UNIVERSITY OF DELHI

NETAJI SUBHAS INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM

SCHEME OF COURSES

FOR

B.E. (INSTRUMENTATION AND CONTROL ENGINEERING)

Passed in the meeting of Academic Council, University of Delhi, held on July 19, 2016

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

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SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

PREAMBLE

I. INTRODUCTION

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

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

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

II. CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions have been moving from the conventional annual system to semester system. Currently many of the institutions have already introduced the Choice Based Credit System. The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The Choice Based Credit System provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses to acquire more than the required credits and adopt an interdisciplinary approach to learning.

A. Programme Education Objectives (PEO)

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

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

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

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

B. Types of Courses

Courses are the subjects that comprise the Instrumentation and Control Engineering programme.

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

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

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

   i. **Core Course (CC)**: This is a course which is to be compulsorily studied by a student as a core requirement to complete the requirement of B.E. 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):** The students can take any course offered by any department of the institute under category of core course (CC) and Discipline Centric Elective (ED).

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

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

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

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

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

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

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

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

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 below:

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. However, a student must get Satisfactory to get the degree.
4. **Fairness in assessment:** The CBCS promotes continuous evaluation system where the weightage of end semester examinations should not be more than 60%. The departments shall design its own methods for continuous evaluation. It shall have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching-learning methods. In this regard, checks and balances will be implemented to ensure fair and effective assessment and examination process.
5. **Computation of SGPA and CGPA:** The following procedure shall be used to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

   i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

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

   Where C_i is the number of credits of the i^{th} course and G_I is the grade point scored by the student in the i^{th} course.

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

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

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

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

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

III. PROGRAMME STRUCTURE

1. The B.E. Instrumentation & Control 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. Instrumentation and Control 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 schemes and a maximum of 28 credits. Normally a student registers for courses leading to 22 credits.

8. B.E. Instrumentation & Control 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. Programme Codes:

The codes for various undergraduate programmes are as follows:

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

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. ICCyy: Core Course
ii. ICDyy: Discipline-centric Elective Course

3. Common Course Codes:

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

iii. FCyyy: Foundation Compulsory Course

iv. FEyyy: Foundation Elective Course

v. EOyyy: Open Elective Course

4. Generic Electives:

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

Table 2: Evaluation scheme

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

VI. EVALUATION AND REVIEW COMMITTEE

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

The ERC has the following functions-

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

(ii) To prepare quizzes, assignments, test papers etc. for Continuous Assessment (CA), Mid-Semester examination (MS) and End Semester (ES) examination and to evaluate them. Normally, each concerned faculty member, who is also a member of ERC, will do this job for his/her class. However, in exceptional circumstances any part of the work may be entrusted to some other member of the ERC.

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

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

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

(vi) To lay guidelines for teaching a course.

VII. ATTENDANCE, PROMOTION AND DETENTION RULES

1. A student should normally attend all the classes. However, a student will be allowed to appear in the examination if he/ she has put in a minimum of 75% attendance separately in each course for which he / she has registered. A relaxation up to a maximum of 25% may be given on the production of satisfactory evidence that (a) the student was busy in authorized activities, (b) the student was ill.
2. A student should submit the evidence to the fact 1(a) and / or 1(b) above within seven working days of resuming the studies. Certificates submitted later will not be considered.
3. No relaxation in attendance beyond 25% is permitted in any case.

4. A student with satisfactory attendance will be promoted to the even semester irrespective of his/ her results in the odd semester examinations.
5. If a student fails to secure a minimum of 22 credits after the completion of second semester, he/ she will not be allowed to register in the third semester till he / she secures a minimum of 22 credits.
6. If a student fails to secure a minimum of 44 credits after the completion of fourth semester, he / she will not be allowed to register in the fifth semester till he / she secures a minimum of 44 credits.
7. There shall be no supplementary examinations. A student who has failed in a course will have to re-register for the course in a subsequent year.
8. If a student fails in any core course during the first four semesters (without repeating a year), he/she will have to re-register for such courses after the fourth semester.
9. If the student does not want to reappear in an **elective course** (that is, EG, ED, EO, FE *but not* CC or FC courses) then he/she can re-register afresh for a new elective course.
10. After second year a student may register for courses leading to a minimum credits as prescribed in the scheme and a maximum of 28 credits. Normally a student registers for courses leading to 22 credits.

VIII. DECLARATION OF RESULTS

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

IX. CURRICULUM MODIFICATION

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

X. CENTRAL ADVISORY COMMITTEE

There shall be a Central Advisory Committee consisting of the following—

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

This Committee shall have the following functions-

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

PROGRAMME OUTCOMES:

At the completion of the programme the students will achieved the following:

PO1: The graduates should be proficient in fundamentals of Electrical Engineering, Instrumentation and measurement and are able to:

(a) Apply the fundamentals to design and create algorithms for the scientific problems.

(b) Should be able to correlate the problems of modeling and simulation for control and analysis purpose.

PO2: The graduates should be competent to interface and have the knowledge of sensors and transducers used for different variables (physical or non physical).

PO3: The graduates should be competent to interface Instrumentation and control components for control and analysis purpose.

PO4: The graduates should be competent, have the knowledge of Biomedical Engineering and should be able to address the problems of human diseases by creating the low cost devices.

PO5: The graduates should be self sufficient and should be able to have the knowledge of Electrical Engineering so that they are able to address the problems of Power quality, Electrical machines, Power electronics and Electric Drives for the benefit of the society.

PO6: The graduates should be self sufficient to design the artificial intelligence based models for various problems based on society and Industry.

SCHEME-SEMESTER-WISE COURSE ALLOCATION

B.E. INSTRUMENTATION AND CONTROL ENGINEERING-SEMESTER I												
Course Code	Type	Courses	L	T	P	Credits	Evaluation Scheme (Percentage weights)					Pre-requisites
							Theory			Practical		
							CA	MS	ES	CA	ES	
FC001	FC	Mathematics-I	3	1	0	4	25	25	50	-	-	None
FC002	FC	Computer Programming	3	0	2	4	15	15	40	15	15	None
FC003	FC	Electrical and Electronics Engineering	3	0	2	4	15	15	40	15	15	None

FC004	FC	Physics	3	0	2	4	15	15	40	15	15	None
FC005	FC	English –I	2	0	0	2	25	25	50	-	-	None
FEXXX 1*	FE	Foundation Elective	-	-	-	2	-	-	-	-	-	-
			23/25 2*			**20**						

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

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

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

B.E. - INSTRUMENTATION AND CONTROL ENGINEERING- SEMESTER II												
Course Code	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
FC006	FC	Mathematics -I I	3	1	0	4	25	25	50	-	-	None
FC007	FC	English - II	2	0	0	2	25	25	50	-	-	None
ICC01	CC	Physics of Materials	3	0	2	4	15	15	40	15	15	None
ICC02	CC	Applied Mechanics	3	1	0	4	25	25	50	--	--	None
ICC03	CC	Signals and Systems	3	1	0	4	25	25	50	--	--	None
ICC04	CC	Power Apparatus	3	0	2	4	15	15	40	15	15	None
FEXXX 1*	FE	Elective Foundation	-	-	-	2	-	-	-	-	-	-
			26/28 2*			**24**						

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

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

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

B.E. INSTRUMENTATION AND CONTROL ENGINEERING- AUDIT COURSES DURING SUMMER COURSES AFTER SEMESTER II					Evaluation Scheme	
Course Code	**Type**	**Subject**	**LTP**	**Credits**	**Theory CA-MS**	**Practical CA-ES**
ACxxx	**Audit Course (AC)**	Audit Courses can be floated during summer break after 2nd semesters on: (I) Courses for improvement: These will not be shown on the degree. (II) Courses on new themes: These will be shown on the degree.	-	NIL	The evaluation scheme and minimum grades for getting "Satisfactory" level, will be decided by the Department. Student has to achieve the minimum grades prescribed for getting "Satisfactory" level.	

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

B.E. INSTRUMENTATION AND CONTROL ENGINEERING-SEMESTER III												
Course No.	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ICC05	CC	Electronic Instrumentation	3	0	2	4	15	15	40	15	15	None
ICC06	CC	Electronics	3	0	2	4	15	15	40	15	15	None
ICC07	CC	Engineering Graphics	2	0	4	4	--	--	--	40	60	None
ICC08	CC	Data Structures	3	1	0	4	25	25	50	-	-	None
ICC09	CC	Chemistry	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).

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

B.E. INSTRUMENTATION AND CONTROL ENGINEERING -SEMESTER IV												
Course No.	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ICC10	CC	Mathematics-III	3	1	0	4	25	25	50	--	--	None
ICC11	CC	Control System-I	3	0	2	4	15	15	40	15	15	None
ICC12	CC	Transducer & measurement	3	1	0	4	25	25	50	-	-	None
ICC13	CC	Industrial Electronics	3	0	2	4	15	15	40	15	15	None
ICC14	CC	Digital Circuits and Systems	3	1	0	4	25	25	50	-	-	None
FExxx 1*	FE	Elective Foundation	-	-	-	2	-	-	-	-	-	-
			24/26 2*			**22**						

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

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

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

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

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

B.E. INSTRUMENTATION AND CONTROL ENGINEERING -SEMESTER V													
Course No.	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ICC15	CC	Microprocessor and Microcontroller	3	0	2	4	15	15	40	15	15	None
ICC16	CC	Process Dynamics and Control	3	0	2	4	15	15	40	15	15	None
ICC17	CC	Analog and Digital Communication	3	0	2	4	15	15	40	15	15	None
ICC18	CC	Control System-II	3	0	2	4	15	15	40	15	15	None
ICD 1*	EO/G/D	Elective(s)	-	-	-	---	-	-	-	-	-	-
			------- **2***			**16-28 3***						

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

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

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

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

B.E. INSTRUMENTATION AND CONTROL ENGINEERING-SEMESTER VI													
Course No.	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ICC19	CC	Industrial Instrumentation	3	0	2	4	15	15	40	15	15	None
ICC20	CC	Robotics	3	0	2	4	15	15	40	15	15	None
ICC21	CC	Digital Signal Processing	3	0	2	4	15	15	40	15	15	None
1*	EO/G/D	Elective(s)	-	-	-	--	-	-	-	-	-	-
			------ 2*			**12-28 3***						

1*: The LTP allocation, Evaluation Scheme and Pre-requisites for Electives are given in Tables 4-6. The "_xx" part of the course code will depend upon student's choice of elective.

2*: The actual weekly load will depend upon the elective choices of the student under the Electives ICDxx/E_xxx .

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

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

B.E. INSTRUMENTATION AND CONTROL ENGINEERING - TRAINING AFTER SEMESTER VI												
Course No.	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ICC22 *1	**CC**	Training	- -	-	-	2	-	-	-	40	60	None

*1: Students will undergo Training In the industry/Research organization/ Reputed Institutions during the Summer vacation after sixth Semester. This will be evaluated as a VII Semester subject during end-semester examination.

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

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

B.E. INSTRUMENTATION AND CONTROL ENGINEERING -SEMESTER VII												
Course No.	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ICC221*	CC	Training	-	-	-	2	-	-	-	40	60	None
ICC232*	CC	Project-I	0	0	4	4	0	0	0	40	60	None
3*	EO/G/D	Elective(s)	-	-	-	--	-	-	-	-	-	-
			----4*			**6-28 5***						

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

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

3*: The LTP allocation, Evaluation Scheme and Pre-requisites for Electives are given in Tables 4-6. The course code will depend upon student's choice of elective.

4*: The actual weekly load will depend upon the elective choices of the student.

5*: A student may register for courses leading to a minimum number of 06 credits and maximum of 28 credits. Normally a student registers for courses leading to 22 credits.

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

B.E. INSTRUMENTATION AND CONTROL ENGINEERING -SEMESTER VIII												
Course No.	**Type**	**Subject**	**L**	**T**	**P**	**Credits**	**Evaluation Scheme (Percentage weights)**					**Pre-requisites**
							Theory			**Practical**		
							CA	**MS**	**ES**	**CA**	**ES**	
ICC241*	CC	Project-II	0	0	4	4	0	0	0	40	60	None
2*	EO/G/D	Elective(s)	-	-	-	--	-	-	-	-	-	-
			------- **3***			**4-28** **4***						

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

2* : The LTP allocation, Evaluation Scheme and Pre-requisites for Electives are given in Tables 2-4. The "_xx" part of the course code will depend upon student's choice of elective.

3*: The actual weekly load will depend upon the elective choices of the student under the Electives ICDxx/E_xxx .

4*: A student may register for courses leading to a minimum number of 04 credits and maximum of 28 credits. Normally a student registers for courses leading to 22 credits.

