	CC	Data Structures	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

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

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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.
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 Queues and Heaps, 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: Trees – mathematical properties, Binary Search 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, Trie data structure
Sorting: Insertion Sort, Quick sort, two-way Merge sort, Heap sort, sorting on different keys, External sorting.
Graphs: Sequential representation of graphs, Adjacency matrices, Search and

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Traversal of graphs: Depth first, breadth first, topological sort.

Outline of Practical Work:
- Programs based on sorting and searching, implementing stacks, queues , 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.Templates and Containers
Survey of new data structures.

1. Nell B Dale,"C++ data structures",ISBN-10: 1449646751, 5-th edition.
2. Freetextbooks.com. Algorithms and data structures.
   Available :http://www.freetechbooks.com/algorithms-and-data-structures-f11.html
3. Robert Lafore,"Data structures in Java".

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Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC03	CC	Digital Logic Design	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. To be able to design a fairly complex digital system from a set of specifications or a description of the system
2. To be able to analyze, test and troubleshoot a digital system
3. To be proficient in using the design tools used in industry to synthesize the digital circuits.

COURSE CONTENT

Introduction to Digital Systems
Number Systems and Codes: Binary, octal and hexadecimal number systems, Number-Base Conversions, Complements of Numbers, Signed numbers, Fixed and floating point numbers, Binary Arithmetic, Binary Codes: BCD, Gray, Excess-3, ASCII, Error detection and correction codes - parity check codes and Hamming code.
Combinatorial Logic Systems: Basic logic operation, Logic gates and Truth tables, Positive and Negative Logic, Boolean Algebra: Basic postulates and fundamental theorems, SOP and POS forms, Min terms, Max terms, Canonical Form, Gate level Minimization: K-map and Quine-McCluskey tabular methods, NAND/NOR implementations
Design Concepts using Hardware Description Language: VHDL Programming Structure, Model, Test Bench, Simulation Tool
Combinational Logic Modules, their applications and VHDL Modeling: Decoders, encoders, multiplexers, demultiplexers, Parity circuits, Comparators, Code Converters, Arithmetic modules- adders, subtractors, BCD Adder, ALU and multipliers, Implementing boolean function with multiplexers / decoders
Introduction to different logic families: Operational characteristics of BJT and MOSFET as switch, Structure and operations of TTL and CMOS gates, Electrical

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characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product etc, Gates with Open Collector/Drain outputs, Tristate logic gates

Sequential Logic systems and VHDL Modeling: Basic sequential circuits- latches and flip-flops: RS-latch, SR-flipflop, D-latch, D flip-flop, JK flip-flop, T flip-flop, Setup-time, HOLD Time, Propagation delay, Timing hazards and races, Characteristic Equations

Sequential logic modules, their applications and VHDL Modeling: Multi-bit latches and registers, shift register: Bidirectional, Universal and Ring Counter; counters: Ripple, Up/Down, Mod N, BCD Counters etc.

State machines: Definition, Classification: Mealy, Moore; Analysis of state machines using D flip-flops and JK flip-flops, Design of state machines - state table, state assignment, transition / excitation table, excitation maps and equations, logic realization, State machine design using State Diagram, and using ASM charts, Design examples

Memory: Read-only memory, Read/Write memory - SRAM and DRAM, EPROM, EEPROM, USB Flash drive

Advanced Topics: synchronous sequential circuits, Testing and testability of logic circuits, Programmable Logic Devices: PROM, PLA, PAL, GAL, SPLDs,CPLDs and their applications, State-machine design with sequential PLDs, FPGAs

Guidelines for Practical Work: In the practical portion of this course, students will use VHDL to model digital systems in a simulator. Students will model basic gates, combinational circuits, sequential circuits, memory and state machine based designs.

1. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL Design", 3rd Edition, McGraw-Hill
2. R.J. Tocci., N.S.Widmer, G.L. Moss, "Digital Systems, Principles and Applications",11th Edition, Pearson Education
3. M. Morris Mano and Michael D. Ciletti,"Digital Design", 5th Edition, Pearson

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4. Mohammed Ferdjallah,"Introduction to Digital Systems: Modeling, Synthesis, and Simulation Using VHDL", Wiley.
5. Alan B. Marcovitz,"Introduction to Logic Design", 3rd Edition, McGraw-Hill

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC04	CC	Analog and Digital Communication	3	1	0	4	25	25	50	-	-	None

COURSE OUTCOMES

1. To gain an understanding of the scientific principles, working and applications of communication systems
2. To gain an understanding of modulation techniques
3. To acquire the skills needed to design communication systems for different applications

COURSE CONTENT

Representation of signals and systems: Fourier Series,Fourier transform and its properties, Hilbert transform, pre-envelope representation, representation of band pass signals**.**

Analog communication: Elements of communication, amplitude modulation & demodulation, DSB-SC Modulation & demodulation, SSB-SC Modulation & demodulation, frequency modulation (direct method only), NBFM, WBFM, frequency demodulation (balanced slope detector and phase discriminator).

Probability theory and random process: probability theory random variables and transformations random processes, mean, correlation, covariance, moments, power spectral density, Gaussian process, Stationarity, Central limit theorem.

Sampling and pulse communication: Sampling theorem , types of sampling, PAM ,

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PPM, PWM.

Pulse code modulation: Quantization (linear & nonlinear), PCM, DPCM, DM.
Digital modulation techniques: Matched filters, Correlator receivers, Gram Schmidt orthogonalization process, ASK, FSK, PSK, QPSK, Error analysis of BPSK, BFSK & QPSK.

SUGGESTED READINGS
    1. Taub, "Principles of communication," McGrawHill

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Course Code	Type	Subject	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Pre-requisites
							Theory			Practical		
							CA	MS	ES	CA	ES	
CEC05	CC	Design and Analysis of Algorithms	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. To be able to analyze a problem in terms of processing steps, time and space complexity.
2. To be able to design and implement the algorithms for any given application.
3. To be able to develop software applications using various programming languages in collaborative groups.
4. To apply the principles learnt in solving problems encountered in career or real life situations.

CONTENTS

Introduction: Algorithm Design paradigms- motivation, concept of algorithmic efficiency,

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run time analysis of algorithms, Asymptotic behavior of algorithms, Asymptotic Notations, Recurrence relation,

Algorithm approaches: Divide-and-conquer Approach: Strassen's matrix multiplication, Dynamic programming approach: principle of Optimality, illustration of dynamic programming with Binomial coefficient, Optimal Binary Search Trees, Solving the 0-1 Knapsack problem with Greedy approach, Backtracking and Branch and Bound techniques.

Computational complexity: Average and worst case complexity of various sorting algorithms, Illustration with in place sorting algorithms: Insertion sort, selection sort, Mergesort, quicksort, heapsort, radix sort.

Illustration with Searching problems: interpolation search,

Theory of NP-completeness: Input size, polynomial time, Non-deterministic polynomial time and intractable problems, NP-completeness and CNF satisfyability, NP-Hard, NP-easy, NP-equivalent problems.

Algorithm approaches: Divide-and-conquer Approach: Strassen's matrix multiplication, Dynamic programming approach: principle of Optimality, illustration of dynamic programming with Binomial coefficient, Optimal Binary Search Trees, Solving the 0-1 Knapsack problem with Greedy approach, Backtracking and Branch and Bound techniques, Breadth/Best first search with Branch and Bound pruning: LC searching Bounding, FIFO branch and bound, LC branch and bound application: 0/1 Knapsack problem, Backtracking, Illustration with n-Queen, 0-1 knapsack, Traveling Salesman Problem.

Advanced Sorting algorithms: Shellsort, Radix Sort, External Sort.

Graphs algorithms: Bellman Ford Algorithm for finding Single source shortest paths. Shortest paths: Floyd's algorithm, The greedy approach, Djikstra's algorithm, Minimum Spanning trees: Prim's algorithm and Kruskal's algorithm, Travelling Salesman Problem.

Max-flow-min cut, Stable Marriages Problem for perfect matching in bipartite graphs.

Prefix codes, hashing.

Optimization techniques: LP solving, MILP, Meta-heuristics, Hill Climbing, Tabu search, Genetic Algorithms.

Outline of practical work

- Implementation of various searching and sorting algorithms, trees and graph algorithms,

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optimization techniques.
- Mini projects to solve realistic problems using the algorithms learnt
- Self study on new algorithm and algorithmic approaches

SUGGESTED READINGS
 1. Berman. Paul, "Algorithms, Cengage Learning".
 2. Richard Neopolitan, Kumar SS Naimipour, "Foundations of Algorithms"
 3. T .H . Cormen, C .E .Leiserson, R .L .Rivest "Introduction to Algorithms", PHI.
 4. E. Horowitz, S. Sahni, and S. Rajsekaran, "Funadmentals of Computer Algorithms," Galotia Publication

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC06	CC	Database Management Systems	3	0	2	4	10	20	40	15	15	None

COURSE OUTCOMES

 1. At the end of the course students would be able to learn about various database models, tools for databases.
 2. Students would be able to recognize and use contemporary logical design methods and develop sophisticated queries to extract information from large datasets.
 3. Understand and evaluate the role of database management systems in information technology applications within organizations.

COURSE CONTENT

Introduction: Database administrator & Database Users, Characteristics of the Database, Database Systems and Architecture, Data Models, Schemes & Instances, DBMS Architecture & Data Independence, Database Languages & Interfaces, DDL, DML, DCL, Overview of Hierarchical, Network & Relational Data Base Management Systems
Data Modeling: Data modeling using The Entity-Relationship Model – Entities, Attributes and Relationships, Cardinality of Relationships, Strong and Weak Entity Sets,

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Generalization, Specialization, and Aggregation, Translating your ER Model into Relational Model, Relationships of higher degree.

Relational Model, Languages & Systems: Relational Data Model concepts, Relational Model Constraints, integrity constraints ,Keys domain constraints, referential integrity, assertions triggers, foreign key

Relational Algebra, relational calculus, domain and tuple calculus

SQL – A Relational Database Language, Data Definition in SQL, View and Queries in SQL, Specifying Constraints and Indexes in SQL.

Relational Data Base Design: Functional Dependencies & Normalization for Relational Databases, Functional Dependencies, Normal Forms Based on Primary Keys, (1NF, 2NF, 3NF & BCNF), Lossless Join and Dependency Preserving Decomposition, Functional dependencies and its closure, covers and equivalence.

Shared Database Access Mechanism, Database Protection

Transaction Management: Transaction Concept and State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability: Testing of serializability, Serializability of schedules, conflict & view serializable schedule, Implementation of Isolation, Transaction processing in distributed databases, fragmentation, locking, Protocols for distributed database, Recoverability: Failure Classification, Storage Structure, Recovery and Atomicity, Log-based Recovery, Shadow Paging, Recovery with Concurrent Transactions,

Concurrency Control Techniques: Lock-Based Protocols, Timestamp-based Protocols, Deadlock Handling, Recovery System, concurrency control in distributed systems.

Estimation of cost and optimization of tuple transfer for join in distributed styles, validation techniques, multiple granularities and multi-version schemes.

Query Processing: Overview, Buffer Management, Indexing, Hashing and Query Processing, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions

Advanced topics: Concepts of Object Oriented Database Management Systems, Distributed Data Base Management Systems.

Case Studies

Outline of practical work :
In this the students will use any query language to the run the querie**s** corresponding to the problems given in the class. All the students will be assigned projects. They will draw various models corresponding to the projects. They will also develop a software for that project using database concepts.

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SUGGESTED READINGS**:**

1. Elmasri, Navathe, "Fundamentals of Database systems", AddisionWisley.
2. Korth ,Silbertz, Sudarshan, "Data base concepts", McGraw-Hill.
3. Date C.J.,"An Introduction to Database systems".

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC07	CC	Object Orientation	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. To be able to visualize and analyze complex real life problems in an object oriented manner
2. To be able to code using any state of the art object oriented language like Java or python
3. To be able to appreciate the relevance of object oriented paradigm in software engineering for reducing cost and effort involved in software development

COURSE CONTENT

Object Oriented Principles: Modeling and Design: Concepts of object orientation: object classes, encapsulation, complex objects, object identity, inheritance and multiple inheritance, Persistence, overloadingand polymorphism

Object Oriented Languages: Detailed discussion and comparison of a Object Oriented Programming language such as Java/ Python (any one)

A. Java Programming Language
Introduction to Java: Importance and features of Java, Language Construct of java including Keywords, constants, variables and looping and decision making construct, Arrays and String: Creating an array, one and two dimensional arrays, string array and methods
Inheritance: Classes Introducing classes, objects and methods: defining a class, adding

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variables and methods, creating objects, constructors, class inheritance., Classes: String and String Buffer classes, Wrapper classes: Basics types, using super, Multilevel hierarchy abstract and final classes, Object class,

Packages and interfaces: Defining, implementing and applying packages and interfaces. Importing packages.

Exception Handling: Fundamentals exception types, uncaught exceptions, final built in exception, creating your own exceptions,

Multithreaded Programming: Fundamentals, Java thread model: priorities, synchronization, messaging, thread classes, Runnable interface, inter thread Communication, suspending, resuming and stopping threads.

Input/output Programming: Basics, Streams, Byte and Character Stream, predefined streams, Reading and writing from console and files. Using Standard Java Packages (lang, util, io, net).

Networking: Basics, networking classes and interfaces, using java.net package, doing TCP/IP and Data-gram Programming, RMI (Remote Method Invocation).

Event Handling: Different Mechanism, the Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter and Inner Classes, Working with windows, Graphics and Text, using AWT controls, Layout managers and menus, handling Image, animation, sound and video, Java Applet. The Collection Framework: The Collection Interface, Collection Classes, Working with Maps & Sets. JDBC: Introduction to DBMS & RDBMS, DBC API, JDBC Application Architecture, Obtaining a Connection, JDBC Models: Two Tier and Three Tier Model, Result Set, Prepared Statement, Callable Statement.

B. Python Programming language

Lexical conventions and syntax. Types and objects, Operators and expressions. Control flow tools: If statement, for statement, the range() function, break and continue statement, and else clauses on loops, pass statements, defining functions

Data structures: Lists, tuplesand sequences, Dictionaries , looping techniques

Modules: standard modules, the dir() function, packages

Classes: Python scope and name spaces, inheritance, Private variables, odds and ends, exception as classes, iterators, generators

Standard library: Operating with system interfaces, File wild cards, command line arguments, error output redirection andprogram

Advanced topics in object orientation: Introduction to object oriented software Engineering

Advanced Concepts: inheritance anomaly, reflection in object oriented systems, multiple interfaces, filter objects, compositional filters, business objects, meta-objects

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Guidelines for practical work

Programming exercises on Java and python programming concepts as detailed above .

SUGGESTED READINGS

1, Betrand Meyer, "Object oriented software Construction" Prentice hall.

2.Grady Booch, "Object oriented Analysis and Design, 2nd edition, Bejamin / cummings,"

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC08	CC	Computer Architecture and Organization	3	1	0	4	25	25	50	-	-	None

COURSE OUTCOMES

1. To understand the architecture of modern processors and organization of its components, and relationship between hardware and software in digital machines.
2. To design instructions and corresponding logic circuits for a simple CPU with its essential components such as ALU, a register file, memory and input-output.
3. To appreciate the evolving technology that governs the evolution of modern computers and continue to keep abreast of state-of-art in computing technology

COURSE CONTENT

Overview of computer organization: Characteristics of a general purpose computer, The stored program concept, von Neumann architecture, Harvard architecture, Programmer's model - the Instruction set architecture (ISA), ISA design and performance criteria, Basic computer organization with CPU, memory and IO subsystems, Interconnect busses, Evolution of CISC and RISC based processors and their merging.