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

TABLE - 3 LIST OF FOUNDATION ELECTIVES										
Code	Name of Foundation Elective	LTP Allocation			Evaluation Scheme					Pre-Requisites
					Theory			Practical		
		L	T	P	CA	MS	ES	CA	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
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	25	-	-	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

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

TABLE 4: LIST OF DISCIPLINE CENTRIC ELECTIVES									
LTP Allocation					**Evaluation Scheme**				
					Theory			**Practical**	
					CA	**MS**	**ES**	**CA**	**ES**
					10	**20**	**40**	**15**	**15**
Code	**Name of Elective**	**L**	**T**	**P**	**Pre-Requisites**				
ICD01	Advanced power apparatus	**3**	**0**	**2**	ICC04				
ICD02	Advanced power electronics	**3**	**0**	**2**	ICC47				
ICD03	AI techniques and application	**3**	**1**	**0**	NIL				
ICD04	Applied cryptography	**3**	**1**	**0**	ICC10				
ICD05	Bioinformatics	**3**	**1**	**0**	EO017				
ICD06	Biomedical signal processing	**3**	**1**	**0**	ICC03				
ICD07	Biometrics	**3**	**0**	**2**	ICC03				
ICD08	Computer network	**3**	**1**	**0**	ICC17				
ICD09	Condition monitoring of power apparatus	**3**	**0**	**2**	ICC04				
ICD10	Design of hydro power system	**3**	**1**	**0**	NIL				
ICD11	Biomedical Instrumentation	**3**	**0**	**2**	ICC05				
ICD12	Discrete time systems	**3**	**0**	**2**	ICC11				
ICD13	Drive system in electric traction	**3**	**0**	**2**	ICC13				
ICD14	DSP controlled electric drives	**3**	**0**	**2**	ICC04, ICC21				
ICD15	Wind and solar based electrical systems	**3**	**1**	**0**	ICC04				
ICD16	Electric drives for hybrid vehicles	**3**	**1**	**0**	NIL				

ICD17	Energy auditing	**3**	**1**	**0**	ICC04
ICD18	Evolutionary computations	**3**	**1**	**0**	NIL
ICD19	Fault detection and diagnosis	**3**	**1**	**0**	NIL
ICD20	High voltage engineering	**3**	**0**	**2**	NIL
ICD21	Instrumentation in electric drives	**3**	**0**	**2**	ICC05
ICD22	Intelligent Control	**3**	**1**	**0**	ICC11
ICD23	Large Scale Systems	**3**	**1**	**0**	NIL
ICD24	Logic and distributed control system	**3**	**1**	**0**	ICC11
ICD25	Mechatronics	**3**	**0**	**2**	ICC06
ICD26	MEMS	**3**	**1**	**0**	NIL
ICD27	Micro system design	**3**	**1**	**0**	NIL
ICD28	Modeling and analysis of electrical m/c	**3**	**0**	**2**	ICC04
ICD29	Non linear Control	**3**	**0**	**2**	ICC11
ICD30	Optimization techniques	**3**	**1**	**0**	NIL
ICD31	Parameter estimation and system identification	**3**	**1**	**0**	ICC18
ICD32	Physiological control systems	**3**	**0**	**2**	ICC11
ICD33	Power apparatus design	**3**	**0**	**2**	ICC04
ICD34	Power converters	**3**	**0**	**2**	ICC13
ICD35	Power quality and harmonics	**3**	**0**	**2**	NIL
ICD36	Principles of cryptography	**3**	**1**	**0**	NIL
ICD37	Advanced Process Control	**3**	**0**	**2**	ICC16
ICD38	Random processes in	**3**	**1**	**0**	ICC11

	control and estimation				
ICD39	Reactive power control and FACTS devices	**3**	**0**	**2**	ICC04
ICD40	Electric Drives	**3**	**0**	**2**	ICC13
ICD41	Robust control	**3**	**0**	**2**	ICC18
ICD42	Selected topics in control	**3**	**1**	**0**	ICC18
ICD43	Sensor networks	**3**	**1**	**0**	NIL
ICD44	Special machines	**3**	**0**	**2**	ICC04
ICD45	Utilization of electrical energy	**3**	**1**	**0**	NIL
ICD46	Virtual instrumentation	**3**	**0**	**2**	ICC05
ICD47	Power Electronics	**3**	**0**	**2**	ICC06

TABLE 5 : GENERIC ELECTIVES (EG)
A student may take any course offered by any other Department of the institute under the categories of Core Course (CC) and Discipline centric Elective (ED). However such options shall be offered to a student as per prescribed guidelines of Institute.

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

TABLE 6 : OPEN ELECTIVES							
LTP Allocation			**Evaluation Scheme**				
			Theory			**Practical**	
L	**T**	**P**	**CA**	**MS**	**ES**	**CA**	**ES**
3	**1**	**0**	**25**	**25**	**50**	**-**	**-**
Code	**Name of Elective**		**Pre-Requisites**				
EO001	Technical Communication		None				
EO002	Disaster Management		None				
EO003	Basics of Finance Management		None				
EO004	Basics of Human Resources Management		None				
EO005	Project Management		None				
EO006	Basics of Corporate Law		None				
EO007	Biological computing		None				
EO008	Basic of social science		None				
EO009	Entrepreneurship		None				
EO010	Social work		None				
EO011	IP and Patenting		None				
EO012	Supply Chain Management-Planning and logistics		None				
EO013	Organization Development		None				
EO014	Industrial Organization and Managerial Economics		None				
EO015	Global Strategy and Technology		None				

EO016	Engineering System Analysis and Design	None
EO017	Biology for Engineers	None
EO018	Energy, Environment and Society	None
EO019	Public Policy and Governance	None

OPEN ELECTIVES					
Course Code	**Course name**	**L**	**T**	**P**	**Pre-requisites**
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

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

Syllabus of Foundation Core Courses

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
FC001	**MATHEMATICS I**	**4**	**3-1-0**	Nil

COURSE OUTCOME (CO):

By the end of this course, the student will be able to

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

COURSE CONTENTS:

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

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

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

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

SUGGESTED READINGS :

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

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

FC002	COMPUTER PROGRAMING	4	3-0-2	Nil

COURSE OUTCOME (CO):

1. To understand the basic terminology 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.

COURSE CONTENTS:

C Programming Language

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

Boolean Logic: Binary Number systems and codes and operations.

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

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

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

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

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

C++ Programming Language

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

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

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

Exception handling, streams based I/O.

Trends: Kinds of programming languages.

Guidelines for practical work based on programming concepts:

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

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

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, "C: The Complete Reference", Tata McGraw Hill. 3. Yashwant Kanitkar, "Let us C", BPB Publication. 4. Byron Gottfried and Schaum Series, "Schaum's Outline of Programming with C", Tata McGraw Hill 5. Budd, "Object Oriented Programming", Addison Wesley. 6. D Samantha, "Object oriented Programming in C++ and Java", PHI. 7. Stroustrup, " Programming in C++", Special Edition, Addison Wesley.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
FC003	**Electrical And Electronics Engineering**	**4**	**3-0-2**	Nil

COURSE OUTCOME (CO):

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

COURSE CONTENTS:

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

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

FC004	PHYSICS	4	3-0-2	Nil

COURSE OUTCOME (CO):

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

COURSE CONTENTS:

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, Brewester's law, Ultrasonic interferometer, numerial aperture of an optical fibre, other experiments based on LASER and optical fiber.

SUGGESTED READINGS:

1. Arthur Beiser and Shobhit Mahajan, "Concepts of Modern Physics", McGraw Hill.
2. Serwey , Moses and Moyer, 'Modern Physics", Cengage Learning.

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

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
FC005	**ENGLISH - I**	**2**	**2-0-0**	Nil

COURSE OUTCOME (CO):

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

COURSE CONTENTS:

- Practice in dictation, punctuation and spellings, listening and reading comprehension.
- Practice with well formed sentences with stress on remedial grammar.
- Exercises in unseen comprehension, paraphrasing, paragraph writing & summarizing.
- Reinforcement in letter writing, preparing CVs, writing book reviews.
- Exposure to the nuances and usages of the language through newspapers and magazines as an exercise to be in line with current form of language used.
- Proficiency in spoken English with focus on confidence building and standard pronunciation through language lab sessions.

Literature

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

Language Skills

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

SUGGESTED READINGS:

- *Examine Your English*: Margaret M Maison

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
FC006	**MATHEMATICS - II**	**4**	**3-1-0**	Nil

COURSE OUTCOME (CO):

By the end of this course, the student will be able to

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

COURSE CONTENTS:

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. Inverse Laplace transform, Convolution theorem.

SUGGESTED READINGS:

1. 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 No.	Title of the Course	Credits	Course Structure	Pre-Requisite
FC007	**ENGLISH - II**	**2**	**2-0-0**	Nil

COURSE OUTCOME (CO):

1. The course will focus on the four integral skills of language, improving the proficiency levels in all of them and to learn to use language as a tool for effective communication.
2. This course will widen the understanding of the learners in all genres of literature (short stories, poetry, autobiographies..) with the help of expository pieces .
3. The course will strive to equip the learner with the ability to express oneself and be understood by others with clarity and precision, in both written and spoken forms.

4. This course will encourage creative use of language through translation, paraphrasing and paragraph writing.
5. Along with the above, the course will also build confidence and encourage the students to use a standard spoken form of English in order to prepare them to face job interviews, workplace and in higher studies.

COURSE CONTENTS:

Literature

Anton Chekov: The Bet

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

Language Skills

1. translation, paragraph writing, paraphrasing, summarizing,
2. comprehension

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".

SYLLABUS OF CORE COURSES

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC01	**PHYSICS OF MATERIAL**	**4**	**3-0-2**	Nil

COURSE OUTCOME (CO):

This course imparts fundamental knowledge to use quantum mechanics as fundamental tool to understand the inherent property of microscopic particles like electrons, holes, nano particles etc of the material and to solve the complex physical problems. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D in materials science and solid state physics. This course is very helpful in understanding the various phenomena/mechanisms which are very useful in designing electronic devices, energy storage devices, superconducting and innovative & compact design based on nano technology.

COURSE CONTENTS:

Crystal Structures, Imperfections and Bonding in Solids - Bravais lattice, Miller indices, Simple crystal structures, Packing fraction; Different kinds of bondings; Types of imperfections, Effect of imperfections, Point defects, Edge and Screw dislocations, Berger's vector, Crystal growth-Introduction.

Fundamental of Quantum Mechanics : Matter Waves and de-Broglie Hypothesis, Uncertainty Principle, Wave Packets, Interpretation of Wave function, Schroedinger's Wave Equation, Simple Eigen value Problems and degeneracy.

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

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

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

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

ceramics, effect of frequency and temperature on polarization.

Magnetic Materials: Ferromagnetism, Antiferro, Ferri-ferro magnetism, ferrites, magnetic storage. **Superconductors:** Types of superconductors, Meissner effect, BCS theory, Josephson's effect, London penetration depth, high temperature superconductors, future applications.

Introduction to Nanoscience and Nanotechnology: Basic principles, Preparation of nano-materials, Properties of nanoparticles ,Types of nanomaterials, quantum well, quantum wire and quantum dots, carbon nanotubes –structure, properties and uses, applications of nanotechnology.

TERM WORK Experiments: Any ten experiments based on the theory course or related subject as above. For examples : Current sensitivity and resistance of a Ballistic Galvanometer, calibration of a given Voltmeter and Ammeter, sparking potential of a Neon Lamp, resistivity of a semiconductor using Four Probe Method, Band Gap of a given specimen, high resistance by Leakage Method, work function by using Richardson Equation, susceptibility of $MnCl_2$, to determine the Plank's Constant, characteristics of a GM Tube, Diode characteristics, Solar cell characteristics, e/m by Thomson's method, Uses of CRO for different measurement, Hall effect and Hall coefficient etc.

SUGGESTED READINGS:

1. A. Bieser, "Concepts of Modern Physics",McGraw Hill.
2. John Allison, "Electronic Engineering Materials and Devices", Tata McGraw Hill.
3. C Kittel, "Solid State Physics:", Wiley.
4. A J Dekker, "Electronic Engineering Materials", Prentice Hall.
5. LH Van Vlack, "Elements of Material Science and Engg.",Addision Wesley.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC02	**APPLIED MECHANICS**	**4**	**3-1-0**	Nil

COURSE OUTCOME (CO):

1. To understand the theory of elasticity including strain/displacement and Hooke's law relationships.
2. To analyze solid mechanics problems using classical methods and energy methods.
3. To apply various failure criteria for general stress states at points.
4. To solve for stresses and deflections of beams under unsymmetrical loading

COURSE CONTENTS:

Basic Laws: Force, moment of a force, couple, equivalent force system, equation of equilibrium, solution of simple plane trusses by analytical and graphical methods, frictional force, first moment and second moment of area.

Bending Moment and Shear force diagrams: Cantilever, simple, over hang supported beams carrying various types of loads.