Instruction Set Architectures: Machine instruction, Machine cycle and Instruction cycles,

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Instruction Set: memory and non-memory reference instructions, instruction categories: data movement, data manipulation, program control and machine control instructions, CISC types addressing modes and instruction formats, RISC type addressing modes and instruction formats.

Central Processing Unit: Specification of a simple CPU using RTL, Design of the data path for the simple CPU, Designing the hardwired control path for the simple CPU, Performance analysis of the simple CPU, Enhancement of the ISA for the simple CPU and design extensions, Characteristics of RISC CPU design: ISA characteristics, pipelining, data and instruction caches, Practical case studies in CISC type and RISC type CPU designs.

Microprogrammed Control Unit: Control memory system, Microinstruction-sequencing, conditional branch, mapping and subroutines, direct, horizontal and vertical microcoding, micro-instruction format and symbolic representation, design of micro-control unit for a simple CPU, applications of microprogramming

Memory organization: Memory hierarchy, Cache organization: Direct, associative and Set associative cache, Auxiliary memory organization, RAID organizations

Input output organization: IO interfacing, Asynchronous data transfer, Programmed IO, Interrupt driven IO, Priority schemes, Direct Memory Access, Serial communication techniques

Computer arithmetic: Design of Binary addition and subtraction units, Algorithms for multiplication and division and their implementation, Floating point arithmetic, etc.

Pipelined architecture: Basic concepts of pipelining, Speedup and throughput, Minimum Average Latency, Instruction pipeline.

Current trends: Discussion on Reconfigurable CPU, Embedded systems, special purpose processors, multiprocessors etc.

Guidelines for Project work:

- Exercises usingassembly-level programming and debugging to illustrate the working of instructions in the ISA of a CISC based /RISC based processor. These exercises should illustrate the status of various registers, flags, counters and pointers after data movement, data manipulation, program control, and stack operations.
- Semester-long group project on the design and simulation /hardware emulation of a simple processor.

SUGGESTED READINGS
1. William stallings, "Computer Organization and Architectue, PHI"

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2. M. Morris Mano, "Computer System Architecture" , PHI
3. J.D. Carpinelli, "Computer Systems Organization and Architecture," Pearson Education
4. Heuring and Jordan, Pearson Education, "Computer Systems Design and Architecture"

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC09	CC	Analog Electronics	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. To understand the physics governing the working of basic electronic devices and describe the working of devices and circuits mathematically.
2. To use devices to design, build and experimentally evaluate electronic circuits
3. To acquire the skills needed to develop complex electronic circuits using components such as amplifiers, oscillators and OP-Amps.

COURSE CONTENT

Review of Semiconductor Diodes and BJT.
Field-Effect Transistors (FET): Field effect transistor: Structure and physical operation of Enhancement-type MOSFET, Depletion-type MOSFET, Basic MOSFET amplifier configuration: Common Source, Common Gate and Common Drain types.
Transistor Amplifiers: Small Signal BJT amplifiers: AC equivalent models (T and Π models), Multistage amplifiers.
Power amplifiers: Class A, B, AB, C and D stages, IC output stages.
Feedback & Oscillator Circuits: Feedback concept, Effect of positive and negative feedback, Basic feedback topologies & their analysis, Sinusoidal Oscillators, Barkhausen criteria, RC, LC and Crystal, Multivibrators
Operational Amplifiers: Ideal OPAMP Basics, Differential Amplifier: Differential and Common mode operation, OPAMP circuits, Inverting & Non Inverting Amplifier, OP-AMP

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applications: Summer, Integrator, Differentiator, Instrumentation Amplifier, Comparator, Schmitt Trigger.

Guidelines for practical work:
Based on the theory as detailed above.

SUGGESTED READINGS

1.Millman and Halkias, Integrated Circuits, Tata McGraw Hill
2.A. S. Sedra, K.S. Smith, Microelectronic Circuits

B.E. COMPUTER ENGINEERING-SEMESTER IV												
Course Code	Type	Subject	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Pre-requisites
							Theory			Practical		
							CA	MS	ES	CA	ES	
CEC10	CC	Microprocessors	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. To acquire insight into architectural details of microprocessors, assembly language programming, and different bus structures and standards.
2. To understand and implement the interfacing of external devices to the processor.
3. To analyze the hardware/software tradeoffs involved in the design of microprocessor and microcontrollers based systems and apply this knowledge to create novel products and solutions for real time problems.

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COURSE CONTENTS

Introduction: General definitions of mini computers, microprocessors, micro controllers and digital signal processors. Overview of 8085 Microprocessor-Pin description, Internal architecture.

Overview of instruction set of 8085-Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set.

Programming – Basic arithmetic operations, Stacks and Subroutines, Counters and Time delays.

Architecture of 8086 Microprocessor: Overview of 8086 microprocessor-Functional Diagram, Register Organization, Memory Segmentation, Signal Descriptions-Common Function Signals, Minimum and Maximum Mode Signals, Timing Diagrams, Interrupts of 8086.

Assembly language of 8086: Instruction Set, Addressing Modes, Assembler directives, 8086 Assembly Programming- simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.

Interfacing with 8086: Interfacing with RAMs, ROMs along with the explanation of timing diagrams. Interfacing with peripheral ICs like programmable peripheral interface 8255, programmer DMA controller 8237, programmable Keyboard controller 8279, programmable interrupt controller 8259 and 8253 programmable timer. Interfacing with key boards, LEDs, LCDs, ADCs, and DACs. Math co-processor 8087.

High end processors: Introduction to 80386 and 80486-The 32 bit processors, Register Organization, Addressing Modes, Data Types, Real Address Mode, Protected Mode, Segmentation, Paging, Virtual 8086 Mode, Introduction to Pentium Processors.

Guidelines for Practical work:

- Assembly language programs: Interchange two blocks of data in memory, Basic arithmetic operations: (a) square and cube of an 8 bit number. (b) LCM of a 16 bit no. (c) GCD of two 16 bit unsigned integers. (d) factorial of an 8 bit number, 16 bit multiplication for signed and unsigned numbers, 32 bit Division, Sorting a given set of 16 bit unsigned integers in ascending/descending order using bubble sort algorithm.
- Code Conversions: ASCII to Binary conversion
- Programs on String Manipulation: (a) Transfer a given source string to destination using string instructions. (b) Reverse a string. (c) Check if the given string is a palindrome or not (d) Scan a string of characters for "FF" (e)

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Determine the end of string (EOS) (f) Case conversion of a string.
- Interfacing various programmable interfaces such as 8255, 8259, 8279, 8237, 8253, 8259.

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085" Prentice Hall.
2. D. V. Hall, "Microprocessor and Interfacing Programming & Hardware" TMH – 2nd Edition.
3. Barry B. Brey, "The Intel Microprocessors: Architecture, Programming & Interfacing" PHI, 6th Edition.
4. Uffenback, "The 8086 Family Design" PHI, 2nd Edition.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC11	**CC**	**Software Engineering**	**3**	**0**	**2**	4	15	15	40	15	15	**None**

COURSE OUTCOMES

1. Understand that software development cannot be done in an adhoc fashion and has to follow a disciplined systematic approach for timely development of software within budget.
2. Learn various techniques used for software project management, software estimation and software testing.

COURSE CONTENT

Introduction: Importance of software engineering as a discipline, The Software evolution, Software characteristics, Software components, Software applications, Crisis-Problem and causes.

Software development life-cycle: Requirement analysis, software design, coding, testing and maintenance and types of maintenance.

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Software Process Models: Water fall model,Evolutionary process models, Throwaway prototyping and Exploratory development like incremental development, Concurrent development and spiral model. Risk management. Capability maturity model (CMM) for process assessment

Requirements Engineering: What is a Requirement, types of Requirements: Functional, Non functional, Domain, Volatile and enduring requirements, Requirement elicitation techniques, Requirements change management, SRS , quality of good SRS, Writing an SRS

Software project Management Project management in software development, role of estimation and metrics in project estimation and process control. Product metrics, Cost estimation models like COCOMO, FP analysis, project scheduling, staffing, software configuration management

Function oriented and object oriented Software design: Difference between structured and Object oriented paradigms, Overview of SA/SD Methodology, structured analysis, data flow diagrams, extending DFD to real time systems, Object oriented design, Modeling using Unified Modeling Language (UML)

Overview of different testing techniques:levels of testing, functional and non-functional testing, static and dynamic testing. Verification and validation, Unit, Integration Testing, Top down and bottom up integration testing, Alpha, Beta and acceptance testing , System testing and debugging.

Software Reliability and Quality Assurance: Reliability issues, Reliability metrics, reliability growth modeling, measurement and prediction of software reliability, Software quality,

Emerging trends.

Guidelines of practical work:

Applyconcepts of Requirements engineering to analyse and model the requirements in oo as well structured paradigms of a generic real life problem and subsequently generate SRS.

Study and application of project management tools to perform effort estimation activity and prepare time line using any technique for a case study.

SUGGESTED READDINGS

1. R . S. Pressman, "Software Engineering – A practitioner's approach", 5th Ed., McGraw Hill Int. Ed., 2001
2. K. K. Aggarwal&Yogesh Singh, "Software Engineering", 2nd Ed., New Age

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International, 2005.
3. Stephen R. Schach, "Classical & Object Oriented Software Engineering", IRWIN, TMH, 1996.
4. Sommerville, "Software Engineering", Addison Wesley, 2004
5. James Peter, W. Pedrycz, "Software Engineering: An Engineering Approach".
6. K. Chandrasehakhar, "Software Engineering & Quality Assurance", John Wiley & Sons, 2004. BPB, 2005.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC12	CC	Computer Graphics	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. To understand the underlying mathematics for output primitives and to incorporate with programming in drawing those primitive.
2. To use graphics primitives in drawing real life objects and to learn how to incorporate characteristics such as shading and animation.
3. To work in collaboration to carry out graphic projects.

COURSE CONTENT

Introduction to computer graphics: Raster Graphics, Graphics hardware, Graphics Libraries and an overview of any one of them such as OpenGL.
Scan Conversion: Line DDA, Midpoint and Bresenham's algorithms, circle, ellipse, parabola, hyperbola.
Line Clipping-Cohen Sutherland, Cyrus Beck, Midpoint Subdivision, Liang-Barsky, Nicholl-Lee-Nicholl
Polygon clipping -Sutherland Hodgman, Weiler Atherton
Polygon Filling-Seed fill, Scanline Approach

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Anti-Aliasing: Un-Weighted and Weighted Area Sampling, Gupta-Sproull Algorithm for Anti-Aliasing

Transformation: 2D Transformation - Geometrical Transformation, Homogeneous Coordinates, Window to View port Transformation, Translation, Scaling and Rotation, 3 D Transformation - Translation, Scaling and Rotation in 3D

Projection: Perspective and Parallel Projection

3 D Viewing: Three dimensional Modeling

Visible Surface Detection (Hidden Surface Elimination): Z-Buffer, Painter Algorithm, Back face Detection, Area subdivision Method, BSP Tree, Octree

Curves and Surfaces: Parametric Cubic Curves, Uniform and Non Uniform Rational B-Spline, Hermite Curve, Bezier Curve, Quadratic Surfaces

Illumination Models: Gouround and Phong Shading Model, Color Model

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SUGGESTED READINGS

1. Foley Van Dam, "Principle of Computer Graphics",
2. Hearne and Baker, "Computer Graphics"

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC13	CC	Computer Networking	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. To acquire a thorough understanding of the state-of-the-art in modern network architecture, protocols, networked systems and applications
2. To become proficient to develop software for modern networking devices
3. To have sufficient background knowledge to conduct networking research and develop innovative ideas.

COURSE CONTENT

Introduction: Fundamentals of Digital Communication, Network Classification, Protocol

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Architecture: Design Issues for the Layers, The TCP/IP Protocol Architecture, The ISO-OSI Model, Other protocols such as SNA, Appletalk, Netware etc.

Physical Layer: Data Transmission Concepts, Transmission Media, Signal Encoding Techniques, Digital Data Communication Techniques - Asynchronous and Synchronous Transmission, Error Detection, Error Correction, Multiplexing – FDM,TDM, ADSL, xDSL

Data Link Layer: Main Functions, Framing, Error Control, Flow Control, Error-Correcting Codes, Error-Detecting Codes, Data Link Protocols: Stop-and-Wait Protocol, One-Bit Sliding Window Protocol, Go Back N, Selective Repeat, HDLC

Queuing Models: Poisson Process, Markov Chain, M/M/1 Queue- delay and little's formula. M/M/S/K, Queues – average queue length, delay and waiting times.M/G/1 Queues

Medium Access Control Sublayer: Channel Allocation: Static, Dynamic, MAC PROTOCOLS – ALOHA, CSMA, Collision-Free Protocols, Limited-Contention Protocols, Detailed Study of Ethernet, 802.11 WIRELESS LANS

Network Layer: Functions,Design Issues, Internetworks: Principle, Protocols and Operations, IP Protocol: IPv4 Header, Addresses, Operation, Subnetting, Classless Interdomain Routing, Network Address Translation, Internet Control Protocol - ARP, RARP, BOOTP, DHCP, OSPF, BGP, IGMP; Problems of IPv4, IPv6, Routing Algorithms, Congestion Control Techniques

LAN: Topologies and Transmission Media, Protocol Architecture, Bridges, Switches
WAN: Switched Communications Networks, ATM Communication

Transport Layer: Functions, Design Issues, TCP, UDP

Application Layer: Internet Applications: FTP, Telnet, DNS, HTTP, SMTP,SNMP

Security in Computer Networks: Fundamentals of Network Security, Encryption, Cryptography, Securing E-mail, Securing TCP Connections: SSL, Network-Layer Security: IPsec, Securing Wireless LANs, Operational Security: Firewalls and Intrusion Detection Systems.

Guidelines for practicalwork:

Programming assignments based on the concepts learned in the theory will be given involving the usage of network status and control commands, real life network analyzer tools (Wireshark), application development using network APIs available in operating systems (Linux) and network simulators (ns2/Opnet). Briefly these will cover the following:

1. Students will develop programs using system calls for process management, inter-process communication, process synchronization, memory management and file

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system management.
2. Basic network operations related command of Linux: ifconfig, route, netstat, ping, arp, traceroute, tcpdump, xxd, host, nslookup, dig, nmap etc.
3. Instant Message Application development making using of socket related system calls and multi threading.
4. Observing the functionality of a Network Protocol Analyzer like Wireshark to understand the layered structure of TCP/IP network stack, develop programs in C/C++ to open the binary packet dump file of wireshark, extract the various fields of the headers of various layers and computing the IP header checksum in the packet and verification of the same.
5. Simulation of the networking algorithms used for Error Control (ARQ protocols), routing, flow control, congestion control etc.

SUGGESTED READINGS

1. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education
2. William Stallings, "Data and Computer Communication", 10th Edition, Pearson Education
3. James F. Kurose & Keith W. Ross, "Computer Networking: A Top –down approach", 6th Edition, Pearson Education
4. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education

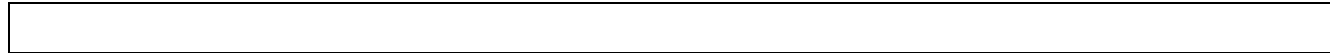| Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC14	CC	Operating Systems	3	1	0	4	25	25	50	-	-	None

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COURSE OUTCOMES

1. Understand how an operating system manages all the resources in a computer system efficiently.
2. Learn algorithms for CPU scheduling, deadlock handling, page replacement and disk scheduling used by an operating system.
3. Useshell commands to efficiently operate a computer system.
4. Learn and usesystem calls for process creation and termination, inter-process communication, process synchronization, memory management and file system management.

COURSE CONTENT

Overview: Operating systems – structure, operations, components, types, services, user interfaces. System calls, system programs, system boot.

Process management: Processes – concept, scheduling, operations on processes, interprocess communications. Threads – single- and multi-threaded processes. CPU scheduling – criteria, algorithms, multiple-processor scheduling. Process synchronization – critical-section problem, semaphores, classic synchronization problems, monitors. Deadlocks – characterization, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Memory management: Main memory – memory allocation schemes, paging, segmentation. Virtual memory – demand paging, page replacement, frame allocation, thrashing.

Storage management: File system – files and directories, structure and implementation of file systems, mounting and unmounting, storage allocation methods, free-space management. Disk – structure, scheduling, management.

I/o management: i/o hardware, i/o interface, kernel i/o subsystem.

Protection and security: Access matrix, security threats.

Guidelines for assignment and project work:
1. Demonstrate system calls for process/thread control such as fork, execve, join,

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wait.

2. Use semaphores and mutex for process synchronization in producer consumer problems.

3. Implement a deadlock free solution to Dining philosophers problem. Demonstrate starvation and deadlock situations.

4. Assignment- simulate algorithms for CPU scheduling, deadlock handling, page replacement and disk scheduling .

SUGGESTED READINGS**:**

1. Silberschatz, A., Galvin P. B., and Gagne, G. 2005, "Operating System Principles (7th ed.), Wiley".

2. Stallings, W. 2014,"Operating Systems: Internals and Design Principles (8th ed.)", Pearson.

3. Tanenbaum, "A. S. 2007. Modern Operating Systems (3rd ed.)", Pearson.

							Evaluation Scheme (Percentage weights)					
B.E. COMPUTER ENGINEERING-SEMESTER V												
Course Code	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Theory**			**Practical**		**Pre-requisites**
							CA	**MS**	**ES**	**CA**	**ES**	
CEC15	CC	Theory of Computation	3	1	0	4	15	15	40	15	15	None

COURSE OUTCOMES

1. Acquire knowledge of Regular Languages, FA, CFG, Push Down Automata and Turing recognizable languages

2. Be able to get a broad overview of the theoretical foundations of computer science

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3. Be able to think analytically and intuitively for problem solving situations in related areas of theory of computer science

COURSE CONTENT

Finite Automata: Deterministic FA, Non deterministic FA, Regular expressions, Finite Automaton with €- moves, Regular Expression, Regular Languages and Kleen's theorem– Conversion of NFA to DFA, Equivalence of finite Automaton and regular expressions, Minimization of DFA, Pumping Lemma for Regular sets, Problems based on Pumping Lemma.

Context Free Grammer: Grammar, Types of Grammar, Context Free Grammars and Languages, Derivations, Ambiguity, Relationship between derivation and derivation trees, Simplification of CFG, Elimination of Useless symbols - Unit productions - Null productions, Chomsky normal form (CNF), Greibach Normal form (GNF), Problems related to CNF and GNF.

Pushdown Automata: Moves, Instantaneous descriptions, Deterministic pushdown automata, Equivalence of Pushdown automata and CFL, pumping lemma for CFL, problems based on pumping Lemma.

Turing Machine: Definitions of Turing machines, Computable languages and functions, Techniques for Turing machine construction, Multi head and Multi tape Turing Machines, The Halting problem, Partial Solvability, Problems about Turing machine- Chomsky hierarchy of languages.

Difficult problems: Unsolvable Problems and Computable Functions, Primitive recursive functions, Recursive and recursively enumerable languages, Universal Turing machine, Measuring and classifying complexity - Tractable and Intractable problems, Tractable and possibly intractable problems, P and NP completeness, Polynomial time reductions, NP-complete problems from other domains: graphs (clique, vertex cover, independent sets, Hamiltonian cycle), number problem (partition), set cover.

SUGGESTED READINGS

1. Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education.
2. John C Martin, "Introduction to Languages and the Theory of Computation", Third Edition, Tata McGraw Hill Publishing Company, New Delhi

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Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC16	CC	**High Performance Computing**	3	0	2	4	15	15	40	15	15	**None**

COURSE OUTCOMES

1. To understand the capabilities, limitations and performance of high performance architectures and their applications in solving challenging problems.
2. Develop the skills to decompose parallelizable problems effectively, write parallel algorithms and use parallel programming paradigms to implement them.
3. Appreciate the multidisciplinary approach for developing and utilizing high performance systems.
4. Keep abreast of the latest developments in high performance computing environments

COURSE CONTENT

Introduction: Flynn's classification of parallel architectures, Kinds of parallelism-Temporal, data and mixed parallelism , Dependencies and hazards - data, control and resource dependencies, PRAM models.

Parallel Programming paradigms: Granularity and Communication overheads, Program decomposition techniques, Shared Memory Programming (pthreads), SPMD model, Message Passing Programming (MPI/Open MP), Parallel sorting, even-odd transposition/ parallel multiplication/ Parallel matrix operations on PRAM models.

High Performance Architectures: Instruction level parallelism-Delays in instruction pipelining, mechanisms to tackle pipeline stalls, superscalar, superpipelined

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architectures, VLIW processors. Array Processors -SIMD architectures, Vector processing architectures. Multiprocessor architectures – shared memory symmetric multiprocessing, clusters and grids. Interconnection networks - characteristics and routing mechanisms. Parallel algorithms on realistic architectures.

Performance and scalability evaluation: Performance Laws: Amdahl's Law, Guftanson's Law, Sun and Li Law, Performance Benchmarks, Overheads in parallel processing, Hardware software matching

Memory and cache Consistency: Memory consistency: strict consistency, Lamport's sequential consistency, strong and weak consistency models. Bus based and directory based cache coherence protocols.

Compiler optimizations for parallel architectures: Vectorization, Tiling, Wavefronting , VLIW optimizations, software pipelining

Guidelines for practical work:

- Shared memory inter-process communication using pthreads – develop applications to demonstrate inter-process communication by thread creation, parameter passing, thread joining using semaphores, mutex and condition variables.
- Message passing parallel programming – develop applications to demonstrate task partitioning and IPC using Message Passing Interface (MPI) and OpenMPIsuch as different parallel implementations of matrix multiplication and sorting .
- Create a simple cluster.

SUGGESTED READINGS

1.Kai Hwang, "Advanced Computer Architecture", McGrawHill
2.V. Rajaraman and C. Siva Ram Murthy,"Parallel Computers, architecture and programming, PHI
3.Michael J Quinn, "Parallel Programming in C wit h MPI and OpenMP", McGrawHill Edu.
4.Peter Pacheco, "An introduction to parallel programming".

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Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC17	CC	Compiler Construction	3	0	2	4	15	15	40	15	15	None

COURSE OUTCOMES

1. Understand the internal organization and behavior of compilers and other language processors.
2. Applythe formal constructs for designing a compiler.
3. Gain an ability to design simple domain-specific languages (DSLs) using compiler construction tools.

COURSE CONTENT

Introduction: Language processors, structure of a compiler, compiler-construction tools, evolution of programming languages, applications of compiler technology, T-diagrams, bootstrapping, just-in-time compilation.

Lexical analysis: Input buffering, specification and recognition of tokens, lexical-analyzer generator.

Syntax analysis: Specification of syntax using grammar. Top-down parsing – recursive-descent, predictive. Bottom-up parsing – shift-reduce, SLR, CLR, LALR. Parser generator.

Intermediate-code generation: Syntax-directed translation. Three-address code. Translation of declarations, expressions, control flow. Backpatching.

Runtime environment: Activation trees and records.

Code optimization: Sources of optimization, basic blocks, optimization of basic blocks, data-flow analysis, loop optimizations.

Code generation: Issues, register allocation and assignment, peephole optimization.

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Guidelines for Practical work:
- Develop simple language processors like desk calculator and assembler.
- Design a small high-level language. Develop a lexical analyzer and a syntax analyzer for the same using the Lex and Yacc tools. Also implement the bookkeeper module.
- Design a small high-level language and implement a compiler for the same. If the target machine of the compiler is a hypothetical machine, then implement a simulator for it.

SUGGESTED READINGS

1. Aho, A. V., Lam, M. S., Sethi, R. and Ullman J. D. 2006,"Compilers – Principles, Techniques and Tools (2nd ed.)", Pearson.
2. Chattopadhyay, S. 2005,"Compiler Design, PHI".
3. Appel, A. W. 200,"Modern Compiler Implementation in C", Cambridge University Press.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC18	CC	**Modeling and Simulation**	3	0	2	4	15	15	40	15	15	**None**

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COURSE OUTCOMES

1. Understand and apply thetechniques for probabilistic and statistical modeling.
2. Analyze and model real world problems and simulate their working using Markov models, queuing models, Monte Carlo and event driven simulation.
3. Estimate the cost and benefits of computer simulation, generation of meaningful results, decision making, and risks and be able to formulate judgments and synthesize conclusions through research of a simulation topic.

COURSE CONTENT

A) Probabilistic and Statistical Modeling:
Overview of R statistical data manipulation language: operational basics, R in interactive and batch mode, R data structures – matrices, lists, data frames, classes, The R functions for discrete probability distributions (Geometric, Binomial, Poisson) and continuous probability distributions (Uniform, Normal, Exponential, Gamma and Beta), quantile functions, Multivariate distributions.
Random graph models: solution strategies with examples such as simple board game, Simulation of Rolling dice, simulation of conditional probability, Combinatorics based probability calculation (examples of dice, groups of students, lottery tickets etc),
Discrete Markov Chains: matrix formulation, state probabilities, Markov analysis with examples.
Continuous Time Markov Chains: CTMC, stationery distributions, rates, birth death process, example of machine repair with failure and repair rates.
Statistics: Sampling distribution, sample mean- a random variable, expected and variance of sample mean, sample mean as approximately normal distribution, Confidence intervals, Significance test, Statistical estimation and inference, Mixture models, Linear Regression
B) Simulation
Simulation Modeling: The Nature of Simulation   Systems, Models, and Simulation Discrete-Event Simulation . Simulation of a Single-Server Queueing system. Alternative Approaches to Modeling and Coding Simulations, Parallel and Distributed Simulation ,Simulation across the Internet and Web-Based Simulation ,Steps in a Sound Simulation Study , Continuous Simulation ,Combined Discrete-Continuous

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Simulation , Monte Carlo Simulation. Advantages, Disadvantages, and Pitfalls of Simulation

Simulation Software : Comparison of Simulation Packages with Programming Languages. Classification of Simulation Software, General-Purpose Simulation Packages, Object-Oriented Simulation.

SUGGESTED READINGS

1. Norm Matloff, "Probabilistic and statistical modeling in Computer Science", Open book, http://heather.cs.ucdavis.edu/probstatbook, From algorithms to Z scores

2. Simulation Modeling and Analysis Third Edition By Law Kelton (Mc-Graw Hill).

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC19	CC	Computer Control Systems	3	1	0	4	30	20	40	-	-	None

COURSE OUTCOMES

1. Understanding of Control system and its various applications.
2. To understands time response analysis and frequency response analysis of systems.
3. To understand supervisory control and data acquisition system (SCADA).
4. Understanding of digital control systems and exposure of related examples.

COURSE CONTENT

Feed Back Characteristics of Control Systems:
Feedback and Non-feedback Systems, Reduction of Parameter Variations by use of Feedback, Control Over System Dynamics by use of Feedback, Control of Effects of

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Disturbance Signal by use of Feedback and Regenerative Feedback.

Time Response Analysis, Design Specifications and Performance Indices:
Standard Test Signals, Time Response of First-order Systems, Time Response of Second-Order Systems, Steady-State Error and Error Constants, Effect of Adding a Zero to a System, P, PI and PID Control Action and Their Effect, Design Specifications of Second-Order Systems and Performance Indices.

Concepts of Stability Criteria:
The Concept of Stability, Necessary Conditions for Stability, Hurwitz Stability Criterion, Routh Stability Criterion and relative Stability Analysis.

The Root Locus Technique:
The Root Locus Concept, Construction of Root Loci, Root Contours, Systems with Transportation Lag, Sensitivity of the Roots of the Characteristic equation, MATLAB : Analysis and Design of Control Systems.

Frequency Response Analysis:
Correlation Between Time and Frequency Response, Polar Plots, Bode Plots, and All Pass and Minimum-Phase Systems. Mathematical Preliminaries, Nyquist Stability Criterion, Definition of Gain Margin and Phase Margin, Assessment of Relative Stability using Nyquist Criterion and Closed-Loop Frequency Response.

Introduction to Design:
The Design Problem, Preliminary Considerations of Classical Design, Realization of Basic Compensators, Cascade Compensation in Time Domain Cascade Compensation in Frequency Domain, Tuning of PID Controllers. MATLAB based Frequency domain analysis of control system.

Digital Control System
Introduction to Digital Control, Discrete time System Representation, Sampling and Reconstruction, Modeling discrete time systems by pulse transfer function. Revisiting Z-transform, Mapping of S-Plane to Z-Plane, pulse transfer function of closed loop systems.

Programmable Logic Controller (PLC) and its applications. Review of computers in process control: Data loggers, Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. Functional block diagram of computer control systems. alarms, interrupts. Characteristics of digital data, controller software, linearization. Digital controller modes: Error, proportional, derivative and composite controller modes.

Emerging Trends

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SUGGESTED READINGS

1. Nagrath& Gopal, "Control Systems Engineering" New Age International. Publishers
2. Ogata, "Modern Control Engineering".
3. Kuo B.C, "Automatic Control System".
4. Scheultz&Melsa,"Linear Control Systems".
5. D' Azzo&Houpis, "Linear Control Systems Analysis & Design".
6. S. A. Boyer. SCADA,"Supervisory Control and Data Acquisition". 3rd Edition, ISA,.
7. M. Johnson and M. H. Moradi, "PID Control. Springer-verlang", London.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC20	CC	IT Law and Ethics	2	0	0	2	25	25	50	-	-	None

COURSE OUTCOMES

1. An understanding of the law that governs the development and dissemination of software.
2. An understanding of the law that governs the dissemination of digitized information.
3. An understanding of ethics related to the IT profession.

COURSE CONTENT

Definition, Applicability, Nature of Intellectual Property: Patents, Trademarks and copyright, Process of Patenting and Development: technological research, Innovation, Patenting, development, International Cooperation on Intellectual Properly, Procedure for grants of patents.
Scope of Patent Rights, government rules for licensing and transfer of technology within country, government rules for licensing and transfer of technology from other country, Patent information and documentation, Legal framework infringement actions and remedies.
Administration of Patent system, New Development in IPR, IPR of Biological systems,

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Computer software, Machinery etc. Case studies.
Protection of databases: Laws under *Sui generis,* EC Directive 96/9/EC, Technological Protection measures, Digital Rights Management, watermarking and certification.

Current laws and trends

SUGGESTED READINGS

1. Introduction to intellectual property: Theory and Practice, By World Intellectual Property Organization.
2. Intellectual Property Rights: Innovation, Governance and the Institutional Environment, Birgitte Andersen, Edward Elgar Publishing Limited.
3. Cristine Greenhalgh, Mark Rogers*,* "Innovation, Intellectual Property, and Economic Growth".
4. The global challenge of intellectual property rights, Robert C. Bird, Subhash Chander Jain.
5. Digital Media and Intellectual Property, Nicola Lucchi.

Course Code	Type	Subject	L	T	P	Credits	CA	MS	ES	CA	ES	Pre-requisites
CEC21	CC	Open Source Technologies	0	0	4	2	-	-	-	50	50	None

COURSE OUTCOMES

1. Understand the importance of open source software in developing software collaboratively, cost saving, localization, vender independence and security.
2. Develop the skills to use and develop various open source technologies.

COURSE CONTENT

This course will train students on various open source technologies with practical work.