Simple stresses and strains and relation: Description of tensile, compressive, shear and volumetric stresses and strains, complementary shear stress, Temperature stresses, compound systems, rods & sleeve, lateral strain and Poisson's ratio.

Transformation: Stresses at any plane. Principle stresses and strains, Mohr's circle.

Torsion: Stresses and strains in pure torsion for solid and hollow circular shafts, power transmitted by shafts.

Theory of simple bending: Bending formula, deflection of beams.

Combined stresses and strains: Combined torsion, bending and direct stresses, strains equivalent bending twisting moments.

SUGGESTED READINGS:

1. R.K Rajput, "Applied Mechanics". Laxmi Publications; 1988.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC03	**SIGNAL AND SYSTEMS**	**4**	**3-1-0**	Nil

COURSE OUTCOME (CO):

Characterize and analyze the properties of CT and DT signals and systems

- Analyze CT and DT systems in Time domain using convolution
- Represent CT and DT systems in the Frequency domain using Fourier Analysis tools like
- CTFS, CTFT, DTFS and DTFT.
- Conceptualize the effects of sampling a CT signal
- Analyze CT and DT systems using Laplace transforms and Z Transforms

COURSE CONTENTS:

Introduction to signals and systems: Introduction to signals, classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable. Introduction to systems, properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions.

Impulse response of a physical system, introduction to convolution, system impulse response and convolution integral, numerical convolution. Sampling theorem, Z-transform, convergence of Z-transform, properties of Z-transform, inversion of Z-transform , evaluation of system frequency response, applications of Z-transform.

Representation of signals in terms of elementary signals, condition for orthogonality, representation of signals by elementary sinusoids, Fourier series representation, power spectrum, Fourier Transform, system function, energy spectrum. Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform.

Statistical Signal Analysis: Classification of random signals, auto correlation function, properties of auto correlation function, measurement of auto correlation function, application of autocorrelation functions, cross correlation functions, properties of cross correlation functions, sum of random processes.

Spectral density, relation of spectral density to autocorrelation function. Auto correlation function of system output, cross- correlation between input and output, white noise, generation of pseudo-random binary noise, analysis of linear systems in time domain using white noise, mean and mean square value of system output, analysis in the frequency domain.

SUGGESTED READINGS:

1. Gabel R.A. and Robert R.A, "Signals and Linear Systems", 3rd Edition, John Wiley and Sons, New York.
2. Oppenheim, Wilsky and Nawab, "Signals and Systems", 2nd Edition, Prentice Hall, New Delhi.
3. C.T.Chen, "Systems and Signal Analysis", Oxford University Press, India, 3rd Edition, ISBN 100195156617.
4. Cooper G.R and McGillem C.D, "Probabilistic Methods of Signals and System Analysis", 3rd Edition, Oxford University Press, Cambridge.
5. Chesmond, Wilson, & Lepla "Advanced Control System Technology", ISBN-8176490326, Viva Books, India.
6. Ziemer R.E., Tranter W.H., and Fannin D.R., "Signals and Systems", 4th Edition, Pearson Education Asia,

Singapore.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC04	**POWER APPARATUS**	**4**	**3-0-2**	Nil

COURSE OUTCOME (CO):

- The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.
- The skill to analyze the response of any electrical machine.
- The ability to troubleshoot the operation of an electrical machine.
- The ability to select a suitable measuring instrument for a given application.
- The ability to estimate and correct deviations in measurements due to the influence of the instrument and due to the accuracy of the instrument.

COURSE CONTENTS:

Transformers: Construction, Operating principles of single phase & three phase transformer, Emf equation, Phasor diagram, Equivalent circuit, Different transformer connections and their vector groups, Scott connection, Paralleling of single phase and three phase transformer, all Testing of transformers, Auto Transformers.

Basic Concepts of Rotating Machines: Principles of electromechanical energy conversion, General working principles and constructional features, types of windings and their mmf patterns, generation of voltage in rotating machines, effect of distribution of winding and generated emf.

Induction Motor: General construction features, types of motors, Concept of rotating magnetic field, starting methods. Production of torque equation, torque-slip and Torque-speed characteristics. Effect of rotor resistance, circle diagram, speed control. Brief idea of double cage and deep bar motor. Testing and parameters of equivalent circuits. Starting methods of IM. Applications of IM

Synchronous Machines: Types and construction. emf equation and methods of harmonic reduction. Voltage regulation – synchronous impedance method using o.c. & s.c test, m.m.f. method. Zero power factor test – potier reactance. Two reaction theory. Parallel operation of alternators – synchronisation methods. starting of synchronous motors. V-curves and inverse of V-curve, excitation control. Power equation and control of synchronising power. Haunting & damper winding. Applications of synchronous machines

Fractional Horse Power Machines: Basic working principle and applications of single phase induction motors and single phase synchronous motors. Universal motor, Permanent magnet machines, servo motors, stepper motor, Reluctance motor. Selection criterion of motor for industrial applications.

SUGGESTED READINGS:

1. P.S. Bhimbhra, “Electrical Machinery”, 6th Edition, Khanna Publishers.
2. D.P. Kothari & I.J Nagrath, “Electric machines”, 3rd Edition, Tata Mc Graw-Hill Publishing Company Limited.
3. Alexander S Langsdorf, “Theory of Alternating Current Machinery”, Tata Mc Graw Hill Edition.
4. Fitzgerald, “Electric Machinery”, Tata Mc Graw Hill Edition.
5. Irving L Koskow, “Electric Machinery & transformer”, 2nd Edition, Prentice Hall India

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC05	**ELECTRONIC INSTRUMENTATION**	**4**	**3-0-2**	Nil

COURSE OUTCOME (CO):

- To be able to understand the various electronics based instrumentation techniques used in industries.
- To learn Op-amp and their applications in instrumentation.
- To learn designs of Op-amp based amplifiers, filters, oscillators and waveform generators.
- To learn working of oscilloscopes, spectrum analyzers, DMMs and distortion analyzers.
- To learn ADC and DAC and design data acquisition systems.

COURSE CONTENTS:

- OP-AMP fundamentals and applications: Open loop characteristics, various amplifier configurations including feedback, Effects of feedback on gain, input impedance, output impedance and bandwidth, instrumentation amplifier.
- Current to voltage and voltage to current converters, application to 4-20mA and ±10V conversions.
- Designs of OP-AMP based active filters, oscillators and waveform generators.
- Some applications of OP-AMPs in sensors signal conditioning.
- Timers and voltage controller oscillators and their applications in measurement.
- D/A and A/D converters, data acquisition systems.
- Digital meters, Digital voltmeters, AC and R.M.S measurements, range settings, frequency measurements, digital multi-meters, digital L-C-R-Q meters, digital wattmeter.
- Waveform measuring instruments, CRO and its applications, special purpose oscilloscopes, DSO, DPO, oscilloscope probes, spectrum analysers, distortion measurements, distortion analysers.
- Modulation and Demodulation.
- Future trends in electronic measurement systems.

SUGGESTED READINGS:

1. TMH. Helfric and Cooper, “Modern Electronic Instrumentation and Measurement techniques”, PHI.
2. David A. Bell, “Electronic Instrumentation and Measurements”, Second edition, PHI.
3. Ramakant A. Gayakwad, “OP-AMP and LIC”, Pearson.
4. Sergio Franco, “Design with OP-AMPS and analog integrated circuits”

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC06	**ELECTRONICS**	**4**	**3-0-2**	Nil

COURSE OUTCOME (CO):

- Able to identify schematic symbols and understand the working principles of electronic devices e.g. Diode, Zener Diode, LED, BJT, JFET and MOSFET etc.
- Able to understand the working principles of electronic circuits e.g. Rectifiers, Clipper, Clamper, Filters, Amplifiers and Operational Amplifiers etc. also understand methods to analyse and characterize these circuits
- Able to understand the functioning and purposes of Power Supplies, Test and Measuring equipments such as Multimeters, CROs and Function generators etc.

COURSE CONTENTS:

Diode and Amplifier circuits: Rectifier circuits. Filter circuits. Limiting and clamping circuits. Special Diode types. Zener voltage regulator. MOSFET and BJT circuits at DC. MOSFET and BJT as amplifier. Biasing MOS and BJT amplifiers. Small signal operation and models for MOSFET and BJT. Single stage MOS amplifiers and BJT amplifiers. High frequency model for MOSFET and BJT.

Single stage integrated circuit amplifiers: Comparison of MOSFET and BJT. Bi CMOS circuits. IC biasing. High frequency response. CS and CE amplifier with active loads. High frequency response of CS and CE amplifier. CG and CB amplifiers with active loads. Cascode amplifier. CS and CE amplifiers with source de-generation. Source and emitter follower.

Differential and multi stage amplifiers: MOS differential pair and its small operation. BJT differential pair. Non ideal characteristics of differential amplifier. Differential amplifier with active load. Two stage amplifiers using MOS and two stage amplifiers using BJT.

Feedback amplifiers, Sinusoidal oscillators: General feedback structure. Properties of negative feedback. Four basic feedback topologies. Loop gain. Stability problem. Basic principle of sinusoidal oscillators. RC oscillator. LC and crystal oscillator.

Output stages and power amplifiers: Class A, class B, class AB output stages. Biasing class AB circuits. Power BJTs, MOS power transistor. Variations on the class AB configuration. IC power amplifiers. Class AB operation.

SUGGESTED READINGS:

1. J. Millman and A. Grabel, "Microelectronics", 2nd Edition, Tata McGraw Hill.
2. David A.Bell, "Solid State Pulse Circuits", PHI, 4th Edition.
3. A.S.Sedra and K.C.Smith, "Microelectronics circuits", 5thEdition, Oxford University Press, India.
4. D.L.Schilling and C. Belove, "Electronic Circuits", Tata McGraw Hill, 3rd Edition.
5. R.Spencer and Mohammed S.Ghausi, "Introduction to Electronic Circuit Design", Pearson.
6. Robert L. Boylestad, "Electronic Devices and Circuit Theory", 8thEdition, Pearson.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC07	**Engineering Graphics**	**4**	**2-0-4**	Nil

COURSE OUTCOME (CO):

- Students will be able to understand the theory of projection.
- Students will be able to know and understand the conventions and the methods of engineering drawing.
- Students will be able to improve their visualization skills so that they can apply these skills in developing new products.
- Students will be able to prepare simple layouts

COURSE CONTENTS:

Introduction: Instruments and their uses, Lettering, Construction and uses of various scales, dimensioning.

Engineering Curves: Parabola, Hyperbola, ellipse, cycloids, involute, spiral, helix and loci of points of simple moving mechanism.

Projections: Straight lines, planes and solids, development of surfaces of right and oblique solids, section of solids, interpenetration and intersection of solids, isometric and oblique parallel projection of solids.

SUGGESTED READINGS:

1. N.D. Bhat, "Engineering Drawing".

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC08	**DATA STRUCTURES**	**4**	**3-1-0**	Nil

COURSE OUTCOME (CO):

- Able to understand the concepts of data structure, data type and array data structure.
- Able to analyze algorithms and determine their time complexity.
- Able to implement linked list data structure to solve various problems
- Write complex applications using structured programming methods

COURSE CONTENTS:

Introduction, Insertion sort, Time complexity, Growth of Functions, Recurrences, Merge sort, Heap sort, Quick sort, Counting sort, Radix sort, Bucket sort.

Stacks and Queues, Linked lists, Pointers, Objects, Hash Tables, Binary Search Trees

Dynamic Programming, Greedy Algorithms, B-Trees, Graph Algorithms

Selected Topics – Fast Matrix multiplications & other operations, FFT, Number theoretic Algorithms, Binomial heaps, Fibonocci heaps, Introduction NP completeness.