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-Open source operating systems: Extended exercises on Linux shell programming, system administration tools, network and security, socket programming
-Open GNU tools
-Android application development
-Open cloud: OpenStack
-Open hardware: Raspberry-Pi, Arduino

SUGGESTED READINGS

1. Discover and Open source world, https://opensource.com
2. Ubuntu Linux, "The complete reference".
3. Benvenuti, "Understanding the Linux network internals"

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SYLLABI OF DISCIPLINE SPECIFIC ELECTIVES							
PART A: WITH PRACTICAL							
LTP Allocation			**Evaluation Scheme**				
L	**T**	**P**	**A**	**MS**	**ES**	**Int**	**ES**
3	**0**	**2**	**10**	**20**	**40**	**15**	**15**
Code	**Name of Elective**		**Pre-Requisites**				
CED01	**Embedded Systems Design**		**CEC08, CEC10**				

COURSE OUTCOMES

1. Gain an understanding of the design issues, methodologies and platforms for embedded systems.
2. Equip oneself with software and hardware development skills needed to model and implement embedded systems.
3. Develop full hardware software embedded applications.

COURSE CONTENT

Embedded Systems & HW-SW Co-Design: Introduction to embedded systems: Evolution, Issues and Challenges, Co-design Flow methodologies, Design exploration, Co-specification, Co-verification, Validation and testing, Co-simulation, Physical design.

Embedded System Platforms: Microcontroller Architecture based on 8051/AVR/ARM with interfacing of Memory and Peripheral Devices, Interrupts Processing, Interfacing with sensors and actuators. (ii) Alternative architectures: Programmable Logic Devices (PLD), Application Specific Integrated Circuits (ASIC), Application Specific Instruction Processors (ASIP), Field Programmable Gate Arrays (FPGA), Reconfigurable devices, Systems On Chip (SOC), VLIW architectures.

Embedded System Software: Modeling UML and RT-UML, Software Development: Flow, Environments and Tools; RTOS Fundamentals

Embedded System Design issues: Performance Analysis and Optimization:

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Speed, Power and Area Optimization; System Reliability, Safety and Security.

Emerging Trends.

Guidelines for Practical work:

- Programming on Microcontroller kits.
- Interfacing input output devices with micro-controller kits
- Developing micro-controller based systems and writing control programs
- FPGA based hardware software systems: programming, simulation and emulation

SUGGESTED READINGS

1. K. Shibu, "Introduction to Embedded Systems", Tata McGraw Hill.
2. Raj Kamal, Embedded Systems,"Architecture, Programming and Design, 2nd Edition" Tata McGraw Hill.
3. G.D. Michelli, M. Sami, "Hardware software codesign" Kluer academic publishers
4. Marilyn Wolf, Computers as Component,"Principles of Embedded Computing"
5. System Design, 3rd Edition, Elsevier, 2011
6. Frank Vahid, Tony Givargis, "Embedded System Design" A Unified Hardware / Software Introduction, 3rdEdition, Wiley, 2006

L	T	P	CA	MS	ES	Int	ES
3	0	2	10	20	40	15	15
CED02	**Big Data and Analytics**			**CEC02, CEC06**			

COURSE OUTCOMES

1. Gain a conceptual understanding of big data analytics concepts, algorithms, data management tools and statistical analysis.
2. Acquire tools to manage various aspects of big data such as Hadoop, HDFS, Map-Reduce based HBase, Cassandra, Pig, Hive etc.

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3. Build applications based on big data.

COURSE CONTENT

Introduction to Big Data: Databases and their evolution,convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data,credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data mobile business intelligence, Crowd sourcing analytics,inter and trans firewall analytics.

NoSql Data Management: Introduction to NoSQL, Types of NoSQL, aggregate data models, aggregates, key-value, document data models, relationships, graph databases, schema less databases, materialized views. Overview of MongoDB. MapReduce, partitioning and combining, composing map-reduce calculations, MapReduce examples such as matrix multiplication.

Hadoop: Introduction to Hadoop,Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop distributed file system (HDFS), HDFS concepts, data flow,Hadoop I/O, data integrity, compression, serialization, Avro file-based data structures**,** Map Reduce workflows, unit tests with MRUnit, test data and local tests – anatomy of Map Reduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats.

Hadoop Related Tools: Hbase,data model and implementations, Hbaseclients, Hbase examples – praxis. Cassandra, Cassandra data model,Cassandraexamples,Cassandraclients, Hadoop integration. Pig,Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats,HiveQL data definition,HiveQL data manipulation – HiveQL queries, Overview of spark.

Data Analysis: Overview of R programming language,Regression Modeling, Multivariate Analysis, Bayesian Modeling, Inference and Bayesian Networks, Support Vector and Kernel Methods, Analysis of Time Series, Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks, Learning And Generalization, Competitive Learning, Principal Component Analysis and Neural Networks, Fuzzy Logic: Extracting Fuzzy Models from Data, Fuzzy Decision Trees, Stochastic Search Methods.

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Emerging Trends.

Guidelines for practical work: Exercises on Hadoop, MapReduce, HDFS, MongoDB, R.

SUGGESTED READINGS

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics, "Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
2. Big-Data Black Book, DT Editorial Services, Wiley India
3. Massive Online Open Courses (MOOCS): Big Data University, Udacity and Coursera.
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
5. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
6. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
7. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
8. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011. 8. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010. 9. Alan Gates, "Programming Pig", O'Reilley, 2011

L	T	P	CA	MS	ES	Int	ES
3	0	2	10	20	40	15	15
CED03	Software Testing			CEC11			

COURSE OUTCOMES

1. Learn the various concepts and methods that can be used to test software before it is delivered to the end user.
2. Learn about various challenges and difficulties faced during the process of software testing and approach for tackling them.

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COURSE CONTENT

Introduction to Software Testing: Definition, Goals, Test metrics, Effective Software Testing versus Exhaustive Software Testing

Software Testing Terminology: Role of testing in SDLC, Discussion of testing terminology such as error, bug and failure, test case and Test plan. , V-Testing Life Cycle Model

Software Verification: Verification and validation Activities, Role of verification and Validation in Testing Strategy. Verification methods: Inspections, Walkthroughs and reviews, SRS document verification, SDD document verification.

Overview of test generation strategies: Types of testing-White box and Black Box testing, Test case generation from source code, test generation from requirements, Test generation from finite state models, test generation from combinatorial designs

Static White box testing Techniques: Inspections, structured walkthroughs and Technical reviews

Structural/Dynamic White Box Testing Techniques: Logic Coverage Criteria, Basis Path Testing,, Loop testing, Data Flow Testing, slice based testing, Mutation Testing

Dynamic Black Box Testing Techniques: Boundary Value Analysis(BVA), Equivalence Class Testing, State-Table Based Testing, decision Table Based Testing, Cause-Effect Graphing Based Testing

Essentials of Graph Theory: What is graph, matrix representation of graph, paths and independent paths, generation of a graph from a program, identification of independent pathsselection

Test Selection and Test minimization and Prioritization of test cases for Regression testing: What is Regression testing, Regression test case selection, reducing the number of test cases, Risk analysis, code coverage prioritization.

Introduction to Object Oriented Testing: Path testing, state based testing class testing**,**

Testing Tools: Static Testing Tools, Dynamic testing Tools

Emerging Trends.

Outline of practical work for Software Testing :

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1. Create a test plan document for any application
2. Study of Any Testing Tool (Win Runner)
3. Study of Any Test Management Tool (QA Complete)
4. Automate the Test cases using Test Automation tool(using QA Complete)
5. Learn how to raise and report Bugs using Bug tracking tool (Bugzilla,Jira using QA Complete)
6. Study of any open source testing tool (Web Performance Analyzer/O STA.

SUGGESTED READINGS

1. Yogesh Singh , "Software Testing", Cambridge University Press
2. Aditya P. Mathur, "Foundations of Software Testing, fundamental Algorithms and Techniques", Pearson Education
3. Naresh Chauhan, "Software Testing Principles and Practices", OxfordUniversity Press.
4. Ramesh Desikan, "Software Testing Principles and Practices",Pearson Education

L	T	P	CA	MS	ES	Int	ES
3	0	2	10	20	40	15	15
CED04	**Mobile Ad-hoc Networks**			**CEC08, CEC13**			

COURSE OUTCOMES

1. Describe the unique issues in ad hoc wireless networks, current technology trends for the implementation and deployment of ad hoc wireless networks.
2. Understand the routing algorithms used in mobile ad hoc network.
3. Learn the issues in QoS solutions and Energy Management Schemes in

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adhoc wireless networks.

COURSE CONTENT

Introduction to adhoc networks: Definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models:- Indoor and outdoor models.

Medium access protocols MAC: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

Network protocols Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

End-end delivery and security Transport layer : Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

Cross layer design and integration of adhoc for 4G Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective. Integration of adhoc with Mobile IP networks.

Emerging Trends.

Outline of practical work:

1. Simulation of various routing protocols taken up in the lecture using glomosim, network simulator.
2. Exercises may be designed to gather an understanding of the limitations of the existing routing protocols.
3. Projects to design and simulate more efficient protocols.

SUGGESTED READING

1. C.Siva Ram Murthy and B.S.Manoj, "Ad hoc Wireless Networks Architectures and protocols," 2nd edition, Pearson Education
2. Charles E. Perkins, "Ad hoc Networking," Addison – Wesley
3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile, "Ad

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hoc networking," Wiley-IEEE press

L	T	P	CA	MS	ES	Int	ES
3	0	2	10	20	40	15	15
CED05	Advanced Data Structures			CEC01, CEC02			

COURSE OUTCOMES

1. Understand and apply amortized analysis on data structures, including binary search trees, meargable heaps, and disjoint sets.
2. Understand the implementation and complexity analysis of fundamental algorithms such as RSA, primality testing, max flow, discrete Fourier transform.
3. Develop applications using concepts learnt such as of linear programming, string matching and game-theory.

COURSE CONTENT

This course extends the core concepts of data structures and introduces new data structures and algorithms that address emerging challenges in computing. Topics include:
- Handling multiple stacks and queues.
- Alternative hashing methods: Division method, middle square method, Fibonacci method, Multiplication method.
- String matching algorithms.
- Trees and Heap structures: Red-black trees and operations, operations on AVL trees, B trees, min-max heap, Binomial heap and Fibonacci heap.
- New tree structures: Palindrome trees , VP Trees, Weak B Trees.
- Succinct data structures: Trie, Patricia Trie, Suffix Trie, Suffix arrays, succinct representation of tree, Cardinal trees and ordinal tree.
- Cache oblivious data structures and algorithms.

Emerging Trends.

Outline of practical work:

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- Implement multiple stacks in same array, multiple queues,
- Implementation of string matching algorithms,
- Implementation of Hashing methods,
- Operations on red black, avl and b-trees
- Operations on min- max heaps, binomial heaps, fibonacci heaps,
- Applications with Palindrome trees, VP trees, weak B trees
- Implementation of vocabulary, word games and web search with tries.

SUGGESTED READINGS

1. Thomas H. Cormen, Charles E. Leiserson, RonaldL. Rivest, and Clifford Stein,"Introduction to Algorithms," Third Edition. MIT Press and PHI, 2010.
2. Sartaj Sahni,"Data Structures and Applications, Chapman and Hall/CRC Press".
3. Palindrome trees: http://adilet.org/blog/25-09-14/
4. Vantage Point (VP) trees: http://stevehanov.ca/blog/index.php?id=130 http://www.dcc.uchile.cl/~gnavarro/ps/spire12.4.pdf
5. Ian Munro, Succinct data structures https://cs.uwaterloo.ca/~imunro/cs840/SuccinctDS.pdf
6. Remco van der Hofstad, Random graphs and complex networks.
7. Eric D Demaine, Cache Oblivious algorithms and data structures, http://erikdemaine.org/papers/BRICS2002/paper.pdf

L	T	P	CA	MS	ES	Int	ES
3	0	2	10	20	40	15	15
CED06	**Natural Language Processing**			**CEC02, CEC05**			

COURSE OUTCOMES

1. Understand the basic properties of human languages and descriptive and theoretical frameworks for handling these properties;
2. Understand the design of tools for basic NLP tasks such as tagging and partial parsing and be able to apply them to text and evaluate their performance;

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3. Understand and apply basic principles of the representation of linguistic meaning and interpretative inference

COURSE CONTENT

Introduction:NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.
Regular Expressions: Chomsky hierarchy, regular languages, and their limitations. Finite-state automata. Practical regular expressions for finding and counting language phenomena. Word morphology.
Language modeling and Naive Bayes: Probabilistic language modeling and its applications. Markov models. N-grams. Estimating the probability of a word, and smoothing. Generative models of language.
Part of Speech Tagging, Sequence Labeling and Syntactic Parsing Lexical syntax. Hidden Markov Models. Maximum Entropy Models. Conditional Random Fields, Grammar formalisms and Treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs.
Semantic Analysis: Lexical semantics and word-sense disambiguation, Multi word expressions. Compositional semantics. Semantic Role Labeling and Semantic Parsing, Discourse Analysis

Emerging Trends.

Guidelines forPractical work:

- Exercises on programming in Python
- Exploring a large corpus with regex tools
- Develop an automatically-trained email spam filter
- Develop a program to automatically determine the language of a given corpus
- Exercises on TK-Natural Language Toolkit
- Exercises on WordNet
- Exercises on Penn Tree Bank
- Exercises on Stanford CoreNLP

SUGGESTED READINGS

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1. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python– Analyzing Text with the Natural Language Toolkit"
2. Christopher D Hanning,Hinrich Schütze, "", MITPress. Cambridge, MA:.
3. Daniel Jurafsky and James H. Martin, "Speech and Language Processing," Prentice Hall; 2nd edition (May 16, 2008)
4. http://nlp.stanford.edu/~manning/
5. http://wwwcsli.stanford.edu/~schuetze

L	T	P	CA	MS	ES	Int	ES
3	0	2	10	20	40	15	15
CED07	**Information and Network Security**			**CEC13, CEC14**			

COURSE OUTCOMES

1. Understand the principles, techniques and tools used for designing secure information systems.
2. Design, implement and maintain secure computer networks.
3. Safely recover an information system or network from a security attack.

COURSE CONTENT

Computer Security Concepts: Threats, Attacks, and Assets, Security Functional Requirements, Fundamental Security Design Principles, Information Security: Confidentiality, Integrity, Availability, Identification and Authentication, Authorization and Access control, Accountability and Auditing.

Cryptography for Data Security: Basic Concepts and Historical Overview, Mathematical Foundations of Cryptography, Symmetric Encryption Techniques, Asymmetric Key Encryption Techniques, Public Key Infrastructure (PKI), Authentication, Message Digest & Digital Signature, Kerberos Key Exchange, Encryption standards and case studies.

Types of Attacks: Malicious programs (e.g., viruses, worms, Trojan horses), Buffer overflow attack, Hacking methods and software tools, Denial-of-service attacks and distributed denial-of-service attacks, IP Spoofing, Routing Protocol attacks, "Spam" Email, DNS and the DNS Cache Poisoning Attack, Windows and Unix

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Vulnerabilities, Dictionary Attacks and Rainbow-Table Attacks on Password Protected Systems, Security Issues in Structured Peer-to-Peer Networks, Web Security: PHP Exploits, Cross-Site Scripting and Other Browser-Side Exploits, Bots and Botnets.

Internet Security: SSL / TLS, Secure Shell, Secure HTTP, Secure FTP, Secure E-Mail (PGP), IPsec: AH, ESP, IKE; DNS Security, Multicast Security, VPN, Secure Internet Routing (BGP, OSPF), Software tools for Internet security.

Protection of Networks from Attacks: Firewalls: Packet Filtering, Proxy-Server; Port and Vulnerability Scanning, Packet Sniffing, Intrusion Detection, and Penetration Testing and tools, Honeypot, Anti-virus software, Access control, Trusted OS design, Auditing and Monitoring.

Wireless / Mobile Network Security: Security Vulnerabilities of Mobile Devices, Wireless network attacks and defenses, Secure ad-hoc network routing.

Database and Cloud Security: The Need for Database Security, SQL Injection Attacks, Database Access Control, Inference, Database Encryption, Cloud Computing: Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Cloud Security as a Service, Study of recent advances in network security domain.

Emerging Trends.

Guidelines for Practical Work:
1. Students will develop programs in C/C++/Java/Python to implement the algorithms covered in the course.
2. Assignments will be given to study the modern day tools being used to detect vulnerabilities of systems and ensure their security.

SUGGESTED READING

1. William Stallings ,"Cryptography and Network Security: Principles and Practice", 6th Edition, Prentice Hall
2. Behrouz A. Forouzan,"Cryptography & Network Security", 2nd Edition, McGraw Hill
3. Michael E. Whitman, Herbert J. Mattord, "Principles of Information Security" 5th Edition, Cengage Learning

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L	T	P	CA	MS	ES	Int	ES
3	0	2	10	20	40	15	15
CED08	Mobile Computing			CEC05, CEC13, CEC14			

COURSE OUTCOMES

1. Understand the characteristics and limitations of mobile hardware devices including their user-interface modalities.
2. Interface a mobile computing system to hardware and networks.
3. Program applications on a mobile computing system and interact with servers and database systems.
4. Develop an awareness of professional and ethical issues, in particular those relating to security and privacy of user data and user behavior.

COURSE CONTENT

Introduction: Overview of Wireless Telephony, Wireless and Mobile Computing Architecture – Limitations of wireless and mobile communication – Wireless Telecommunication Networks: Digital cellular Systems, TDMA - CDMA – Wireless Networking Techniques –Mobility Bandwidth Tradeoffs – Portable Information Appliances.

Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, WAP: Architecture, protocol stack, application environment, applications.

Mobile Networking:Virtual IP Protocols - Loose Source Routing Protocols - Mobile IP – CDPD – GPRS – UMTS - Security and Authentication – Quality of Service – Mobile Access to the World Wide Web.

Database Issues : Hoarding techniques, caching invalidation mechanisms, client server computing with adaptation, power-aware and context-aware computing, transactional models, query processing, recovery, and quality of service issues.

Data Dissemination: Communications asymmetry, classification of new data delivery mechanisms, push-based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques.

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Mobile Agents computing, security and fault tolerance, transaction processing in mobilecomputing environment.

Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs.Recent Advances in Mobile Computing.

Outline of practical work :

1. Study of GSM architecture and signalling techniques.
2. Study of Cellular system and related concepts.
3. Study of GPRS service
4. Study of WAP architecture
5. Study of Bluetooth architecture.
6. Study of IEEE 802.11 network topology.
7. Study of Distributed mobile computing.

SUGGESTED READING

1. Mobile Communication 2nd edition by Jochen Schiller, Pearson education
2. Mobile Computing by Asoke Talukder, Roopa Yavagal (Tata McGraw Hill)

L	T	P	CA	MS	ES	Int	ES
3	0	2	10	20	40	15	15
CED09	**Advanced Networks**			**CEC08, CEC13**			

COURSE OUTCOMES

1. To acquire knowledge so as to become familiar with the state of the art in modern day computer networks: network architecture, protocols and systems.
2. To gain knowledge of various analytical methods used in the design and engineering of next-generation networks and use simulations to evaluate the

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performance of various design concepts.
3. To understand the current directions in design of computer networks from literature readings in order to perform high-quality research.
4. To learn about various threats and attacks on web application and adopt ethical practices in using and designing web base application

COURSE CONTENT

Networking review and challenges in modern day networks :Traffic
Engineering: Latest techniques of Congestion Control and Flow Control, Routing: Secure, Scalability, Reliability.
Disruption Tolerant networking: high packet loss, frequent interruptions, mobility, high latency, and unpredictable conditions.
Distributed Computing networks : (Grids), Data Center networking, Networking and Virtualization, Peer to Peer and Overlay networking, Opportunistic networks, Software-defined networking, Content based Network Architectures: Wireless Sensor networks, Internet of Things and other content based paradigms, Network Security.
Advanced topics based on recent research publications on future generation computer networks

Guidelines for project work:
There will be one semester wide study project exploring the latest advances in the area assigned to each student. Students will present their work at the end of course.

SUGGESTED READINGS

There is no required textbook. Required reading material for this course will come in the form of research papers.

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L	T	P	CA	MS	ES	Int	ES
3	1	0	30	20	40	-	-
CED10	**Logic Programming**			**CEC02, CEC15**			

COURSE OUTCOMES

1. To understand knowledge systems and problem solving
2. To acquire logic programming skills

COURSE CONTENT

Concepts: Logic and control, problem solving, knowledge representation
Prolog: Introduction, example programs in prolog, compiling prolog programs, prolog data structures, dataflow and recursion, list processing, graphs in prolog, negation, database clauses, assert and retract operations, advanced features.
Variants of logic programming such as: abductive, constraint, concurrent, inductive, higher order, linear, object oriented, transactional logic programming.

SUGGESTED READING

1. Ivan Bradco, "Prolog: Programming for Artificial Intelligence," Pearson.
2. Ulf Nilsson and Jan Maluszynski, Logic, Programming and Prolog

L	T	P	CA	MS	ES	Int	ES
3	0	2	10	20	40	15	15
CED11	**Internet and Web Technology**			**CEC08, CEC13**			

COURSE OUTCOMES

1. Acquire knowledge of web protocols and develop understanding of concepts of Internet security.
2. Able to implement studied technologies in systematically developing a website

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with due regard to ethical and environmental issues.
3. Understand the significance of emerging web technologies for the advancement of society.

COURSE CONTENT

Web Technologies: TCP/IP, HTTP, HTTPs, Telnet, FTP, WWW, URL, Email, Domain Name Service, Web Browsers, Search Engines-Architecture, Crawlers, Type of crawlers, search tools; Chat & Bulletin Board Services, SNMP, VPN, VoIP &Internet Telephony.

Security: Concept of Internet security, Firewall-Functioning, types of Firewall, IP Security- Architecture, Authentication header, Encapsulating security payloads, combining security associations. Sniffing, spoofing, viruses, worms, Trojan horses, and their security. Physical security, Biometric systems, Data security, systems, security, Computer System security, communication security.

Cyber Laws: Introduction, The rights the various parties have with respect to creating, modifying, distributing, storing and copying digital data- concurrent responsibilities and potential liabilities.

Web Design: Key issues in web site design, Use of Different HTML tags in web pages, Building HTML documents, Cascading Style Sheets-Internal, Inline and external style sheets, Java Script, Dynamic HTML with Java Script, XML technologies –XML, DTD, XSD, XSLT, XQuery, XPath.

Web programming, PHP, database connectivity with MySQL, security and identity.

Outline of Practical Work:

1. Exercise based on developing websites and portals using HTML, CSS, Java Script.
2. Exercise based on implementation of XML technologies.
3. Projects based on PHP and MySQL to be implemented.

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SUGGESTED READINGS

1. B. A. Forouzan, "Data Communications and Networking (3rd Ed.)", TMH
2. Allamaraju and Buest ,"Professional JAVA Server Programming", SPD Publication
3. Deitel and Deitel, "Internet and World Wide Web: How to Program", 4e, Pearson Education
4. Anders Moller, Schwartzbach, "An Introduction to XML and Web Technologies", Pearson Education.
5. Krishnamoorthy & S. Prabhu, "Internet & Java Programming", New Age Publication.
6. Deitel and Deitel, Nieto, Lin, Sadhu, "XML: How to Program", 4e, Pearson Education.

L	T	P	CA	MS	ES	CA	ES
3	0	2	10	20	40	15	15
CED12	Emerging Programming Paradigms			CEC07			

COURSE OUTCOMES :

1.To acquire knowledge of emerging paradigms like agile software development, design patterns and component based development.
2.To be able to apply the concepts for designing complex object oriented solutions in a collaborative environment
3. To imbibe the habit of continuous process of learning new and emerging technologies in the field of programming languages

COURSE CONTENTS

The contents of this course will be based on current state of art technologies like aspect oriented requirements engineering, design and architectural patterns software and collaborative agile software development.

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SUGGESTED READING

1. Eric gamma et al., design patterns, Addison Wesley, 1995
2. Gul Agha et al, research directions in Concurrent Object oriented Programming, MIT Press , 1993.

L	T	P	CA	MS	ES	CA	ES
3	0	2	10	20	40	15	15
CED13	**Wireless Technologies**			**CEC09, CEC13**			

COURSE OUTCOMES

1. Develop an understanding of the basics of wireless communication and how communication takes place in wireless networks.
2. Discuss about cellular communication.
3. Understand the nuances of GSM and CDMA technologies.
4. Understand the emerging wireless technologies.

COURSE CONTENT

Evolution Of Mobile Cellular Networks, Global System for Mobile Communications, GPRS, PCs, WLAN, UMTS, IMT2000, cdma2000 evolution, LTE
Origins of Ad Hoc: Packet Radio Networks: Challenges, Architecture, Component of Packet Radios, Routing in PRNETs, Route Calculation, Pacing Techniques, Media Access, Flow Acknowledgements
Ad-Hoc Wireless Networks: Mobile Devices, Wireless Sensor Networks, Traffic Profiles, Types of Ad Hoc Mobile Communications, Types of Mobile Host Movements.
Ad-Hoc Wireless Media Access Protocols: Introduction, Challenges in Channel access, Receiver Initiated MAC Protocols, Sender Initiated MAC Protocols, Protocols-MACA, MACA-BI, PAMAS, DBTMA, MARCH
Overview of Ad Hoc Routing Protocols: Table Driven approaches, DSDV,WRP,

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CSGR, Source Initiated on-demand approaches, AODV, DSR, TORA, SSR,LAR, PAR, ZRP, STAR, RDMAR

Ad Hoc Wireless Multicast Routing: Multicasting in Wired Networks, Multicast routing in Mobile Ad hoc Networks, Protocols- AODV multicast, CAMP, ODMRP, LBM, DVMRP, Comparisons of protocols

Performance of Ad hoc Networks: Introduction, Performance Parameters, Route Discovery Time, End to End Delay, Communication throughput, Packet loss, Route Repair time, Power Management

Security Issues:Security of wireless infrastructures, Security Principles, Depp packet Inspection

Emerging Trends

SUGGESTED READING

1. Wireless Networks by Clint Smith and Daniel Collins (2014)
2. Wireless Networking Absolute Beginner's Guide by Michael Miller (2013)
3. 802.11 Wireless Networks: The Definitive Guide , Second Edition by Matthew S. Gast (2005)
4. Designing and Deploying 802.11n Wireless Networks by Jim Geier (2010)
5. Wireless Communications & Networks (2nd Edition) by William Stallings (2004)

L	T	P	CA	MS	ES	CA	ES
3	0	2	10	20	40	15	15
CED14	**Advanced algorithms**			**CEC01, CEC02, CEC05**			

COURSE OUTCOMES

1. Candidate will be able to understand paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice with asymptotic notations.
2. Able to use different computational models (e.g., divide-and-conquer, greedy approach, dynamic programming, back tracking, branch and bound) with their complexity measures like running time, disk space for solving real life complex

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problems for lifelong learning.

3. Understand the difference between the lower and upper bounds of various problems and their importance in deciding the optimality of an algorithm and relating these analyses to real life problems.

4. Able to understand solvable / unsolvable problems the classes P, NP and NP-complete.

COURSE CONTENT

Advanced Solutions to Basic Data Structuring Problems: Fibonacci Heaps, Persistent data structures, Splay Trees, Van Emde Boas Priority Queues, Dynamic Data Structures for Graph Connectivity/Reachability

Bit Tricks: Word-level Parallelism, Transdichotomous Model, $O(n \log n)$ Integer Sorting ,String Algorithms: Rabin-Karp Fingerprinting Algorithm, Suffix Trees,

Maximum Flows: Augmenting Paths and Push-Relabel Methods, Minimum Cost Flows, Bipartite Matching

Linear Programming: Formulation of Problems as Linear Programs, Duality, Simplex, Interior Point, and Ellipsoid Algorithms

Online Algorithms: Ski Rental, River Search Problem, Paging, The k-Server Problem, List Ordering and Move-to-Front

Approximation Algorithms: One Way of Coping with NP-Hardness, Greedy Approximation Algorithms, Dynamic Programming and Weakly Polynomial-Time Algorithms, Linear Programming Relaxations, Randomized Rounding, Vertex Cover, Wiring, and TSP

Fixed-Parameter Algorithms: Another Way of Coping with NP-Hardness, Parameterized Complexity, Kernelization, Vertex Cover, Connections to Approximation

Parallel Algorithms: PRAM, Pointer Jumping and Parallel Prefix, Tree Contraction, Divide and Conquer, Randomized Symmetry Breaking, Maximal Independent Set,

External-Memory Algorithms: Accounting for the Cost of Accessing Data from Slow Memory, Sorting, B-trees, Buffer Trees, Cache-oblivious Algorithms for Matrix Multiplication and Binary Search

Computational Geometry: Convex Hull, Line-segment Intersection, Sweep Lines, Voronoi Diagrams, Range Trees, Seidel's Low-dimensional LP Algorithm Streaming Algorithms: Sketching, Distinct and Frequent Elements

Guidelines for Project Work:

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Implementation of the algorithms covered in theory

SUGGESTED READINGS
1.A.V. Aho, J.E. Hopcroft, and J.D. Ullman, "DataStructures and Algorithms," Addison Wesley, Reading Massachusetts, USA,
2.Donald Knuth, "The Art of Computer Programming: Fundamental Algorithms," Addison-Wesley .
3.Donald Knuth,"The Art of Computer Programming," Volume 3: Sorting and Searching, Third Edition. Addison-Wesley.
4.Thomas H. Cormen, Charles E. Leiserson, RonaldL. Rivest, and Clifford Stein, "Introduction to Algorithms,".
5.Sartaj Sahni,"DataStructures and Applications," Chapman and Hall/CRC Press.

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PART B							
SYLLABI OF DOMAIN SPECIFICELECTIVES WITH TUTORIAL							
LTP Allocation			**Evaluation Scheme**				
L	**T**	**P**	**CA**	**MS**	**ES**	**CA**	**ES**
3	**1**	**0**	**25**	**25**	**50**	**-**	**-**

Code	Name of Elective	Pre-Requisites
CED15	Fault Tolerant Computing	CEC 04, CEC08

COURSE OUTCOMES

1. To appreciate that fault tolerant design methods are needed tackle various hardware and software faults that affect realistic computing systems
2. To be able to design fault tolerant computing systems in a cost effective manner for different applications
3. To apply various quality metrics to evaluate fault tolerant systems such as reliability, availability and dependability.

COURSE CONTENT

Fundamental Concepts
Faults and errors, fault classification, fault assumptions, fault tolerant attributes and system structure.
Hardware Fault-Tolerant Design Techniques
Hardware redundancy, standby sparing, NMR and combined approaches, time redundancy.
Self-checking concepts, error-detecting codes for digital circuits such as Berger codes, two-rail codes, AN codes, m-out-of- codes.
Information redundancy, error detecting and correcting codes for data communication.
Dependability Evaluation Techniques: Reliability and availability models: - Combinatorial techniques, Fault-Tree models, Graceful degradability and Continuous Time Markov Chain models, Reliability importance metrics such as structural importance and Birnbaum importance, Performability Models.

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Architecture of Fault-Tolerant Computers (case study): General-purpose systems, high-availability systems, long-life systems, critical systems.

Software Fault Tolerance: Software faults and their manifestation, FT software design techniques and reliability models.

Fault Tolerant Parallel/Distributed Architectures: Multiprocessor fault tolerant scheduling, FT networks.

Recent topics in fault tolerant systems: Security, fault tolerance in wireless/mobile networks and Internet.