SUGGESTED READINGS:

1. Cormen, Leiserson and Rivest, “Introduction to Algorithms”, 2nd Edition, Mc Graw Hill, New York, New Delhi,.
2. Ronald L. Rivest, “Algorithms, Data structures and Programs”, Prentice Hall, New Jersey.
3. Knuth D. E, “Fundamental algorithms”, 3rd edition, Addition Wesely, New Delhi.
4. Horowitz, Sahni and Rajasekaran, “Fundamentals of Algorithms”, Galgotia Publications, New Delhi.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC09	**CHEMISTRY**	**4**	**3-1-0**	Nil

COURSE OUTCOME (CO):

After completion of the course the students will be able to

- understand the basic concept of Physical, Inorganic and Organic Chemistry
- understand the concepts of Polymers, Metals and Alloys
- understand the concept of Thermal Methods and their applications and basic the basic principles of Green Technology
- perform titrimetric analysis
- learn different titration methods by performing experiments

COURSE CONTENTS:

Electrochemistry & Catalysis : Transport No., Nernst Equation of electrode Potential, Reference electrodes, Subsidiary Electrodes, Concentration Cell, Batteries & Fuel Cells, Kinetics of Catalysis

Phase Rule : Deduction of Phase Rule, Basic Definition and Explanation, Phase Diagram of some simple systems (Water & Sulphur), Phase transportation of Cu-Ni, Ag-Pb and some binary systems

Thermal Method of Analysis : Elementary discussions of TGA, DTA & DSC

Inorganic Chemistry : Transition Metal complexes, Crystal Field Theory, synthesis & property of Metallurgy, Ferrous & Non-Ferrous Alloys

Electronic Effects : Inductive Effect, Hyperconjugation & Resonance and their effect on physical & chemical properties of molecules, Mechanisms of some Reactions

Polymers : Effect of polymer structure on properties and production, Technical Applications and synthesis of some thermoplastic and thermoset resins, Natural Rubber, Elastomers, Inorganic Polymers, Ion-exchange Polymers, Conducting Polymers, Bio-degradable Polymers, Molecular Weight of Polymers

Spectroscopy : Infrared, Ultra-Violet and Visible and NMR Spectroscopy and their applications

Analytical Chemistry: Chromatographic Methods of Separation, Gas Chromatography, HPLC & Potentiometric methods

Green Technology : Introduction, Basic Principles of Green Technology, concept of atom economy, Tools of Green Technology, zero waste Technology

SUGGESTED READINGS:

1 K. J. Laidler, "Chemical Kinetics"
2. R. T. Morrison & R. N. Boyd, "Organic Chemistry"
3. J. D. Lee, "Concise Inorganic Chemistry"
4. A. I. Vogel, "Quantitative Inorganic Chemistry"
5. Jain and Jain, "Engineering Chemistry"
6. Balram Pani, "Engineering Chemistry"
7. Shashi Chawla, "Engineering Chemistry"

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC10	**MATHEMATICS-III**	**4**	**3-1-0**	Nil

COURSE OUTCOME (CO):

By the end of this course, the student will be able to

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

COURSE CONTENTS:

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

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

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

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

SUGGESTED READINGS:

1. R. K. Jain and S. R. K. Iyenger, "Advanced engineering mathematics", Narosa.
2. Erwin Kreyszig, "Advanced engineering mathematics", Wiley.
3. Michael Greenberg, "Advanced engineering mathematics", Pearson Education.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC11	**CONTROL SYSTEM-I**	**4**	**3-0-2**	Nil

COURSE OUTCOME (CO):

- Describe the response characteristic and differentiate between the open loop and closed loop of a control system.
- Derive mathematical model for simple electrical and mechanical systems using transfer function and state variable method.
- Determine the response of a control system using poles and zeros to determine the response of a control system.
- Determine the stability of a control system using frequency domain analysis.

COURSE CONTENTS:

Systems and their representation: Terminology and basic structure of control system, Open loop and Closed loop systems, Physical Systems and their Mathematical models, Electrical and Mechanical Systems,DC and AC Servomotors, Synchro Error Detector, Tacho Generatorand, Stepper Motor etc., transfer function, Block diagram representation of physical systems, Block diagram algebra, Signal Flow graph and Mason's formula. Analogous Systems

Time response: Types of test inputs, Response of first and second order system, Time domain specifications, Error coefficients, generalized error series. 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 And Algebraic Criteria:-The Concept of Stability, Necessary Conditions for Stability, Routh Stability Criterion and relative Stability Analysis.

Root Loci:, Root locus plot, Properties of Root loci and applications, Stability range from the loci. Determination of roots of the closed loop system, transient response and stability from root locus.Effect of pole zero addition, desired closed loop pole location

Frequency response: Frequency-domain techniques – Polar plots, Frequency response for systems with transportation lag, Frequency-domain specifications. Nyquist stability criterion, Bode plots- gain margin and phase margin.Correlation between time response and frequency response.

Design of Compensators: Proportional (Constant gain), Lead, Lag and lead-lag compensator design using root loci and Bode plots.

SUGGESTED READINGS:

1. Ogata K, "Modern Control Engineering", 4th Edition, Prentice Hall, New Delhi.
2. Richard Dorf & Robert Bishop, "Modern control system", 10th edition, Pearson Education.
3. B.C Kuo, "Automatic control systems", 7th Edition, Prentice Hall, New Delhi.
4. Nagrath , I. J. & Gopal M. "Control Systems Engineering" New Age International. Publishers

5. Scheultz & Melsa, "Linear Control Systems".
6. Nise, Norman and S., "Control System Engineering" , John Wiley and Sons.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC12	**TRANSDUCER AND MEASUREMENT**	**4**	**3-1-0**	Nil

COURSE OUTCOME (CO):

Students will be able to:

- To learn the static and dynamic characteristics of measurement systems.
- To learn fundamentals, design and applications of various transducers.
- To learn performance enhancement of transducers.
- To design transducers based complete measurement systems.
- To apply various transducers systems for measurement applications.

COURSE CONTENTS:

1. Performance Characteristics - I: Various definitions related to instrumentation and measurements, Block diagram representation of an instruments, Loading effect, Instrument selection etc.
2. Performance characteristics - II: Static performances characteristics, Formulation of system differential equations, Dynamic response of I^{st} and 2^{nd} order systems, Compensations.
3. Performance enhancements and elementary closed loop control configurations.
4. Resistive transducers: Resistance potentiometer, Strain gage, calibration, thermal compensations, Signal conditioning aspects.
5. Temperature transducers, Thermocouple, RTD, Thermistors, Lead compensation and signal conditioning aspects, Design aspects of constant current source.
6. Capacitive Transducers: Various configurations- Air gap and dielectric filled, Applications of linear and angular measurements, Humidity measurement, Advantages and Disadvantages.
7. Piezo-electric Transducers: Piezo-electric effect, inverse Piezo-electric effect, crystals, properties, configurations and modeling, sensitivity coefficients, frequency response of PZT, accelerometers and vibration pickups applications.
8. Hall transducers and applications.
9. Optical Transducers: Various photo electric transducers, IR and UV detectors.
10. Some other transducers: LVDT, Hotwire anemometers, Electromagnetic flow meter, Flapper and nozzle.
11. Elastic Transducers: Springs, Bellows, Diaphragm, Thin plates, membranes, Bourdon tubes, special features and applications.
12. Introduction to MEMS and future trends in measurement systems.

SUGGESTED READINGS:

- Sensors and Transducers, "Patranabis D", PHI, New Delhi.
- Nakra and Chaudhry, "Instrumentation, Measurement and Analysis", TMH.
- J.W. Dally et al, "Engineering Measurements", Wiley.
- T. G. Beckwith, "Mechanical Measurements", Pearson.
- Bentley, "Principles of Measurement Systems", Pearson.

- DVS Murty, "Transducers and Instrumentation", PHI.
- Ernest O. Doebelin, "Measurement systems application and design international student Edition", TMH.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC13	**INDUSTRIAL ELECTRONICS**	**4**	**3-0-2**	Nil

Course Outcomes: Learner should be able to ….

1. Demonstrate the knowledge of basic functioning of semiconductor Switching devices.
2. Understand concept of AC-DC, DC-AC and DC-DC conversion.
3. Understand the applications of power electronic converters.
4. Understand UPS SMPS and electrical drives etc.

Content:

Power semiconductor switches: Gate Characteristics, V-I characteristics, driver circuits, turn on characteristics, turn off characteristics, Two transistor model of SCRs. SCRs - series and parallel connections.

AC to DC converters: Natural commutation, single phase and three phase bridge rectifiers, semi controlled and fully controlled rectifiers, dual converters, inverter operation.

DC to DC converters: Voltage, Current, load commutation, thyristor choppers, design of commutation elements, MOSFET/IGBT choppers, AC choppers.

DC to AC converters: Thyristor inverters, McMurray-Mc Murray Bedford inverter, current source inverter, voltage control, inverters using devices other than thyristors, vector control of induction motors.

AC to AC converters: Single phase and three phase AC voltage controllers, integral cycle control, single phase cyclo-converters - effect of harmonics and Electro Magnetic Interference (EMI).

Applications in power electronics: UPS, SMPS and Drives.

SUGGESTED READINGS:

1. Rashid M. H, "Power Electronics - Circuits, Devices and Applications", 2nd Edition, Prentice Hall, New Delhi.
2. Dubey G. K, Doradla S.R, Joshi and Sinha R.M, "Thyristorised Power Controllers", New Age International Publishers, New Delhi.
3. Vedam Subramanyam K, "Power Electronics", 2nd Edition, New Age International Publishers, New Delhi.
4. Mohan, Undeland and Robbins, "Power Electronics", John Wiley and Sons, New York.
5. Joseph Vithyathil, "Power Electronics", McGraw Hill, New York.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC14	**DIGITAL CIRCUITS AND SYSTEMS**	**4**	**3-1-0**	Nil

COURSE OUTCOME (CO):

- Acquired knowledge about basics of digital electronics.
- Acquired knowledge about solving problems related to number systems and Boolean algebra.
- Ability to identify, analyze and design combinational circuits.
- Ability to design various synchronous and asynchronous sequential circuits.
- Acquired knowledge about internal circuitry and logic behind any digital system.

COURSE CONTENTS:

Introduction to logic families RTL, DTL, TTL, ECL, IIL, types of MOS etc. Introduction to IC fabrication techniques, logic gates, boolean algebra (complete), Binary erithmatic, binary codes. Transistorised bistable, Astable, Monostable, multivibrator, Schmitt trigger, flip-flop, latch, clocked flip-flop, TTL clock generator,

monostable and Astable multivibrator. Counters, ripple, synchronous and programmed counters, decoders, multiplexers, PLAS and code convertors.

Sequential ciruits- Syncrhonous and Asynchronous, digital to analog conversion, analog to digital, voltage to frequency, frequency to voltage conversion, design of display systems, Semiconductor memories.

SUGGESTED READINGS:

1. M. Morris Mano, "Digital Logic and Computer Design", Prentice Hall of India.
2. John M.Yarbrough, "Digital Logic, Application & Design", Thomson.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC15	**MICROPROCESSOR & MICRPCONTROLLER**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

1. Understanding of working principle of Microcomputer, interfacing of memory and I/Os.
2. To understand the technical limitations and challenges of program execution timings, size of codes, and coordinating with other peripheral devices.
3. How to select proper technological devices for designing any digital systems.
4. To prepare for next generation researcher and system designer/developer in the area of fast changing and emerging digital processing units.
5. To train enough to understand related scientific and technological terminologies, and how to protect the system from undue exploitation and misinterpretation by the service providers in this area.

COURSE CONTENTS:

Introduction: Evolution of microprocessors and microcontrollers, General Architectural Concepts, memory devices, and I/Os.

8086/8088 Microprocessor: Pin signal assignments, minimum and maximum mode, architecture, addressing modes, interrupts, Types of instructions and their format and assembly language programming, introduction to 8087 math coprocessor and its instruction set.

Peripheral Devices and Their Interfacing: Memory and I/O interfacing, data transfer schemes, programmable peripheral interface (8255), Display and keyboard Interface (8279), programmable interrupt controller (8259), programmable counter/interval timer (8253/8254), special purpose interfacing devices, elements and circuits for interfacing.

Microcontrollers: Architecture, Addressing modes, instruction set and assembly language programming of 8051 microcontroller.

Case studies of different Applications: Measurement and control of electrical and physical systems, data acquisition etc.

SUGGESTED READINGS:

1. John E. Uffenbeck, "The 8086/8088 Family: Design, Programming, and Interfacing", PHI
2. Barry B. Bray, "Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Prentium Proprocessor, Pentium II, III,"
3. Rajkamal, "8051 Microcontroller".

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC 16	**PROCESS DYNAMICS AND CONTROL**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

Students will be able to:

- Understand Design aspects of process control system
- Model the dynamic and static behavior of Chemical Process.
- Apply linearization techniques on nonlinear systems.
- Dynamic behavior of 1st order, 2nd order and Higher- order systems.

COURSE CONTENTS:

Introduction to feedback Control, Dynamic Behavior of feedback Controlled processes, stability analysis of feedback systems, Design of Feedback Controllers, Frequency Response Analysis of Linear Processes, Design of feedback Control Systems using Frequency Response Techniques.

Introduction to Proportional (P), Integral (I), Derivative (D) controllers, PI & PID controllers. Detailed comparison of PID controller algorithms. Derivative action on process output vs. error. Problems with proportional "kick" and reset "wind-up".

Analysis and Design of Advanced Control Systems: Feedback Control of systems with large dead time or Inverse Response, Cascade Control, Selective Control Systems, Split- range Control, Feedforward Control, Ratio Control, Inferential Control Systems.

Final Control Element: Signal Conversion (I/P or P/I converters) Actuators, pneumatic control valves, valve petitioners and design of pneumatic control valve.

Introduction to Programmable Logic Controller (PLC) and its programming.

Introduction to Supervisory Control & Data Acquisition (SCADA) Systems, Distributed Control System (DCS) and Modern Industrial Communication protocols.

SUGGESTED READINGS:

- Curtis Johnson, "Process Control Instrumentation Technology",8th Ed., Pearsoned Education, New Delhi.
- G. Stephanopoulos, "Chemical Process Control. An Introduction to Theory and Practice", Prentice Hall India.
- D. E. Seborg, T. F. Edgar, and D. A. Mellichamp, "Process Dynamics and Control", 2nd ed., Wiley.
- D. R. Coughanowr, "Process Systems Analysis and Control", 2nd Ed. New York: McGraw-Hill.
- B. A. Ogunnaike and W. H. Ray, "Process Dynamics, Modeling and Control", New York: Oxford University Press.
- B. G. Liptak, "Process Control and Optimization", 4th edition. Instrument Engineer's Hand Book, CRC press, London.
- B. G. Liptak, "Process Measurement and Analysis", 4th edition. Instrument Engineer's Hand Book, CRC press, London.
- F. G. Shinskey, " Process Control System", New York: McGraw-Hill.
- W. Boyes, "Instrumentation Reference Book 3rd ed.", Butterworth-Heinemann Publication, USA.
- John. W. Webb Ronald A Reis , "Programmable Logic Controllers - Principles and Applications", 3rd edition, Prentice Hall Inc., New Jersey.
- W. Bolton, "Programmable Logic Controllers",5th edition, Newnes.

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC17	**Analog & Digital Communication**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

1. Understanding of Information Communication Payload also called Information objects. Difference between Voice, Video and Data in terms of their electrical signal characteristics, and their associated signal bandwidth.
2. To understand the technical limitations and challenges of transportation/communication of Information Signals particularly overcoming of compulsory noisy environments.
3. How to select proper technological devices such as various types of telephone instruments, mobiles, PDAs, Networking devices, medias etc. for communications between smart transducers/instruments in a minimum associated cost with maximum utilization of natural resources involved i.e. copper, fiber, and ether media as well as available and feasible energy resources.
4. To prepare for next generation researcher and system designer/developer in the area of fast changing and emerging Communication Technology Services.
5. To train enough to understand related scientific and technological terminologies, its clear definition and proper interpretation that are being used to specify for selection of various tools and services and formulation of national and international level policies and guidelines to protect the undue exploitation and misuse of natural resources on the earth by some clever and cunning service providers in this area.

COURSE CONTENTS:

Information representation. Why to talk about Signal Modulation. Classification of Signals. Energy and Power signal. Fourier Series Representation of signals. Fourier Transform, and spectral density.

Introduction to AM, FM and PM: Their generation methods, analysis in frequency domain and recovery of Information; Noise effects in AM, FM, and PM and how to minimize its effect.

Introduction to Random Processes: Probability, Random Variables, Probability Density Function, Cumulative Distribution Function, Mean, Moments, Transforms, Autocorrelation and Covariance functions, Types of Random Processes, Stationary, Wide-Sense Stationary, and Ergodic Processes, Response of linear systems to random signals.

Pulse Analog Modulation: Sampling theorem, Sampling of low pass signals, Aliasing effects, Aperture effect, PAM, PWM, PPM; Modulation and Demodulation; its spectral analysis and effects of Noise.

Pulse Digital Modulation: Pulse Code Modulation, Quantization, SNR, Probability of error for PCM, DPCM, DM, ADM; Modulation and Demodulation; Inter-symbol Interference, Eye Diagram.

Digital Pass Band Transmission and Reception: Phase shift Keying, FSK, QPSK, QAM, Effects of noise and error probability.

SUGGESTED READINGS:

1. BP Lathi, “Modern Digital and Analog Communication Systems”.
2. Couch, “Digital and Analog Communication”.
3. Haykins, “Communication Systems”.
4. Popoulis, “Probability, RV and Stochastic Processes”.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC18	CONTROL SYSTEM-II	4	3-0-2	Nil

COURSE OUTCOME (CO):

- At the end of the course students will be derive mathematical models of various systems.
- Able to understand the concept of non-linearties.
- able to do the stability analysis of linear and non linear systems

COURSE CONTENTS:

UNIT I: Systems in state space: Concept of state and state model, State equation from transfer Function and vice versa, Modeling of Linear systems in State Space, State space representation of Physical Systems, Building blocks of state space model , Canonical forms, Solution to state-space equations, state transition matrix, properties ofstate transition matrix, computation of state transition matrix.Canonical forms of State Space representation.Definition of Controllability and Observability . State feedbackcontrol for controllable canonical form, State feedback control in general, Output feedbackcontrol.Full-order and reduced-order observers and their design.

UNIT II: Introduction to Non-linear system behavior and different types of non-linearities, Modelling Non Linearities, Describing function analysis, assumptions and definitions, DF of common non-linearities, existence of limit cycles, jump phenomenon, stability analysis.

UNIT III: Equilibrium points and stability concepts, stability definitions, Modeling energy of thesystem in terms of quadratic functions,Lyapunov direct method, Second Method of Lyapunov, Positive definite functions and Lyapunov functions, existence of Lyapunov functions, Lyapunov analysis of Non linear and LTI systems,Variable gradient method, Krasovskii method, performance analysis

UNIT IV: Introduction to Optimal Control Theory, Various types of Optimal Control Problems,Calculus of Variations, Euler-Lagrange Equation, Fixed End Point and Variable End Point Problem , Lagrange Multipliers, Isoperimetric Constraints, Hamiltonian Formulation,Linear Quadratic Regulator, Pontryagin's Principle of the Minimum (Maximum),MinimumTime and Minimum fuel Optimal Control Problem.

SUGGESTED READINGS:

1. Brogan W. L, "Modern Control Theory", 3rd Edition, Prentice Hall Inc., New Jersey.
2. Raymond A. DeCarlo, "Linear Systems, A state variable approach with numericalimplementation", Prentice Hall Inc., New Jersey.
2. D.E Kirk , "An Introduction to Optimal Control Theory".
3. M. Gopal, "State Variable Analysis and Design", TMH Publication.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC19	Industrial Instrumentation	4	3-0-2	Nil

COURSE OUTCOME (CO):

- To learn the fundamentals and design aspects of industrial and analytical instrumentations suitable for working in any process industry.
- To learn multidisciplinary measurement techniques for industrial measurements like level, flow, pressure, viscosity, humidity, moisture, density and pH.
- To learn analytical instrumentation systems for Spectrometry, Chromatography and Mass Spectrometer.
- To learn analytical measurement data analysis.

COURSE CONTENTS:

1. Pressure Measurement: Basic principles, Different types of manometers, Manometer dynamics, Dead weight testers, very low and very high pressure, measurement of vacuum – McLeod gauge – Pirani gauge-thermal conductivity gauge – Ionization gauge.
2. Flowmetery**:**
   a. Theory of fixed restriction variable head type flow meters – venturi meter, orifice plate, flow nozzle, Dall tube, installation of head flow meters, pitot tube.
   b. Area flow meters and mass flow meters: turbine flow meter – rotameter, mass flow meter, domestic water meter.
   c. Electrical Type Flow Meter**:-**Principle and constructions of electromagnetic flow meter – ultrasonic flow meters, laser Doppler anemometer, target flow meter, solid flow rate measurement, guidelines for selection of flow meter.
3. Level Measurement **-** Gauge glass technique, float type level indicator, level switches, level measurement using displacer and torque tube, bubbler purging method. Boilers drum level measurement, differential pressure method, electrical type of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors etc.
4. Chromatography: Gas chromatography, Liquid chromatography – Principles, types and applications, high pressure liquid chromatography, detectors.
5. Estimation of specific gases in a mixture.
6. Measurement of Viscosity, Humidity, Moisture, Turbidity and pH.
7. Spectro-Photometers**:** Spectral methods of analysis – UV – Visible spectrophotometers – single beam and double beam instruments – sources and detectors – IR spectrophotometers – sources and detectors – FTIR spectrometers – atomic absorption spectrophotometers – flame emission spectrophotometers – sources of flame photometry – Mass spectrometers and their applications.
8. Statistical treatment of experimental data.
9. Understanding and interpretation of instruments data sheets.
10. Future trends in industrial measurement systems.

SUGGESTED READINGS:

- Khandpur, "Handbook and Analytical instruments", TMH.
- S.K. Singh, "Industrial Instrumentation and Control", TMH.
- K. Krishnamurty, "Industrial Instrumentation", New Age International.
- Skoog, " Holler and Nieman", Thomson.
- Ewing G.W., "Instrumental Methods of Analysis" , McGraw-Hill.
- Willard, Merrit, Dean and Seattle, "Instrumental Methods of Analysis", CBS Publishing and Distribution.
- Liptak B.G., "Process Measurement and Analysis", 4th Edition, Chilton Book Company, Radnor, Pennsylvania.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC20	**Robotics**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

1. Understanding of working principle of Robotic Manipulators and its associated sensors so that it can perform the movement in a closed loop control environment.
2. To understand the technical limitations and challenges of body of Robot, selecting the best path with avoidance of obstacles etc.
3. How to select proper technological devices, size and configuration of arms and associated motors, sensors and actuators for the particular robotic applications.

4. To prepare for next generation researcher and system designer/developer in the area of Robotic applications.
5. To train enough to understand related scientific and technological terminologies to compete in international market.

COURSE CONTENTS:

Introduction: Basic concepts, definition and origin of robotics, different types of robots, robot classification, applications, robot specifications.

Introduction to automation: Components and subsystems, basic building block of automation, manipulator arms, wrists and end-effectors. Transmission elements: Hydraulic, pneumatic and electric drives. Gears, sensors, materials, user interface, machine vision, implications for robot design, controllers.

Kinematics, dynamics and control: Object location, three dimensional transformation matrices, inverse transformation, kinematics and path planning, Jacobian work envelope, manipulator dynamics, dynamic stabilization, position control and force control, present industrial robot control schemes.

Robot programming: Robot programming languages and systems, levels of programming robots, problems peculiar to robot programming, control of industrial robots using PLCs.

Automation and robots: Case studies, multiple robots, machine interface, robots in manufacturing and non-manufacturing applications, robot cell design, selection of a robot.

SUGGESTED READINGS:

1. Spong and Vidyasagar, "Robot Dynamics and Control", John Wiley & Sons.
2. Asfahl C.R, "Robots and Manufacturing Automation", John Wiley & Sons, New York.
3. Klafter R.P, Chmiclewski T.A, Negin M, "Robotics Engineering: Integrated approach", Prentice Hall, New Jersey, 1994.
4. Mikell P, Weiss G.M, Nagel R.N and Odrey N.G, "Industrial Robotics", McGraw Hill, New York.
5. Deb S.R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi.
6. Fu, Gonzalez, and lee, "Robotics: Control, Sensing, Vision, and Intelligence", TMH Publication.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC21	**Digital Signal Processing**	**4**	**3-0-2**	Nil

COURSE OUTCOME (CO):

- To learn time domain analysis of the discrete time systems.
- To learn the fundamentals and applications of spectrum analysis.
- To learn the fundamentals of frequency domain analysis.
- To design and analyze FIR digital filters.
- To design and analyze IIR digital filters.
- To learn DSP implementations using LABVIEW environment.

COURSE CONTENTS:

1. Discrete Time Signals and Systems **:** Introduction, discrete time sequences, Examples of sequences – step, impulse, ramp, sine and exponential, properties of signals and sequences, interpolation and decimation, linear time invariant systems and their properties, stability, causality, system responses, convolution and

correlation, sum, system description as LCCDE, solutions of system using difference equations, ZIR, ZSR, natural and forced responses.

2. Z- Transform : Introduction, Z-transform and its properties – convolution – inverse Z-transform, system transfer function, system responses and computation of ZIR, ZSR, natural and forced responses, other applications in DSP.
3. DFT and Fast Fourier Transform (FFT) : Introduction, Sampling, Fourier transform, Discrete Fourier series – properties, frequency domain analysis – linear convolution using discrete Fourier transform, spectral estimation, leakage, zero padding, windowing, Windows: Rectangular, Hamming and Kaiser, Introduction to Radix 2 FFT's – decimation in time FFT algorithm – decimation in frequency FFT algorithm – computing inverse DFT using FFT.
4. Finite Impulse Response (FIR) Filters: Introduction, Amplitude and phase response of FIR filters, linear phase filters, windowing technique for the design of linear phase FIR filters. Windows: Rectangular, Hamming and Kaiser. Frequency sampling technique, introduction to optimal filters.
5. Infinite Impulse Response (IIR) Filters: Introduction, Properties of IIR digital filters, design of IIR filters from continuous time filters, impulse invariance and bilinear transformation techniques. Finite word length effects: Elementary ideas of the finite word length effects in digital filters.
6. Introduction to designs of notch filters.
7. Introduction to time and frequency analysis.
8. DSP implementation aspects for DSP processors and computers with LabVIEW/MATLAB.