Current trends and future directions

Seminar and talks

SUGGESTED READINGS

1. D.K. Pradhan, "Fault-Tolerant Computer System Design,".
2. B.W.Johnson, "Design and Analysis of Fault-Tolerant Digital Systems," Addison-Wesley.
3. D.K. Pradhan, "Fault-Tolerant Computing, Theory and Techniques,"Prentice Hall.
4. D.P.Siewiorek and R.S.Swartz, "Reliable Computer Systems: Design and Evaluation," Digital Press.
5. K.S.Trivedi,"Probability and Statistics with Reliability, Queueing and Computer Science Application," Prentice Hall.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
Code	Name of Elective			Pre-Requisites			
CED16	Artificial Intelligence			CEC02, CEC05			

COURSE OUTCOMES

1. Distinguish between a conventional system and an intelligent system
2. Explain Artificial Intelligence concept and its applications
3. Represent knowledge using various different techniques

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4. Use the appropriate searching techniques in achieving desired goals
5. Apply Artificial Intelligent techniques in solving problems of a particular domain

COURSE CONTENTS

Foundational issues in intelligent systems
What is Artificial Intelligence? The AI problems, Underlying assumption, AI technique, Criteria for success,
Problems, Problem Spaces and Search Defining problem as a state space search, production systems, problem characteristics, production system characteristics Generate and test, hill climbing, Best first search, best first- A * algorithm, AO* algorithm problem reduction, constraint satisfaction, means and ends analysis
Game Playing: Overview, Mini-max search procedure, Alpha-beta cutoffs
Knowledge representation issues: Representations and mappings, approaches to knowledge representation, issues in knowledge representation
Using Predicate Logic: Representing simple facts in logic, representing instance and Isa relationships, computable functions and predicates, resolution,
Representing knowledge using rules: Procedural vs. declarative knowledge, logic programming, forward vs. backward reasoning
Nets and Frames
Reasoning under uncertainty and Machine Learning: Non-monotonic reasoning, Bayesian networks, Fuzzy logic, Dempster-Shafer theory
Planning: Overview, blocks world problem, components of planning system, goal stack planning
Fundamental concepts of Artificial Neural Networks: Models of ANNs; Feedforward & feedback networks; learning rules; Hebbian learning rule, perception learning rule, delta learning rule, Widrow-Hoff learning rule, correction learning rule, Winner –lake all learning rule, etc.
Introduction to Natural Language Programming
Overview of Expert System Technology: Rule based Expert Systems, Expert system shells
Current trends and Projects: Current trends in AI, Presentation and discussion of projects
AI programming Languages: Languages and Programming Techniques for AI-Introduction to PROLOG and LISP, Search strategies and Logic Programming in LISP, Production System examples in PROLOG.
Outline of practical work:

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There will be approximately several laboratory (programming) assignments during the semester.

The programming assignments are designed to provide students with hands-on experience with some of the AI topics covered in the course.Students are required to complete a research or design project in AI on a topic to be chosen in consultation with the faculty.

A written report on the project and a brief oral presentation summarizing the same is expected at the end of the semester.

Students may choose to work individually or in small groups (consisting of 2-3 members each) on the project.

An ideal project should be one that demonstrates some creativity, attempts to answer some interesting research question(s), or offers an interesting AI solution to a problem of practical interest.

SUGGESTED READING

1. S Russel and P Norvig, " Artificial Intelligence- A Modern Approach," Pearson Education.
2. E. Rich and K.Knight, "Artificial Intelligence," Tata McGraw Hill.
3. Simon Haykin, "Neural Networks :A Comprehensive formulation," AW.
4. Nils J Nilsson, "Artificial Intelligence a new Synthesis," Elsevier.
5. Ivan Bratko, "Prolog Programming for Artificial Intelligence," Addison Wesley.
6. George F Luger, "Artificial Intelligence- Structures and Strategies for Complex Problem Solving," Pearson Education.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-

CED17	Machine Learning	CEC02, CEC05

COURSE OUTCOMES

1. To develop an understanding of the fundamentals of machine learning and statistical pattern recognition.

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2. To gain an insight into the various components of machine learning such as supervised learning, unsupervised learning, learning theory,reinforcement learning and adaptive control.

3. To acquire skills that can be applied to various components of machine learning to applications like robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.

COURSE CONTENT

Introduction : Definition of learning systems. Goals and applications of machine learning.

Inductive Classification : The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm.Learning conjunctive concepts.

Decision Tree Learning : Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity. Occam's razor. Overfitting, noisy data, and pruning.

Ensemble Learning :Using committees of multiple hypotheses. Bagging, boosting, and DECORATE. Active learning with ensembles.

Experimental Evaluation of Learning Algorithms :Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.

Computational Learning Theory : Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity: quantifying the number of examples needed to PAC learn. Computational complexity of training. Sample complexity for finite hypothesis spaces. PAC results for learning conjunctions, kDNF, and kCNF. Sample complexity for infinite hypothesis spaces, Vapnik-Chervonenkis dimension.

Rule Learning: Propositional and First-Order : Translating decision trees into rules. Heuristic rule induction using separate and conquer and information gain.

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First-order Horn-clause induction (Inductive Logic Programming) and Foil.Learning recursive rules. Inverse resolution, Golem, and Progol.

Artificial Neural Networks :Chapter 4. Neurons and biological motivation. Linear threshold units. Perceptrons: representational limitation and gradient descent training. Multilayer networks and backpropagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks.

Support Vector Machines : Maximum margin linear separators. Quadractic programming solution to finding maximum margin separators. Kernels for learning non-linear functions.

Bayesian Learning : Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logisitic regression. Bayes nets and Markov nets for representing dependencies.

SUGGESTED READINGS

1. Richard Duda, Peter Hart and David Stork, "Pattern Classification," John Wiley & Sons.
2. Tom Mitchell, "Machine Learning." McGraw-Hill.
3. Richard Sutton and Andrew Barto, "Reinforcement Learning: An introduction," MIT Press.
4. Trevor Hastie, Robert Tibshirani and Jerome Friedman, "The Elements of Statistical Learning," Springer.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED18	Computer Vision			CEC02,CEC05, CEC12			

COURSE OUTCOMES

1. To develop an understanding of the fundamentals of image formation, camera imaging geometry, feature detection and matching, multiview geometry including

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stereo, motion estimation and tracking, and classification.
2. To gain an insight into the image formation and analysis, as well as the ability to extract information much above the pixel level.
3. To acquire skills that can be appliedwhile operating on images in a context-aware manner or where images from multiple scenarios need to be combined or organized in an appropriate way.

COURSE CONTENT

Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Miscellaneous: Applications: CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends - super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS.

Guidelines for project based work: Semester long projects, presentations,

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research work, term papers based on the above topics.

SUGGESTED READINGS

1. Richard Szeliski, "Computer Vision: Algorithms and Applications," Springer-Verlag London Limited.
2. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach,"Pearson Education.
3. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision," Cambridge University Press.
4. K. Fukunaga; "Introduction to Statistical Pattern Recognition," Second Edition, Academic Press, Morgan Kaufmann.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED19	Semantic Web			CEC02, CEC05			

COURSE OUTCOMES

1. Identify the component technologies of the Semantic Web and understand the concept of Linked Web.
2. Illustrate the design principles of the Ontology and Semantic for developing technologies
3. Understand certain limitations of the Semantic Web technologies, and be aware of the kinds of services it can and cannot deliver.

COURSE CONTENT

Overview and Introduction: Knowledge Representation, Ontologies and Description Logic, Semantic Web in Depth: RDF and RDF Schema, Semantic Web in Depth: OWL
Writing OWL ontologies: Protégé, Semantic Web Methodologies and Design

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Patterns, Semantic Web in Depth: SPARQL, Semantic Web in Depth: Rules
Publishing on the Semantic Web: Linked Data, Semantic Web Vocabularies and Applications, Semantic Web vs Web2.0, Trust and Community
Applications: Information Integration, Ontology Alignment, Scalable Reasoning and Knowledge Acquisition

SUGGESTED READING

 1. *A Semantic Web Primer, third edition*, MIT Press, 2012, Grigoris Antoniou, Paul Groth, Frank van Harmelen and Rinke Hoekstra
 2. Allemang, D., & Hendler, J. (2011). Semantic Web for the working Ontologist. 2nd Edition, Morgan &Kaufmann Publisher. [ISBN:978-0-12-385965-5]
 3. Heath, T., & Bizer, C. (2011). Linked Data: Evolving the Web into a Global Data Space. Morgan&Claypool Publisher. (Free copy :http://linkeddatabook.com/editions/1.0/http://linkeddatabook.com/editions/1.0/)

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED20	Advanced databases			CEC02, CEC06			

COURSE OUTCOMES

 1. To get acquainted with new models and optimization techniques in digital databases

 2. To conduct research in the domain of databases and acquire the habit of keeping abreast of latest developments

COURSE CONTENT

 Database system architecture: query processing and optimization, transaction processing concepts, concurrency control techniques, database recovery techniques, database security and authorization, enhanced data models for

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advanced applications,
Object relational databases: Object oriented databases, Non-SQL databases, Temporal databases, deductive databases, database technology for decision support systems,
Distributed and Web databases: data mining techniques
Advanced database:concepts, emerging technologies and applications.

SUGGESTED READING

1. Nabil R. Adam, Bharat K. Bhargava, "Advanced database systems, Lecture Notes in Computer Science,"
2. Jan L. Harrington, Morgan Kaufmann, "Object Oriented databases clearly explained,"
3. Carlo Zanialo, "Advanced database systems," Morgan Kauffmann.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-

| CED21 | Internet of Things | CEC13, CEC10 | |

COURSE OUTCOMES

1. To design full connected-product experiences by integrating Internet services and physical objects.
2. To analyze, design and develop prototypes of Internet-connected products using appropriate tools.
3. To identify, classify and describe different kinds of Internet-connected product concepts.
4. To analyze the challenges and applying adequate patterns for user-interaction with connected-objects.

COURSE CONTENT

Introduction to the internet of things: Origins. Early concepts and products. Examples of current products and value propositions. Architectures and design

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patterns. Analysis of a full connected-object experience. State of the Art, challenges and future directions.

Design principles for connected devices: Clam and ambient technology, privacy, loosely connected devices, graceful degradation.

Prototyping: Cost and ease of prototyping, changing embedded platform by moving into the cloud, open source, closed source and mixed source

Prototyping devices: sensors, actuator, platforms for IoT design: micro-controllers, systems on a chip, Ardiuno, Raspberry-pi, Electric Imp

Integrating internet services: XML and JSON. HTTP APIs for accessing popular Internet services (Facebook, Twitter, and others). Practical activities.

User experience and interaction design: The three levels of user engagement: aesthetics, functional and emotional. Good examples of user interaction design. Designing your own user experience. Practical activities.

Project development and competition. Development of a project including: value proposition, physical connected object prototyping, programming the behaviour, accessing Internet services and designing the user experience. Project competition.

SUGGESTED READINGS

1. Mike Kuniavsky, "Smart Things: Ubiquitous Computing User Experience Design," Morgan Kaufmann Publishers.
2. "Designing the Internet of Things,"
3. Adrian McEwen, Hakim Cassivalli, Wiley.
4. Massimo Banzi, "Getting Started with Arduino (Make: Projects),"O'Reilly Media.
5. Donald A. Norman, "Emotional Design: Why We Love (or Hate) Everyday Things. Basic Books,".
6. Tom Igoe, Dan O'Sullivan, "Physical Computing: Sensing and Controlling the Physical World with Computers," Premier Press.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED22	Software Quality			CEC11			

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COURSE OUTCOMES

1. Understand the quantitative aspect of software quality.
2. Learn and apply prevalent software quality tools and techniques for measuring quality in traditional manufacturing set up.
3. Apply these tools and techniques in the software scenario.
4. Understand and learn the various quality management tools in the different stages of Software Development life cycle

COURSE CONTENT

Introduction to Quality: The Quality Tradition: Origins of Quality Movement: Deming and Crosby's view of quality, Different Views of Quality: Transcendental, User, Manufacturing, Product, Value based, Total Quality Movement (TQM), Application of TQM to Software Engineering.
Why does software fail, Software quality: definition, how is software quality different? Static quality attributes, Dynamic quality attributes.
Software Quality Models: McCalls, Boehms, ISO9126, GQM, Gilb's template
Quality Management, Quality assurance Standards, ISO standards, CMM, CMMI, 3 Sigma, 6 Sigma Statistical Process Control (SPC).
Seven tools of quality control: Pareto Charts, Graphs, Check sheets, histograms, Scatter Plots, Cause and Effect Diagrams.
Business Process Redesign (BPR): Benefits of BPR in software development, TQM and BPR poised opposite to each other, Quality Function Deployment (QFD),
Application of Seven Management and Planning tools for Software Requirements Capturing*: Affinity diagrams, Interrelationship diagraphs, hierarchy diagrams,, Matrix diagram, Matrix data analysis, process decision program chart, arrow Diagram/Precedence Diagram, Computer Aided quality engineering (CAQE) and tools for quality management.
MetricsSoftware: Definition, Types of Software Metrics, Organisation, Project, Process, Product, Product Complexity metrics, Halsteads Software Science Metrics,
OO Metrics: Chidamber and Kemrer, OO metrics suite.

Guidelinenes for Practical Work:
Study and use of various available quality assurance tools in manufacturing and software scenarios

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SUGGESTED READING

1. Akao, Y. (1988), "Quality function deployment: Integrating Customer requirements into Product design," Productivity Press.
2. Crosby, P.,"Quality is free,"
3. Fenton N., "Software Metrics a Rigrous Approach," Wiley.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED23	Requirements Engineering			CEC11			

COURSE OUTCOMES

1. To appreciate the importance of Requirements Engineering in the Software development Life Cycle
2. To model the real life problem with the help of requirements engineering techniques.
3. To learn about representation of requirements through various requirements engineering techniques.

COURSE CONTENT

Introduction: Basics of Requirements engineering, Requirements management, Requirements and software life cycle.

Processes in Requirements Engineering: Framework for describing requirements engineering process.Conceptual foundation of elicitation, System Analysis techniques used for elicitation. Requirements specification, Requirements validation.

Modeling Principles and Techniques for Requirements Engineering: Requirements specification from the enterprise view. Representation of with functional and non-functional view of the requirements.

Tools: Concept –Method –Tool view of Requirements Engineering, Role of CASE in Requirements Engineering.

Emerging Trends

Guidelines for Practical work:

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Application of the requirements engineering techniques i.e. requirements elicitation and analysison a real life situation and prepare a formal requirements document

SUGGESTED READING

1. P. Loucopoulos and V. Karakostas,"System Requirements Engineering," McGraw-Hill.
2. K.Weigers, "Software Requirements,"Microsoft Press.
3. Ian Sommerville and P Sawyer, "Requirements engineering a good practice Guide," Wiley India.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-

CED24	Digital watermarking and Steganography	CEC02, CEC05

COURSE OUTCOMES

1. Acquire the knowledge of emerging digital watermarking and steganography techniques andtheir potential impact on society.
2. Understand the significance of digital watermarking in different applications.
3. Analyze the various issues related to security of user data.

COURSE CONTENT

Digital Watermarking: Introduction to Watermarking techniques. A Survey of Current Watermarking Techniques, Watermark detection and analysis, Application of cryptography in digital watermarking.
Classification of watermarking techniques: Robust and Fragile Watermarking. Techniques for protection of multimedia data and databases, Security Analysis of watermarking techniques.
Applications of digital watermarking: Copyright protection, Intellectual property issues, Digital Signatures, Authentication.
Steganography: History of Steganography, Principles of Steganography,

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Steganography in computer file systems, Steganalysis techniques, Application of cryptography in steganography, Steganography algorithms, Various applications of steganography.

Emerging trends: Advance steganography or watermarking techniques, Forensic watermarking and steganography.