SUGGESTED READINGS:

- Ashok Ambardar, "Digital Signal Processing", Cengage.
- Li-Tan, "Digital Signal Processing",Wiley.
- S. K. Mitra, "Digital Signal Processing", TMH.
- Schaums series, "Digital Signal Processing", TMH.
- Oppenheim and Schafer, "Digital Signal Processing", Prentice Hall, New Delhi.
- Proakis and Manolakis, "Digital Signal Processing - Principles, Algorithms and Applications", Pearson.

Subjects for Semester VII

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC22	**Training**	**2**	--------	Nil
COURSE OUTCOME (CO):				
COURSE CONTENTS:				
SUGGESTED READINGS:				

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

ICC23	**Project-I**	**4**	---------	Nil
COURSE OUTCOME (CO):				
COURSE CONTENTS:				
SUGGESTED READINGS:				

Course No.	**Title of the Course**	**Credits**	**Course Structure**	**Pre-Requisite**
EO/G/D	**Elective(s)**	**4**		As per list of course
COURSE OUTCOME (CO):				
COURSE CONTENTS:				
SUGGESTED READINGS:				

Subjects for Semester VIII

Course No.	**Title of the Course**	**Credits**	**Course Structure**	**Pre-Requisite**
ICC24	**Project-II**	**4**	----------	Nil
COURSE OUTCOME (CO):				
COURSE CONTENTS:				
SUGGESTED READINGS:				

Course No.	**Title of the Course**	**Credits**	**Course Structure**	**Pre-Requisite**
EO/G/D	**Elective(s)**	**4**		As per list of course
COURSE OUTCOME (CO):				
COURSE CONTENTS:				
SUGGESTED READINGS:				

Syllabus of Discipline Centric Electives

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD01	**ADVANCED POWER APPARATUS**	**04**	**3L-0T-2P**	Power Apparatus

COURSE OUTCOME (CO):

- Student will have understanding about the basic principles of special purpose motors.
- Student will be able to analyze the behavior of special purpose motors.

COURSE CONTENTS:

Introduction: Review of Transformers, Induction Machines, Synchronous Machines, DC machines and the applications.

Stepper Motors: Introduction, Construction and Principle of Stepper Motors, Step Angle Types of Stepper Motors Variable Reluctance Stepper Motors, Multi-stack VR Stepper Motor, Permanent-Magnet Stepping Motor, Hybr Stepper Motor, Summary of the Stepper Motors, Applications.

Permanent-Magnet DC Motor

Construction and Principle, Performance and Speed Control, Low-inertia DC Motors, Shell-type Low-inertia DC Mot Printed-circuit (Disc) DC Motor- Main features, Advantages, Disadvantages and Applications.

Permanent-Magnet Synchronous Motors: Construction and Performance, Applications, Synchros, Types Synchros- Control Transmitter, Control Receiver, Control Transformer, and Control Differential, Voltage Relation Applications of Synchros, Torque Transmission and Error Detection.

Switched Reluctance Motor: Construction and Working Principle of Switched Reluctance Motor, Advantages a Disadvantages, Applications, Comparison between VR Stepper Motor and SR Motor.

Servomotors: DC Servomotors, AC servomotors, Two-phase AC servomotor, Three-phase AC servomotors

SUGGESTED READINGS:

1) P.S. Bhimbra, "Electrical Machinery", Khanna Publishers, Delhi,7th Edition
2) A.E.Fitzerald, C.Kingsley and S.D.Umans, "Electric Machinery", Tata McGraw Hill,6th Edition
3) Ashfaq Hussian, "Electrical Machines", Dhanpat Rai & Company,2nd Edition
4) S. J. Chapman, "Electrical Machinery Fundamentals", McGraw Hill,New York,2nd Edition

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD02	**ADVANCED POWER ELECTRONICS**	**04**	**3L-0T-2P**	Power Electronics

COURSE OUTCOME (CO):

- Select an appropriate power semiconductor device and design a power converter for the required application
- Determine the power circuit configuration needed to fulfill the required power conversion with applicat constraints.

- Design the control circuit and the power circuit for a given power converter
- Determine the drive circuit requirements in terms of electrical isolation and the requirement of bipolar dri and ease of control.

COURSE CONTENTS:

AC to DC Converters: Harmonic analysis of output voltage and input current for 2-pulse and 6 pulse controll rectifiers and methods of reducing these harmonics, Multi-pulse rectifiers.

DC to AC Converters: Analysis of output voltage waveforms of single phase and three phase voltage source inverte Methods of reducing output harmonics.

Resonant Converters: Classification, basic resonant converter, loads resonant converter, resonant switch converter a zero voltage switching.

Power Conditioners and UPS: Power line disturbances, generation of harmonics, harmonic standards a recommended practice, power conditioners and uninterruptible power supplies, EMI & EMC related issues, mitigati methods

Motor Drive Applications: Converters for adjustable speed DC motor and induction motor drives. Methods improving voltage, current profile of an electric drive, latest trends in the drive performance control.

SUGGESTED READINGS:

1) Nedmohan, Undeland and Riobbins, "Power Electronics", John Wiley India, publishers,Delhi,3rd edition
2) G.K.Dubey, "Thyristorised Power Controllers", Wiley Eastern
3) B.K.Bose, "Modern Power electronics & Drives", Prentice Hall, PJR
4) P.S.Bhimbra, "Power Electronics", Khanna Publishers, Delhi (4th edition)
5) Werner Leonhard, "Control of Electrical Drives", Springer International Publication,3rd Edition
6) M. Ramamoorty, "An introduction to Thyristors and their applications", Macmillan

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD03	**AI TECHNIQUES AND APPLICATIONS**	**4**	**3L-0T-2P**	**Nil**

COURSE OUTCOME (CO):

- Understanding about various artificial intelligence techniques such as fuzzy logic, neural network and hybrid techniques

COURSE CONTENTS:

Artificial Intelligence: Definition, problem solving methods, searching techniques, knowledge representation, reasoning methods, predicate logic, predicate calculus, multivalue logic.

Fuzzy Logic: Crisp sets, fuzzy sets, fuzzy set operations, properties, membership functions, measures of fuzziness, fuzzification and defuzzification methods, fuzzy relations, operation on fuzzy relations, fuzzy numbers and arithmetic, fuzzy implications, approximate reasoning, systems based on fuzzy rules, fuzzy inference. Application of fuzzy-logic to engineering problems, Fuzzy Control Systems, fault diagnosis etc.

Artificial Neural Network: Introduction: Biological foundation, mathematical model of biological neuron, types of activation function, feed-forward and feedback ANN models.

Learning Paradigms: Supervised and unsupervised learning, learning rules, single layer and multilayer perceptron model, error back propagation learning algorithm, pattern classification, clustering, Kohonen self-organizing feature

map, radial basis function network, support vector machines, Hopfield network, Associative memory and BAM, applications of ANN models to engineering problems.

Evolutionary Techniques: Introduction and concepts of genetic algorithms and evolutionary programming

Hybrid Systems: Neuro-fuzzy systems, adaptive neuro-fuzzy inference system, evolutionary neural networks, fuzzy evolutionary systems, Neuro-Genetic, Genetic-Fuzzy systems

Some Practical applications

SUGGESTED READINGS:

1. NP Padhy , "Artificial Intelligence and Intelligent Systems", Oxford University Press
2. Rajasekaran S. and Pai G.A.V., "Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and applications", PHI New Delhi.
3. Lin C. and Lee G., "Neural Fuzzy Systems", Prentice Hall International Inc.
4. Goldberg D.E. "Genetic Algorithms in Search Optimization & Machine Learning", Addition Wesley Co., New York.
5. Kosko B., "Neural Networks & Fuzzy Systems A dynamical systems approach to machine intelligence", Prentice Hall of India.
6. Ronald R. Yager and Dimitar P. Filev, "Essentials of Fuzzy Modeling and Control", John Wiley & Sons Inc
7. T. Terano K Asai and M. Sugeno, "Fuzzy System Theory and its applications", Academic Press

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD04	**Applied Cryptography**	**4**	**3L-0T-2P**	Principles of Cryptography

COURSE OUTCOME (CO):

- Able to analyze different cryptographic protocols (i.e from basic protocols to advanced protocols)
- Able to link the same to different information security features.

COURSE CONTENTS:

1. Introduction to Protocols- Introduction, Communication Using Symmetric Key Cryptography, One way Function, Hash function, One way hash Function, Communication Using Public Key Cryptography, Digital Signatures.
2. Basic Protocols- Key Exchange, Different Authentication methods, Secret Splitting- Need, different methods, applications; Secret Sharing.
3. Intermediate Protocols- Undeniable Digital Signature, Group Signature, Proxy Signature, Fair Coin Flip.
4. Advanced Protocols- Zero Knowledge Proof- Introduction, methods, Applications; Blind Signature- meaning, applications.
5. Using Algorithm- Choosing an Algorithm, Public Key Cryptography vs. Symmetric Key Cryptography, Public Key Digital Signatures, Cryptographic Hash Functions.
6. Information / Computer Security- Basic security objectives, Security attacks, Security services, E-mail security: Pretty Good Privacy.

SUGGESTED READINGS:

- Bruce Schneier, "Applied Cryptography", Wiley-India.

- William Stallings, "Cryptography and Network Security", Pearson Education

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD05	**BIOINFORMATICS**	**04**	**3L-0T-2P**	Nil

COURSE OUTCOME (CO):

- To develop understanding of modern molecular biology and genomics.
- To understand the advantages and disadvantages of different machine learning techniques in bioinformatics and how the relative merits of different approaches can be evaluated by correct benchmarking techniques.
- To understand how theoretical approaches can be used to model and analyse complex biological systems.

COURSE CONTENTS:

Unit 1: Introduction: Aim and branches of Bioinformatics, Application of Bioinformatics, Role of internet and www in bioinformatics. Basic biomolecular concepts: Protein and amino acid, DNA & RNA, Sequence, structure and function. Forms of biological information, Types of Nucleotide Sequence: Genomic DNA, Complementary DNA (cDNA), Recombinant DNA (rDNA), Expressed sequence tags (ESTs), Genomic survey sequences (GSSs). DNA sequencing methods: Basic and Automated DNA sequencing, DNA sequencing by capillary array and electrophoresis, Gene expression data.

Unit 2: Bioinformatics Resources: NCBI, EBI, ExPASy, RCSB, DDBJ: The knowledge of databases and bioinformatics tools available at these resources, organization of databases: data contents, purpose and utility. Open access bibliographic resources and literature databases: PubMed, BioMed Central, Public Library of Sciences (PloS), CiteXplore.

Unit 3: Sequence databases: Nucleic acid sequence databases: GenBank, EMBL, DDBJ; Protein sequence databases: Uniprot-KB: SWISS-PROT, TrEMBL, UniParc; Structure Databases: PDB, NDB, PubChem, ChemBank. Sequence file formats: Various file formats for bio-molecular sequences: GenBank, FASTA, GCG, MSF etc. Protein and nucleic acid properties: Proteomics tools at the ExPASy server, GCG utilities and EMBOSS, Computation of various parameters

Unit 4: Sequence Analysis: Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues and xenologues Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, matrix derivation methods and principles.

Unit 5: Sequence alignment: Measurement of sequence similarity; Similarity and homology. Pairwise sequence alignment: Basic concepts of sequence alignment, Needleman and Wunsch, Smith and Waterman algorithms for pairwise alignments, gap penalties, use of pairwise alignments for analysis of Nucleic acid and protein sequences and interpretation of results.

SUGGESTED READINGS:

1. Mount D., "Bioinformatics: Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press, New York.
2. Baxevanis, A.D. and Francis Ouellellette, "Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins", B.F., Wiley India Pvt Ltd.
3. Teresa K. Attwood, David J. Parry-Smith, "Introduction to bioinformatics", Pearson Education.
4. Jean-michelClaverie Cedric Notredame, "Bioinformatics for Dummies", Publisher: Dummies

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD06	**BIOMEDICAL SIGNAL PROCESSING**	**4**	**3L-0T-2P**	Nil

COURSE OUTCOME (CO):

- Student will be able familiar with the Z- transformation and Fourier Transformation.
- Student will be able to apply the concepts of signal processing for Biomedical Signals analysis

COURSE CONTENTS:

Unit 1. Z transform introduction, definition, convergence. Inverse Z transforms, Analysis of discrete time systems using Z transforms. Solutions of differential equations. Transfer functions and stability.

Unit 2. Fourier transform for continuous signals. Energy spectrum, Properties (without proof), Gibbs phenomena, Auto and cross correlation. Discrete Fourier transforms. Properties (without proof), Inverse DFT, introduction to FFT

Unit 3. IIR & FIR Filters, Low pass, High Pass, Band Pass Filters using windows – Kaiser Windows. Sampling Theorem, aliasing Nyquist criteria, ADC's and DAC's.

Unit 4. Digital signals and systems: Classification of systems causal, time varying, time invariant, lumped. Introduction to digital signals systems. Convolution, Auto-correlation and cross correlation , Use of Matlab signal processing toolbox on various real bio - medical signals.

Unit 5. Introduction, Characteristics of Bio - Signals, Types of Signals, Measurement, Transformation. and reduction, computation of signal parameters that are diagnostically significant, stationary and non - stationary bio - signals, Application areas of Bio -Signals analysis - EEG, ECG, Phonocardiogram, Spiro Gram, Evoked Signals.

SUGGESTED READINGS:

1. Proakis, "Digital signal processing", PHI.
2. R. P. Singh, "Signal Analysis",Second edition Tata McGraw – Hill
3. Mauro R Prentice, "Engineering Electronics", Hall.
4. Malmivuo, J. and Plonsey, "R. Bioelectromagnetism: Principles and Applications of Bioelectric and Biomagnetic Fields", Oxford University Press, New York
5. D C Reddy, "Biomedical Signal Processing", McGraw Hill.
6. Metin Akay, "Biomedical signal processing", academic press.
7.Tompkins, 'Biomedical signal processing", academic press.
8. Rabiner and Gold, "Theory and application of digital signal processing", EEE pub.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD07	**BIOMETRIC**	**4**	**3L-0T-2P**	**Digital Signal Processing**

COURSE OUTCOME (CO):

- Familiarity with different biometric traits and to appreciate their relative significance.
- A good knowledge of the feature sets used to represent some of the popular biometric traits.
- Be able to assess the performance of a biometric matcher.
- Recognize the challenges and limitations associated with biometrics.

COURSE CONTENTS:

Unit I: Understanding Biometrics: Types of Biometrics, Fingerprint and Hand Biometrics: Fingerprints, Palm

Scan, Hand Veins, Signature Biometrics, Retina and Facial Biometrics : Identifying a Retinal Scan, Iris Scanning, Facial Imaging, Other Types of Biometric Identification Schemes : Recognizing Speech, Gait-Recognition Biometrics.

Unit II: Fundamentals: Introduction of image processing basics, basic image operations, filtering, enhancement, sharpening, edge detection, smoothening, enhancement, thresholding, localization.

UNIT III: Characteristics of Biometric Systems: Biometric Concepts and Terms: Biometric system, identification and verification. FAR/FRR, system design issues. Positive/negative identification.Biometric system security, authentication protocols, matching score distribution, ROC curve, DET curve, FAR/FRR curve.Expected overall error, EER.

UNIT IV: Fusion in biometrics: Introduction to Multibiometrics - Information Fusion in Biometrics - Issues in Designing a Multibiometric System , Sources of Multiple Evidence , Levels of Fusion in Biometrics , Sensor level , Feature level, Rank level, Decision level fusion - Score level Fusion.

SUGGESTED READINGS:

1. David D. Zhang, "Automated Biometrics: Technologies and Systems", Kluwer Academic Publishers, New Delhi
2. Rafael C.Gonzalez, Richard E.Woods and Steven L.Eddins, "Digital Image Processing", Pearson Education, New Delhi
3. Arun A. Ross ,KarthikNandakumar, A.K.Jain, "Handbook of Multibiometrics", Springer, New Delhi

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD08	**Computer Networks**	**4**	3-0-2	Analog & Digital Comm.

COURSE OUTCOME (CO):

1. To understand the working of Computer Communication and its utilization in smart and intelligent Instruments, consumer appliances, Telemetry and Industrial processes.
2. The concept of Data Communication methods in coordination with emerging devices and Data Access Protocols. In depth working of various networking applications such as Web, Email, Internet, issues related to ISP selection, and devices and media used to connect DeskTop, LapTop, etc. To understand the socket programming for development of new protocol and networking services.
3. How to measure performance of Computer Networks and to understand the associated parameters that may affect the speed and quality of the Internet services.
4. To understand IP Addressing Mechanism, Issues related to security of critical systems/servers from the threats arose from internal disgruntled users and outside hackers.
5. To prepare for next generation researcher and system designer/developer in the area of fast changing and emerging new Computer Networks Protocols.
6. To train the students enough to understand related scientific and technological terminologies, its clear definition and various networking protocols that are being used to specify new and challenging services and formulation of national and international level policies and guidelines to protect the undue exploitation and misuse of natural resources on the earth by some clever and cunning service providers in this area.

COURSE CONTENTS:

Introduction to Data Communication and the Internet:

What Is the Internet? Services Description, Definition of Protocol; The Network Edge –Internet/Network Access Methods; Physical Media; The Network Core – Packet Switching, Circuit Switching; Delay, Loss, and Throughput in

Packet-Switched Networks, Overview of Delays; Throughput. Protocol Layers and Their Service Models;

Application Layer: Principles of Network Applications; Network Application Architectures; Application-Layer Protocols; The Web and HTTP – Overview, Non-Persistent and Persistent Connections, Message Format. Commands and Replies. Electronic Mail – SMTP, Comparison with HTTP, Mail Message Format, Mail Access Protocols. DNS– The Internet's Directory Service, Services Provided by DNS, How DNS Works, DNS Records and Messages. Socket Programming: Creating Network Applications, with UDP and TCP.

Queuing Theory: Birth Death Process, Littel's Formula, Candel's Notation, M/M/1/ queue.

Transport Layer: Introduction and Transport-Layer Services, Relationship Between Transport and Network Layers, Multiplexing and Demultiplexing, UDP, Principles of Reliable Data Transfer, Go-Back-N (GBN), Selective Repeat (SR), Connection-Oriented Transport: TCP, its Connection, TCP Segment Structure, RTT, Flow Control, TCP Connection Management, Principles of Congestion Control, Network-Assisted Congestion-Control – ATM ABR Congestion Control, TCP Congestion Control.

The Network Layer: Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks, The Internet Protocol (IP): Forwarding and Addressing in the Internet, Datagram Format, IPv4 Addressing, ICMP, Routing Algorithms, The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, Hierarchical Routing, Routing in the Internet, Intra-AS Routing, RIP, OSPF, BGP, Broadcast and Multicast Routing.

The Link Layer: Links, Access Networks, and LANs: Introduction to the Link Layer and its Services, Error-Detection and -Correction Techniques, Checksumming Methods, CRC; Link-Layer Addressing and ARP, Ethernet, Link-Layer Switches, Spanning Tree Protocol, VLANs, MPLS.

SUGGESTED READINGS:

1. Kurose and Ross, "Computer Networking: A Top-Down Approach", 6th Edition.
2. Peterson and Davi, "Computer Networks".
3. Berstecas , "Data Communications",Queuing Theory.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD09	**CONDITION MONITORING OF POWER APPARATUS**	**4**	**3-1-0**	**Power Apparatus**

COURSE OUTCOME (CO):

- Able to understand the concepts of condition monitoring of various electrical machines.

COURSE CONTENTS:

Introduction: Introduction to subject course, Introduction to condition monitoring, Condition monitoring and Diagnostics Engineering management, Techniques employed in the field of Condition monitoring, Identification of equipments in sub-station

Characterization of electrical equipment insulation condition : permittivity and capacitance, resistivity and insulation resistance, time constants, dielectric dissipation factor, partial discharge, physical and chemical changes, Modes of deterioration and failure of practical insulating materials; dielectric losses, partial discharges-sources,

forms and effects, ageing effects, Modes of deterioration and failure of practical insulating materials, Damage due to partial discharge, thermal stress aging, overview of , Identification of major requirements for electrical insulating materials, Concepts of Insulation Design.

Condition Monitoring of Power Transformer:

Transformer oil testing and interpretation-Introduction, mineral insulating oil**,** Four functions of Transformer oil, causes of oil ageing, ageing rate accelerators, control of acceleration factors, development of a comprehensive testing program, various tests on transformer oil such as power factor, Moisture, Neutralization number, Interfacial tension, Relative density, color, visual examination, BDV, dissolved gas analysis, furanic compounds, degree of polymerization and remaining life; and their interpretation as per national and international standards.

Electrical testing of transformer-Various electrical tests on transformer such as Power Factor, Turns ratio, DC resistance test, Insulation resistance test, Leakage reactance, frequency response analysis, partial discharge; and their interpretation as per national standards, international standards and guidelines, Concept of condition index evaluation of transformer, transformer bushing diagnostics.

Condition Monitoring of rotating electrical machines:

Introduction, electric motor failures, simple preventive techniques, methods of motor monitoring such as current, temperature, starting strategies and soft starts, resistance, lubrication, cleaning, general inspection, advanced techniques for electric generator monitoring, vibration monitoring, stator current monitoring.

Condition Monitoring using Artificial Intelligence

Applications of artificial neural networks (ANNs), Fuzzy-Logic (FL), Support vector machine (SVM), Wavelet transform (WT), Genetic algorithm (GA) and Swarm optimization techniques for condition monitoring. AI based noise and vibration analysis and signal processing for rotating machine.

SUGGESTED READINGS:

1. R.E James and Q. Su, "Condition assessment of high voltage insulation in power system equipment",IET.
2. P. J. Tavner, J. Penman and Howard Sedding, "Condition Monitroing of Rotating Electrical Machine", IET
3. M Horning, J. Kelly, S. Myres and R Stebbins, "Transformer Maintenance Guide", Transformer Maintenance Institute USA.
4. B. K. N. Rao, "Handbook of Condition Monitoring", Elsevier Science Publisher
5. Y. Han and Y. H. Song, "Condition Monitoring Techniques for Electrical Equipment – A Literature Survey." IEEE Trans. on Power Delivery, Vol. 18, No. 1, January 2003.
6. W. H. Tang and Q. H. Wu,"Condition Monitoring and Assessment of Power Transformers Using Computational Intelligence", Springer-Verlag London Limited.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD10	**DESIGN OF HYDRO POWER STATION**	**4**	3L-1T-0P	Nil

COURSE OUTCOME (CO):

- To develop understanding about the planning and layout designing for a hydro power plant
- To develop understanding about the various electrical machines used in hydro power generation

COURSE CONTENTS:

Layout & Planning of Hydro Power Plant: Introduction, layout of power house, types of hydro power schemes, stages of investigation, PFR, DPR, hydrology, water availability and water conductor system. Penstocks, types,

penstock supports, trash racks.

Power Potential Estimation of Hydro Power Plants: Head, dependability analysis, layout of electrical equipments in hydro power station, selection of number of units, capacity of power plant and energy generation, and economics of the hydro power plant.

Turbines: Introduction, types of hydraulic turbines and their suitability for power plant, governing of turbines, electro hydraulic governors, time constants of governors and their importance, testing of hydraulic turbines, cavitation, silt erosion.

Hydro Generators: Introduction, construction and types of hydro generators, specifications of hydro generators, characteristics of hydro generators, general arrangement of water wheel generators: large horizontal shaft generators, vertical and reversible generators, low speed generators, umbrella type, brakes and jacks, losses, insulation and temperature limits, testing of generators, generator cooling and ventilation, fire protection, design of auxiliary and grounding systems, switchyard equipments, transformers and circuit breakers.

Stability of Hydro Power Plants: Special features of hydro power plant stability.

SUGGESTED READINGS:

1) J.Guthrie Brown, "Hydro Electric Engineering: Vol.I,II,III", Blackie & Son Ltd., London.
   Nigam, A Hand Book of Hydro Electric Engineering, Nem Chand Publishers, Roorkee.
2) B.R.Gupta, "Generation of Electrical Energy", S. Chand & Co.
3) M.V.Deshpande, "Elements of Electrical Power Station ,Design", Ah Wheeler & Co Ltd.
4) Kothari & Nagrath, "Electrical Machines", TMH.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC11	**Biomedical Instrumentation**	**4**	**3-0-2**	Nil

COURSE OUTCOME (CO):

- Student will have the understanding about human anatomy and physiology
- Students will be able to measure the biomedical signals of the human body
- Students will be able to diagnose the human body by referring EEG, ECG, EMG signals.

COURSE CONTENTS:

Physiological Systems of the Body: Brief description of musculoskeletal, endocrine, gastrointestinal, nervous, circulatory and respiratory systems; the body as a control system; the nature of bioelectricity, action events of nerve; the origin of biopotentials.

Bio potential Electrodes: Signal acquisition; electrodes for biophysical sensing; electrode-electrolyte interface; skin preparation, electrode-skin interface and motion artifact; surface electrodes; microelectrodes; Internal electrodes; electrode arrays; electrodes for electric stimulation of tissues; electrode polarization, electrical interference problems in biopotential measurement; electrical safety.

The Heart System and Its Measurements: The heart; electro conduction system of the heart; the ECG waveform; the standard lead system; the ECG preamplifier; ECG machines; Cardiac monitors; Transient protection; common-mode and other interference-reduction circuits.