SUGGESTED READINGS

1. Katzenbeisser and Petitcolas ,"Information Hiding: Techniques for steganography and digital watermarking," Artech House.
2. Johnson, Duric, and Jajodia, "Information Hiding – Steganography and Watermarking – Attacks and Countermeasures," Kluwer Academics publishers.
3. Cox, Miller, and Bloom, "Digital Watermarking," Academic Press.
4. Jeng-Shyang Pan, Hsiang-Cheh Huang, Lakhmi C. Jain, "Information Hiding and Applications," Springer.
5. Michael Konrad Arnold, Martin Schmucker, Stephen D. Wolthusen, "Techniques and applications of digital watermarking and content protection", Artech House.
6. Research papers on digital watermarking and steganography of refereed journals.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED25	Service Oriented Architectures			CEC13, CEC14			

COURSE OUTCOMES

1. Understandthe basic principles of service orientation and service oriented analysis techniques
2. Gain an insight in the technology underlying the service design and learn advanced concepts such as service composition, orchestration and choreography
3. Acquire skills to apply various components of service oriented architecture such as SOAP, Entity-centric business service design, application service design etc and their combination to implement the solutions.
4. Ability to plan , analyze and design enterprise software applications based on

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service – oriented architecture.

COURSE CONTENT

Introduction: Roots of SOA, Characteristics of SOA ,Comparing SOA to client-server and distributed internet architectures, Anatomy of SOA, How components in an SOA interrelate, Principles of service orientation

Web services: Service descriptions, Messaging with SOAP, Message exchange Patterns, Coordination ,Atomic Transactions, Business activities, Orchestration, Choreography, Service layer abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer

Service oriented analysis: Business-centric SOA, Deriving business services, service modeling, Service Oriented Design, WSDL basics, SOAP basics, SOA composition guidelines, Entity-centric business service design, Application service design, Task- centric business service design

SOA platform basics: SOA support in J2EE, Java API for XML-based web services (JAX-WS), Java architecture for XML binding (JAXB), Java API for XML Registries (JAXR) , Java API for XML based RPC (JAX-RPC).

WS-BPEL basics: WS-Coordination overview ,WS-Choreography, WS-Policy, WS-Security

Emerging trends

SUGGESTED READING

1. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design," Pearson Education.
2. Papazoglou, Mike , "Web Services & SOA: Principles and Technology ," Pearson – Prentice Hall.
3. Bell, Michael , "Service-Oriented Modeling (SOA): Service Analysis, Design, and Architecture," Wiley.
4. Erl, Thomas , "SOA Design Patterns," Prentice Hall .

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L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED26	Real Time Systems			CEC08,CEC14			

COURSE OUTCOMES

1. Understand the real time system requirements and design analysis.
2. Understand the architectures, operating systems and performance issues of real time systems.
3. Design a real time multi-tasking system or an embedded system controller.

COURSE CONTENT

Introduction: Real time systems models and classification, real time task characterization, performance measures and estimation techniques.

Real-time process management: Task Scheduling for uniprocessor systems-Rate monotonic, EDF, handling priorities with critical sections and interrupts, reward based scheduling for accuracy-driven tasks

Advanced task scheduling: Scheduling for multiprocessor systems, adaptive scheduling techniques, fault tolerant scheduling

Programming environment: RTOS, Programming languages, tools and techniques .

Real-time system design: Design techniques for reliability, fault tolerance and other application-specific quality considerations.

Real time communication: Communication media, network topologies, protocols.

Recent developments: Trends in real-time systems design and development

SUGGESTED READINGS

1. Phillip A. Laplante, "Real time systems design and analysis," Wiley India.
2. Jane, W.S. Liu, "Real Time Systems,"

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L	T	P	CA	MS	ES	CA	ES
1	0	25	25	50	-	-	

CED27	Ethical Hacking	CEC13. CEC14

COURSE OUTCOMES

1. Demonstrate systematic understanding of the concepts of security at the level of policy and strategy in a computer system.
2. Identify and analyze the stages an ethical hacker requires to take in order to compromise the target system.
3. Acquire knowledge of ethical laws and tests.

COURSE CONTENT

Introduction: Brief history of hacking, Nature of modern IT and its vulnerabilities, Hacking methodologies, Penetration Testing, Legal and Ethical Considerations, Creating and Implementing a Test Plan.

Strategy of Attack: Foot-printing and Social Engineering, Host Reconnaissance, Port Scanning, Enumeration of Services, Gaining Access to a System, Trojans, Viruses, Worms and Covert Channels, Sniffing and Evasion.

Attacking a System: Session Hijacking, Web Server Attacks, Database Attacks, Password Cracking, Network Devices & Attacks, Wireless Network Attacks, Trojans and Backdoor Applications, OS Specific Attacks, Buffer Overflows, Denial of Service Attacks, Smashing the stack, Maintaining access and roadblocks, Evading Intrusion Detection Systems, Firewalls and Honeypots, Social Engineering Attacks, Physical Penetration Attacks.

Report Generation of Attacks: Developing a penetration testing report Cryptography, Protecting Networks with Security Devices, Defending Against Social Engineering and Physical Penetrations Attacks

Emerging Trends.

Outline of Project Work: Students will be assigned a semester wise study project to explore the advancements in this area and present their work at the end of the course.

SUGGESTED READINGS

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1. Michael T. Simpson, Kent Backman, James E. Corley, "Hands-On Ethical Hacking and Network Defense," CENGAGE Learning.
2. Steven DeFino, Barry Kaufman, Nick Valenteen, "Official Certified Ethical Hacker Review Guide," CENGAGE Learning.
3. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy," Elsevier.
4. Whitaker & Newman, "Penetration Testing and Network Defense," Cisco Press.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED28		Digital Forensic		CEC02, CEC05, CEC13			

COURSE OUTCOMES

1. Understanding digital investigations that conform to accepted professional and ethical standards of conduct, including impartiality and the protection of personal privacy and are based on the standard investigative process: identification, preservation, examination, analysis and reporting.
2. Acquire the ability to identify and document potential security breaches of computer data that suggest violations of legal, ethical, moral, policy and/or social standards.
3. Ability to apply a solid foundational grounding in computer networks, operating systems, file systems, hardware and mobile devices to digital investigations and to the protection of computer network resources from unauthorized activity.
4. Acquiring skills to work collaboratively with clients, management and/or law enforcement to advance digital investigations or protect the security of digital resources.

COURSE CONTENT

Introduction: History of forensics, Types of investigations, The Forensic Process, Traditional Digital Forensic Process

Concepts of Computer Security: Security Incidents and Response, Real life examples of Computer Crime, Digital Forensics rules, Procedures, and Challenging

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aspects

Legal Issues: Stages of Investigative Process, Applying Forensic Science procedures to digital resources

File Systems: File Structures, Boot Processes and Systems logs of various popular operating systems (Windows, Linux, Macintosh), State-of-the art Computer Forensics Tools, Role of Image Files and Multimedia Files in digital forensics.

Network Forensics: Digital Evidence on Physical, Data-Link Layers, Network and Transport Layers, Internet Application Services; Live Acquisitions, Investigating Intrusions, Cell Phone and mobile device forensics, Virtual Machine and Cloud Forensics

Digital Evidence in the Courtroom: Admissibility, Authenticity and Reliability, Evidence classification, Evidence presentation.

Report Writing for High Tech Investigations: Forensics tools to generate reports, Expert Testimony in High Tech Investigations, Ethics for the Investigator and Expert Witness

Anti-forensics: Counter measures to impair forensics analysis

Emerging Trends: Current development in the field and research Challenges

Outline of Project Work: Students will be allotted a study project that will require them to explore the new dimensions in this area and present their work at the end of course.

SUGGESTED READINGS

1. Bill Nelson, Christopher Steuart, Amelia Phillips , "Guide to Computer Forensics and Investigations," Cengage.
2. John Sammons, "The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics," Syngress Media.
3. Eoghan Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet," Academic Press Inc.

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L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED29	CAD of VLSI			CEC02, CEC03, CEC05			

COURSE OUTCOMES

1. To understand the VLSI design flow and the automation tasks involved in this flow.
2. To implement algorithms for various steps of the process such as partitioning, placement, routing, floor planning etc.
3. To use hardware definition languages and CAD tool to design, simulate and test digital circuits and systems.

COURSE CONTENT

Overview of CMOS circuits and characteristics: CMOS Logic, The inverter, Combinational Logic, NAND gate, NOT Gate, Compound Gates, Multiplexers, Memory-Latches and Registers. Switching Characteristics - analytic delay models, empirical delay model, gate delay. Power Dissipation - Static dissipation, Dynamic dissipation, short-circuit dissipation, total power dissipation.
VLSI design process: VLSI design flow, Hardware Definition Languages – Verilog/VHDL: their use in modeling, synthesis, simulation and writing test benches.
Logic synthesis: Two-level and multilevel gate optimization, Partitioning, scheduling, allocation, technology mapping.
Physical Design: Placement, Routing, Floorplanning, clock routing.
Design Verification: Informal, semi-formal and formal verification, Languages for verification, Simulation for Functional testing, Timing verification and Delay estimation, power estimation.
Design for testability: Introduction, Automatic test generation,Built in self test (BIST), Boundary scan.
Emerging Trends: CAD for FPGA design and other topics

SUGGESTED READINGS

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1.	Neil H.E. Weste and Kamran Eshraghian, "Principles of CMOS VLS Design – A System Perspective ,".
2.	Addison Wesley Pub.
3.	S. Ramachandran, "Digital VLSI systems design," Springer.
4.	Wayne Wolf , "Modern VLSI Design: system on silicon," Addison Wesley Longman Publisher.
5.	J. Bhasker, "Verilog VHDL synthesis: a practical primer," B S Publications.
6.	S.M. Sait and H. Youssef, "VLSI physical design automation: theory and practice," World Scientific Pub. Co.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED30	Middleware Technologies			CEC13, CEC14			

COURSE OUTCOMES

1. Develop an understanding of the fundamentals of how to use middleware to Build distributed applications and implement various Business Processes using that.
2. Gain an insight into the middleware technologies and implement different Business models using these technologies.
3. Acquire skills to be applied to various components ofmiddleware technologies to Build Distributed applications, middleware,interoperability and Web services architectures.

COURSE CONTENT

Introduction: Moving to e-business, what is IT architecture? Why is this different from what we did before? Rewrite or evolve? , Who develops the architecture? Early days, Preliminaries, Remote procedure calls, Remote database access, Distributed transaction processing, Message queuing, Message queuing versus distributed transaction processing, what happened to all this technology?
Objects,Components and Web: Using object middleware, Transactional component middleware, COM, EJB, Final comments on TCM, Internet Applications. **Web services:** Service concepts, Web services, and Using Web services: A pragmatic

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approach.

Technical Summary of Middleware : Middleware elements, The communications link, The middleware protocol, The programmatic interface, Data presentation, Server control, Naming and directory services, Security, System management, Comments on Web services, Vendor architectures, Vendor platform architectures, Vendor distributed architectures, Using vendor architectures, Positioning, Strawman for user target architecture, Marketing, Implicit architectures, Middleware interoperability.

Using middleware to build business application: What is middleware for? Support for business processes, Information retrieval, Collaboration, Tiers, The presentation tier, The processing tier, The data tier, Services versus tiers, Architectural choices, Middleware bus architectures, Hub architectures, Web services architectures, Loosely coupled versus tightly coupled.

Security: What security is needed, Traditional distributed system security, Web services security, Architecture and security

Application design and Architecture: Problems with today's design approaches, Design up front or as needed?, The role of business rules, Existing systems, Reuse, Silo and monolithic development, The role of architecture, Levels of design, Reconciling design approaches.

Implementing business processes: What is a process? Business processes, Information and processes, Architecture process patterns, Clarification and analysis, Error Handling, Timing, Migration, Flexibility

Emerging Trends

Guidelines for project based work: Semester long projects/presentations/ research work/ term papers based on the above topics.

SUGGESTED READINGS

1. Chris Britton and Peter Eye, "IT Architectures and Middleware: Strategies for Building Large, Integrated Systems," Pearson Education.
2. Qusay H. Mahmoud, "Middleware for Communications," John Wiley and Sons.
3. Michah Lerner, "Middleware Networks: Concept, Design and Deployment of Internet Infrastructure,"Kluwer Academic Publishers.

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L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED31	Multimedia Applications			CEC12			

COURSE OUTCOME

1. Understanding range of concepts, techniques and tools for creating and editing interactive multimedia applications.
2. Identify both theoretical and practical aspects in designing multimedia systems.
3. Gain ability to develop multimedia applications using contemporary hardware and software technologies.

COURSE CONTENT

Fundamentals of multimedia: media and data streams, sound/audio, image, graphics, video and animation.

Data compression: coding requirements, source, entropy, and hybrid coding, JPEG, H.261, MPEG, MP3 and etc.

Multimedia communication architecture: multimedia workstations, cache systems, storage systems and optical storage.

Multimedia operating system: real-time operation, resource management, process management, file systems and Multimedia networking.

Multimedia synchronization: presentation requirements, reference model and synchronization techniques.

Multimedia database: data organization, management, indexing, storage and retrieval.

Multimedia applications: digital libraries, system software, toolkits, conferencing paradigms, structured interaction support, and examples from video/audio/graphics conferencing.

Emerging Trends in Web technologies

Guidelines for project based work: Semester long projects/presentations/ research work/ term papers based on the above topics.

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SUGGESTED READINGS

1. Li , Ze - Nian, "Fundamentals of Multimedia," PHI.
2. Ramesh Yerraballi, "Multimedia Systems Concepts Standards and Practice,"PHI.
3. "Multimedia Communications: Applications, networks, protocols and standards," Pearson.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED32	Human Computer Interfacing			CEC03, CEC12			

COURSE OUTCOMES

1. To be able to understand the importance of designing interactive products that are usable.
2. To be able to communicate effectively about requirements, design, and evaluation activities relating to interactive products.
3. Evaluate an interactive product using suitable techniques.

COURSE CONTENT

Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.
The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.
Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.
Screen Designing : Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow –

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Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls.

Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

Software tools – Specification methods, interface – Building Tools.

Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers.

Emerging Trends in HCI.

Guidelines for project based work: Semester long projects/presentations/ research work/ term papers based on the above topics.

SUGGESTED READINGS

1. Galitz, "The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques," Wiley.
2. Dix, A. Finlay, J., Abowd, G. and Beale, "Human-Computer Interaction," Prentice Hall.
3. Preece, J., Sharp, H. and Rogers, "Interaction Design: Beyond Human-Computer Interaction," Wiley.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED33	Emerging Applications of Computing			CEC02,CEC05			

COURSE OUTCOMES

1. Appreciate and apply state of the arttechnologies in different fields of computing.
2. Continue to learn new approaches, tools and applications in the field of computing.

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COURSE CONTENT

The content of the course will be taken up based currently emerging technologies, developments, advances and innovations in different fields of computing.

SUGGESTED READING

Will be decided according to students' interests and field of expertise of the faculty.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED34		Cryptography		CEC01			

COURSE OUTCOMES

1. To learn the mathematics, logic and science underlying the principles of cryptography.
2. To implement the cryptographic algorithms and use them in developing applications.

COURSE CONTENT

Classical ciphers: Cryptanalysis of classical ciphers, Probability theory, Perfect security

Block ciphers: DES, AES, Block cipher modes of operation

Private-key encryption: Chosen plaintext attacks,, Randomised encryption Pseudo randomness, Chosen cyphertext attacks

Message authentication codes : Private-key authentication, CBC-MAC, Pseudorandom functions, CCA-secure private-key encryption

Hash functions: Integrity ,Pre-image resistance,2nd pre-image resistance, Collision freeness, SHA-256,NMAC/HMAC

Key distribution : Key distribution centres,Modular arithmetic and group theory Diffie-Hellman key exchange

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Public-key Distribution: EIGamal encryption, Cramer-Shoup encryption, Discrete logarithm problem

Digital Signatures: RSA signatures, RSA-FDH and RSA-PSS signatures, DSA signatures, X.509 certificates , Certification paths.

Emerging Trends in Cryptography.

Guidelines for project based work: Semester long projects/presentations/research work/ term papers based on the above topics.

SUGGESTED READINGS

1. Christof Paar, Jan Pelzl, "Understanding Crytography," Springer.
2. Niel Ferguson, "Cryptography Engineering- Design principles and practical application," Wiley.
3. William Stallings, "Cryptography and network security – principles and practice ," Pearson.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED35	Information Theory and coding			CEC01			

COURSE OUTCOMES

1. To learn about the basic principles of information theory
2. To acquire the skills to apply various coding techniques in information theory

COURSE CONTENT

Basic Concepts: Uncertainty and Information, Shannon Entropy, Joint and conditional Entropies, Mutual Information, Uniquely decipherable and Instantaneous codes, Noiseless coding problem. Source coding Theorem, Block coding, construction of Optimal codes, Huffman's & Shannon Fano coding methods.

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Channel capacity: Discrete memoryless channel, channel capacity, BSC and other channels, Information measure for continuous ensembles capacity of AWGN channel.

Error control coding: The channel coding Theorem, Application to BSC , Source Coding with fidelity criteria, Types of codes, error and error control strategies, Linear block codes, syndrome and error detection, Minimum distance, Error detecting and correcting capabilities of a block code, Syndrome decoding , Hamming codes, Cyclic codes, Generator and parity – check matrices, encoding, syndrome computation and error detection and decoding, BCH codes, decoding of the BCH codes, Introduction to RS codes. Convolution codes, Maximum likelihood, Viterbi algorithm, Introduction to Turbo codes.

Guidelines for practical work: Seminars/ Talks/presentations/ research work/ term papers based on the above topics.

SUGGESTED READINGS:

1. R Ash, "Information Theory," Dover Science Publications.
2. Cover and Thomas,"Element of Information Theory," John Wiley & Sons.
3. Shulin& Daniel J. Costello Jr, "Error Control coding: Fundamental & Application,"Prentice Hall. Simon Haykin,"IncCommunication Systems," Wiley Student Edition

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED36	Rough Set Theory			CEC01			

COURSE OUTCOME

1. To understand the need for approximate analysis and computation methods in the context of real-life sophisticated applications
2. To use the tenets of rough set theory in developing applications.

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COURSE CONTENT

Basic Concepts: Information systems and Decision Systems, Lower and Upper approximations, Reducts, accuracy of approximation, positive region, classification rules, motivation for rough set analysis

Properties of Rough Sets

Techniques for Rough set analysis: Steps for rough set analysis,Boolean reasoning for finding discernability and reucts, MD heuristic, types of reducts (generalized, approximate, dynamic, ensemble), and approaches for finding reducts (genetic algorithms, hybrid approaches). Rules: support, confidence, strength. Classification accuracy, precision, recall.

Rough Membership : Lower and upper approximation under rough membership

Rough mereology.

Discretization and feature selection: Decision relative discretization, cuts parallel to axes of feature space, Hyperplanes, award and penalty functions

Tolerance sets: Tolerance relations and sets, functional representation of T-norms, Co-norms, Negations , Lower and upper approximations under tolerance sets, Credibility of rules

Applications of Rough Set Theory.

Emerging trends: Fuzzy rough sets and current topics.

Guidelines for project work: Project/ Seminars/ Talks/presentations/ research work/ term papers based on the above topics.

SUGGESTED READING

1.Jan Komorowski et al, "Rough Set Tutorial,"http://eecs.ceas.uc.edu/~mazlack/dbm.w2011/Komorowski.RoughSets.tutor.pdf
2. Polowski Lech, "Rough Set- Mathematical; foundation," Springer.

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L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED37	Cloud Computing			CEC13, CEC14			

COURSE OUTCOMES

1. Understand the concept of cloud computing, its quality issues, services, applications, benefits and limitations.
2. Understand the underlying technologies that drive a cloud computing environment.
3. To keep abreast of the trends in cloud technology and available cloud environments such as GoogleApps, Microsoft Azure and Amazon Web Services.

COURSE CONTENT

Introduction: Concept of a cloud, Purpose, characteristics, challenges and developments in cloud computing, Virtualization, On-demand Cloud Computing, Current cloud Technologies and Environments, Benefits and limitations.

Virtualization: Characteristics of virtualization, Types of virtualization, Hypervisors and some case studies.

Cloud architectures: Software as a Service, Platform as a Service, Infrastructure as a Service, Storage as a Service, Applications as a Service, other services

Types of cloud architectures: Public, Private, Hybrid, Design issues with cloud: scalability, fault tolerance, security, trust, privacy.

Data in the cloud: GFS,HDFS, Big Tables.

Concurrent Computing: Thread programming, MPI programming, Parallel Computing with Map Reduce and extensions.

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Case studies and emerging trends: Related toissues in migration to cloud, Cloud computing economics etc.

SUGGESTED READINGS

1. K. Chandrasekaran, "Essentials of Cloud Computing,"
2. T. Velte, A. Velte and R. Estenpeter, "Cloud Computing – A practical approach,"
3. U.S. Pandey, Kavita Choudhary, "Cloud Computing,"
4. S. Chand, R. Buyya, C. Vecchiola, S.T. Selvi, "Mastering Cloud Computing,"

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-
CED38	Soft Computing			CEC02,CEC05			

COURSE OUTCOMES

1. Understand the complexity of current information systems due their inherent uncertainty and imprecision.
2. Ability to use methodologies that can exploit the tolerance for imprecision to develop robust and cheap solutions for intelligent systems.
3. Develop skills to apply various components of soft computing such as fuzzy logic, evolutionary computing, probabilistic computing etc and their combination to implement the solutions.

COURSE CONTENT

Foundations of soft computing: Computational issues in intelligent information systems.
Approximation theories: Overview of Fuzzy set theory, Rough Set theory, granular computing, Mixed approaches.
Neural networks: learning process, single layer perceptrons, back propagation algorithm, support vector machines
Evolutionary Algorithms: Overview and theory of genetic algorithms, genetic operations, selection methods, tackling multi-objective functions, extensions
Swarm optimization: Techniques based on nature-driven optimization such as ant

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colony, bird flocking, fish schooling, bat algorithm, cuckoo search etc.

Case Studies and Emerging trends: In the direction/area of cooperative agents, adaptive systems applications etc.

Guidelines for project work: Project/ Seminars/ Talks/presentations/ research work/ term papers based on the above topics.

SUGGESTED READINGS

1. N.K. Sinha and M.M. Gupta, "Soft computing and Intelligent systems," Elsevier
2. Eva Volna, "Introduction to soft computing," Free e-book.
3. Andrea G. B. Tettamanzi, Marco Tomassini, "Soft Computing: IntegratingEvolutionary, Neural and Fuzzy Systems,"

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-

CED39	Distributed Computing	CEC13, CEC14

COURSE OUTCOMES

1. Understand the concepts of distributed computing systems along with design and implementation issues.
2. Acquire skills to analyze design and implement distributed algorithms

COURSE CONTENT

Distributed computing systems (DCS): Introduction, DCS design goals: Transparencies, Fundamental issues
Distributed Coordination: Temporal ordering of events, Lamport's logical clocks, Vector clocks; Ordering of messages, Physical clocks, Global state detection
Process synchronization: Distributed mutual exclusion algorithms, Performance matrix, Inter-process communication
Deadlocks, Load scheduling and balancing techniques: Deadlock in distributed

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systems, Round robin load balancing, client side load balancing, server side load balancing, applications (such as routers)
Distributed System Models: System Architectures & Client-Server Models
Distributed Algorithms and Programming Systems: Search Engines, Page ranking, leader election, Hashing, Caching, Remote Procedure Call.
Discussion on distributed computing platforms such as CORBA/ DCOM/ Java RMI/ Hadoop Map-Reduce,
Workflow Systems: Grid Computing , Cloud Computing , Virtualization , IaaS Clouds , Filesystems, Networked Filesystems, Parallel Filesystems
Distributed Filesystems: Data-Intensive Computing , Distributed Hash Tables , Consistency Models , Fault Tolerance , Many-core Computing

Emerging Trends in Distributed Computing.

Guidelines for practical/project work:

Programming using Remote Procedure Calls (RPC) mechanisms using Java RMI/CORBA/DCOM, Map Reduce Programming with Hadoop / SparkProgramming with message passing for implementing distributed algorithms.

Project work to build a cluster

SUGGESTED READINGS

1. G. Coulouris, J. Dollimore, "Distributed Systems Concepts and Design," Addison Wesley.
2. Hwang & Dongarra & Fox,"Distributed and Cloud Computing, From Parallel Processing to the Internet of Things,"
3. M. Singhal, N.G. Shivarathri , "Advanced Operating Systems,", McGraw Hill.
4. Randy Chow, T. Johnson, "Distributed Operating Systems and Algorithms," Addison Wesley.
5. A.S. Tanenbaum,"Distributed Operating Systems," Prentice Hall.
6. M. Tamer Ozsu, PatrickValduriez, "Principles of Distributed Database Systems," Prentice Hall International

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L	T	P			CA		MS	ES	CA	ES
3	**1**	**0**	**25**	**25**	**50**	-	-			

CED40	Design and Architectural Patterns		CEC07	

COURSE OUTCOMES

1. To appreciate the benefits of design and architectural patterns in object oriented software development
2. To learn the use of various design patterns and architectural patterns

COURSE CONTENT

Introduction: Patterns andMotivation for using patterns

Design patterns: Façade, adaptor, strategy, bridge, decorator, publisher-subscriber, factory method, factory, template, singleton, object pool and their implementation in Object Oriented languages such as C#/Java.

Architectural patterns: Architectural patterns used in various applications such as interactive applications (Model View Controller MVC and Presentation-Abstraction-Control PAC) ,distributed architectures (Broker, pipes and filters), Adaptable systems (Reflection), Communication (Proxy) and other architectural patterns.

Guidelines for project work: Project/ Seminars/ Talks/presentations/ research work/ term papers based on the above topics.

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SUGGESTED READINGS

1. Frank Buschmann *et al, "*Pattern oriented software architecture," Wiley India.
2. ErichGamma, RichardHelm, RalphJohnson,and JohnVlissides, "Design Patterns: Elements of Reusable Object-Oriented, Software"   Addison Wesley
3. "Software architectural patterns," OReilley media
4. "Architectural Patterns – the Open Book,"
   http://pubs.opengroup.org/architecture/togaf8-doc/arch/chap28.html.

L	T	P	CA	MS	ES	CA	ES
3	1	0	25	25	50	-	-

| CED41 | Rule based computing | | CEC15 | | | | |

COURSE OUTCOMES

1. Understand the basic knowledge representation, problem solving, and learning methods.
2. Develop intelligent systems by assembling solutions to concrete computational problems.
3. Understand the role of knowledge representation, problem solving, and rule based learning in intelligent-system engineering.

COURSE CONTENT

Overview: Rule based Reasoning**,** Production systems, Rule-based Systems, Review of propositional and first order logic, Skolemisation, unification and its algorithms, Goals and sub-goals, forward and backward chaining.

Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents, How the components of agent programs work.

Solving Problems: Solving problems by Searching, Problem-Solving Agents,

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Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies.

Adversarial Search and Constraint Satisfaction Problems, Study of minimax algorithm

Building a knowledge base: Logical agents and Classical Planning, Study and comparison of knowledge representation structures, Knowledge Representation and Inference, Natural Language

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, Representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees

Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, Inducing decision trees from examples

Emerging trendsand Future Directions:in Rule based Computing.

Guidelines for project work: Project/ Seminars/ Talks/presentations/ research work/ term papers based on the above topics.

SUGGESTED READINGS

1. Russell, Stuart J., and Peter Norvig,"*Artificial intelligence: a modern approach*," Prentice Hall.
2. Patrick Henry Winston , "Artificial intelligence," Addition Wesley.
3. Elain Rich and Kevin Knight, "Artificial Intelligence," TMH.

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SYLLABI 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,

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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:
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)**

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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
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

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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.

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

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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

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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 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**	**2L-0T-0P**	**None**

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Sciences		

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,

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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.
3. To create awareness among the students regarding environmental degradation and the importance of development and sustainable Development.

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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):			

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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.
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-

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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
 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:

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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.
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	1L-0T-2P	None

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Development		

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	1L-0T-2P	None

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	Communication and 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):			

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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.

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

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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
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,

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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 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			

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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 (Thāt), ĀshrayRāga, Rāga, Lakshana, Shruti, Alankar, Gamak, Vadi-SamvādiAnuvādi-Vivādi, 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 Rāgas&TālaRāga- Yaman, Jaunpuri, Khamaj. Tāla- Ektāl, Jhaptāl
Unit 4 :Genaral discussion and definition of the following:-
a. Khyāl, MaseetKhani – Razakhani gat, Dhrupad, Tarana, Meend, Soot, Murki, Kan, Khatka, Krintan, Harmony, Melody.
b. Writing of Bhatkhande Swarlipi Paddhati.
c. Writing of Tālasand Compositions in Notation.
d. Detailed study of Rāgas (Rāga- Bihag, Malkauns, Vrindavani Sarang) and comparative study of Rāgas.
e. Essay, Shastriya Sangeet (Classical Music) & SugamSangeet(Light Music)
Unit 5 : Vedic Music – Samvedic Sangeet, Swara, Vadya, Bhakti, Vikār .
General study of Natyashastra, SangeetRatnakar.

SUGGESTED READINGS:
1. Vasant and Laxmi Narayan Garg,`` Sangeet Visharad,'' Sangeet Karyalay
2. Sarat Chandra Pranjpayee and Chowbhamda ,`` BhartiyaSangeetkaItihas,''

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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,"

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:			

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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):
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.

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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:

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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 systems. The idea of Swaraj. Various social initiatives by

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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.

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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
   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.

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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.
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.

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26 . ParamhansaYogananda, " Autobiography of a Yogi," Rider publication.

27. Sahasrabudhe, "Gandhi and Question of Science,"Other India Press.

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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

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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 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

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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 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

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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.

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).

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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

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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

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,

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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; 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

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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.
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

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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:

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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, 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,

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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, 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

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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:

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-	3L-1T-0P	None

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	Planning and Logistics		

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

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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.

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

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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 and Managerial Economics	3L-1T-0P	None

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

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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:

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

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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.

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

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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

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Human Physiology," Society for Industrial and Applied Mathematics

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

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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.
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.

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Course No.	Title of the Course	Course Structure	Pre-Requisite
EO020	Mathematics IV, 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:
1. Curtis F. Gerald and Patrick G. Wheatley, ``Applied Numerical Analysis,'' Pearson, Education Ltd.
2. E. Balagurusamy, ``Numerical Method,'' Tata McGraw Hill

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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	Mathematics V, 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.

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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	Mathematics VI, Abstract and Linear Algebra	3L-1T-0P	None

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	Mathematics VII,	3L-1T-0P	None

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	Optimization Techniques		

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

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO024	Mathematics-VIII, 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:

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1. Online Manuals of the related Software.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO025	Mathematics IX, 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 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

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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

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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

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

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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):

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

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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 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

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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, 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

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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.

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3. A. K. Sharma, ``Semiconductor Electronics," New Age International (P) Limited Publisher.	

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

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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

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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
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

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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

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related fields and finally equips students to take up R&D and higher studies.

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

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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

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

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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.
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; $\lambda/4$ 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.

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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 techniques in Physics**	3L-0T-2P	None

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:

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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

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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:

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.

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