Physiological Pressure and other Cardiovascular Measurements and Devices: Physiological pressure; blood pressure measurements; sphygmomanometer; oscillometric and ultrasonic methods; practical problems in pressure monitoring; cardiac output measurement; plethysmography; blood flow measurements; phonocardiography; vectorcardiography; defibrillators; pacemakers; heart lung machines.

The Human Respiratory System and Its Measurement: Respiratory anatomy (lungs, conducting airways, alveoli,

pulmonary circulation, respiratory muscles); lung volumes and gas exchange, mechanics of breathing; parameters of respiration; regulation of respiration; unbalanced and diseased states; environmental threats to the respiratory system; respiratory system measurements; respiratory transducers and instruments; spirometry, body plethysmography.

Measurement of Electrical activity in Neuromuscular System and Brain: Neuron potential; muscle potential; electromyography (EMG); electroencephalography (EEG); EEG electrodes and the 10-20 system; EEG amplitude and frequency bands; the EEG system – simplified block diagram; preamplifiers and EEG system specifications; EEG diagnostic uses and sleep patterns; visual and auditory evoked potential recordings; EEG system artifacts.

SUGGESTED READINGS:

1. Carr Joseph J. and Brown John M., "Introduction to Biomedical Equipment Technology", 4th Ed., New Delhi: Pearson Education India
2. Webster John G (Ed.), "Medical Instrumentation, Application and Design", 3rd ed., Singapore: John Wiley & Sons (Asia) Pte. Ltd.
3. Webster J G (ed.), "Encyclopedia of Medical Devices and Instrumentation", Vols. 1-4, New York: Wiley
4. Bronzino J D (ed.), "The Biomedical Engineering Handbook", FL: CRC Press
5. Khandpur R S, "Handbook on Biomedical Instrumentation", TMH, 13th reprint, New Delhi

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD12	**DISCRETE TIME CONTROL SYSTEMS**	**4**	3-0-2	Control System I

COURSE OUTCOME (CO):

- Able to do stability analysis of discrete time systems
- Able to design compensators using bode plot

COURSE CONTENTS:

UNIT 1: 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

UNIT2. Time-response of discrete systems, second order systems, Discrete PID Controller and its application

UNIT3. Stability analysis of discrete time systems, Jury stability test, stability analysis using bilinear transformation, Root locus method

UNIT4. Frequency Response, Nyquist criteria and Sampling Theorem, Bode Plot and determination of frequency response parameters.

UNIT5. Compensator design using Bode Plot.

UNIT6. Introduction to State Space in discrete time domain, Various Canonical forms, State equation and its solution, Controllabilty and Observability, Pole-placement by state feedback, Full order and reduced order observer.

SUGGESTED READINGS:

1. Ogata, "Discrete Time Systems".
2. B.C Kuo, "Digital Control Systems".

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD13	**DRIVE SYSTEM IN ELECTRIC TRACTION**	**4**	3-0-2	Knowledge of Electric Machines and Power

				Electronics

COURSE OUTCOME (CO):

- Students will be able to identify the applications of modern ac and dc drives in Electric Trains, Trams, Electric Buses.

COURSE CONTENTS:

General features of electric traction, mainline and suburban trains, nature of load and motor for traction. Mechanism of train movement, duty cycle, torque sharing between motors, driving axle code. Calculation of tractive effort, drive rating and energy consumption, specific emery consumption. Electrical motors for traction, starting and speed control of sc motors and ac motors .Power electronic converters in modern traction practice, phase controlled converters, choppers, VSI for ac motor, PWM control. Diesel electric traction, characteristics of diesel engine. AC drives in Electric Traction, comparative advantages over dc drives.

SUGGESTED READINGS:

1. Dubey G.K., "Fundamental of Electrical Drives", Narosa Publishing House, New Delhi.
2. Shepherd W., Halley L.N., Liang D.T.W., "Power Electronics and Motor Control", Cambridge Printing Press, UK.
3. Andrews H.I., "Railway Traction-The Principles of Mechanical and Electrical Railway Traction", Elsevier, Prentice Hall.
4. Bose B.K., "Power Electronics & Variable Frequency Drives – Technology & Applications", IEEE Press, Standard Publisher Distributors, Delhi.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD14	**DSP CONTROLLED ELECTRIC DRIVES**	**4**	3-0-2	Knowledge of Microprocessor and Electric Drives

COURSE OUTCOME (CO):

- Students will be able to implement DSP-based conventional control algorithms and modern control theory for closed loop control of AC/DC drives.

COURSE CONTENTS:

DSP Processors: Review of microcontrollers and microprocessors; Architecture of DSPs, bus architecture and memory, data addressing; Instruction set; General purpose I/O; Interrupts; external interfacing; Programming of DSP, C language and assembly language; execution, speed issues; Analog-to-Digital converter; Event managers. Feed Back Signal Processing: Measurement of electrical and mechanical variables- current, speed and position of motor, signal conditioning. DSP Based Control of Converters: Control of Buck-Boost DC-DC converter; Implementation of Clarkes and Park's transformation; Implementation of Space Vector Modulation for inverters; Control of matrix converters. DSP Based Control of Closed Loop Drive: DSP implementation of speed and current PI control; DSP based control of dual converter fed dc motor; BLDC motor, induction motor; Field Oriented Control- Direct and Indirect controls. Modern Control Theory Applications: Fundamental of Fuzzy Logic Control; Fuzzy control of closed loop dc drive; Fundamentals of ANN control; Neural current and speed control of induction motor. Design of Controllers: Mathematical modeling; Design of current and speed controllers in continuous and discrete data system, stability studies.

SUGGESTED READINGS:

1. Dubey G. K., "Power Semiconductor Controlled Drives", PrenticeHall International Editions.

2. Bose B. K., "Power Electronics and Variable Frequency Drives", IEEE Press, Standard Publisher Distributors.
3. Bose B. K., "Microcomputer Control of Power Electronics and Drives", IEEE Press.
4. Toliyat H. A. and Campbell S., "DSP Based Electromechanical Motion Control", CRC Press.
5. Kenjo T., "Power Electronics for the Microprocessor Age", Oxford University Press.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD15	**WIND AND SOLAR BASED ELECTRICAL SYSTEMS**	**4**	3-0-2	Power Apparatus

COURSE OUTCOME (CO):

- Able to understand wind energy power generating system.
- Able to understand solar energy power generating system.
- Able to maintain/fault diagnosis of the generating system

COURSE CONTENTS:

Basic characteristics of sunlight - solar spectrum - isolation specifics - irradiance and irradiation - pyranometer - solar energy statics - Solar PV cell - I-V characteristics - P-V characteristics - fill factor - maximum power point. PV module - blocking diode and bypass diodes - composite characteristics of PV module - PV array - PV system - PV-powered fan - PV fan with battery backup - PV-powered pumping system - PV powered lighting systems - grid-connected PV systems. Wind source - wind statistics - energy in the wind - turbine power characteristics - aerodynamics - rotor types - parts of wind turbines - braking systems - tower - control and monitoring system. General characteristics of induction generators - grid-connected and selfexcited systems - steady-state equivalent circuit - performance predetermination - permanent magnet alternators - steady-state performance. Power electronic converters for interfacing wind electric generators - power quality issues - hybrid systems - wind-diesel systems - wind-solar systems.

SUGGESTED READINGS:

1. Roger A. Messenger and Jerry Ventre, "Photovoltaic systems engineering", CRC press, second edition
2. M. Godoy Simoes and Felix A. Farret,"Renewable Energy Systems - Design and Analysis with induction generators", CRC press, first edition
3. Ion Boldea, "The electric generators hand book - Variable speed generators", CRC press
4. S N Bhadra, S Banerjee and D Kastha, "Wind Electrical Systems", Oxford University Press

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD16	**ELECTRIC DRIVES FOR HYBRID VEHICLES**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- Students will be familiar with the concept of hybrid vehicles, types of electric drives used in hybrid vehicles and their control.

COURSE CONTENTS:

Introduction: History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs. Hybridization of Automobile: Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell Behicles and its constituents. Plug-in Hybrid

Electric Vehicle: PHEVs and EREVs, blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging. Power Electronics in HEVs: Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers. Electric Machines and Drives in HEVs: Induction motor drives, Field oriented control of induction machies; Permanent magnet motor drives; Switched reluctance motors; Doubly salient permanent magnet machines. Case Studies.

SUGGESTED READINGS:

1. Pistooa G., "Power Sources , Models, Sustanability, Infrstructure and the market", Elsevier
2. Mi Chris, Masrur A., and Gao D.W., " Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives".

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD17	**ENERGY AUDITING**	**4**	3-0-2	Power apparatus

COURSE OUTCOME (CO):

- Students will have basic knowledge of Basics of Energy its various forms and conservation.
- Students will be able to apply their knowledge for Evaluation of thermal performance and Energy Manageme & Audit.
- Students will be able contribute towards Energy Monitoring and Targeting, Heat Recovery and Co-generatio

COURSE CONTENTS:

Energy Scenario: Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sect reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy sonservation and importance, Energy strategy for the future, Energy conservation Act-2001 and its features.

Energy Management and Audit: Definition, Energy audit- need, Types of energy audit, Energy management (aud approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requireme Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy au instruments

Material and Energy Balance: Facility as an energy system, Methods for preparing process flow, Material and ener balance diagrams.

Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payba period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analys Financing options, Energy performance contracts and role of ESCOs.

Electrical System: Electricity tariff, Load management and maximum demand control, Power factor improveme Distribution and transformer losses. Losses in induction motors, Motor efficiency, Factors affecting motor performan Rewinding and motor replacement issues, energy efficient motors. Light source, Choice of lighting, Luminan requirements, and Energy conservation avenues

SUGGESTED READINGS:

1) Abbi, Y.P. and Jain, S., "Energy Audit and Environment Management", Teri Press
2) P.Diwan and P.Dwivedi, "Energy Conservation", Pentagon Press
3) A.Thumann, W.J.Younger, T.Niehus, "Energy Audits", CRC Press

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD18	**EVOLUTIONARY COMPUTATIONS**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- To develop knowledge of evolutionary computation techniques and methodologies set in the context of mode heuristic methods.
- To gain experience in matching various evolutionary computation methods and algorithms for particul classes of problems.
- To gain experience in applying various evolutionary computation methods and algorithms as a part of softwa development.
- To develop knowledge and experience indeveloping evolutionary algorithms for real-world applications.

COURSE CONTENTS:

Introduction: A brief history of evolutionary computation, Elements of Genetic Algorithms, A simple genet algorithm, Applications of genetic algorithms.

Genetic Algorithms in Scientific Models: Evolving computer programs, data analysis & prediction, evolving neur networks, Modeling interaction between learning & evolution, modeling sexual selection, measuring evolutiona activity.

Theoretical Foundation of Genetic Algorithm: Schemas & Two-Armed and k-armed problem, royal roads, exa mathematical models of simple genetic algorithms, Statistical- Mechanics Approaches.

Computer Implementation of Genetic Algorithm: Data structures, Reproduction, crossover & mutation, mappi objective functions to fitness form, fitness scaling, coding a multiparameter, mapped, fixed point coding, discretizati and constraints.

Some Applications of Genetic Algorithms : The risk of genetic algorithms, De Jong's & function optimizatio Improvement in basic techniques, current application of genetic algorithms

Advanced Operators and Techniques in Genetic Search: Dominance, duplicity, & abeyance, inversion & oth reordering operators. Other micro operators, Niche & speciation, multiobjective optimization, knowledge bas techniques, genetic algorithms & parallel processors.

SUGGESTED READINGS:

1) David E. Goldberg, "Genetic algorithms in search, optimization & Machine Learning", Pearson Education
2) Melanle Mitchell, "An introduction to genetic algorithms", Prentice Hall India
3) Michael D. Vose, "The simple genetic algorithm foundations and theory", Prentice Hall India
4) Masatoshi Sakawa, "Genetic Algorithms & Fuzzy Multiobjective Optimization", Kluwer Academic Publisher
5) D. Quagliarella, J Periaux, C Poloni & G Winter "Genetic Algorithms in Engineering & Computer science", Jo Wiley & Sons

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD19	**FAULT DETECTION AND DIAGNOSIS**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- Able to understand the principles of Faulty detection and diagnosis
- Know about different type of faults occurred in a system.
- Understand Mathematical analysis of different faults.
- Understand Structured and directional concepts techniques for FDI design.

COURSE CONTENTS:

Introduction to Fault Detection and Diagnosis: Scope of FDD:- Types of faults and different tasks of Fault Diagnosis and Implementation - Different approaches to FDD: Model free and Model based approaches. Classification of Fault and Disturbances- Different issues involved in FDD- Typical applications.

Analytical Redundancy Concepts: Introduction- Mathematical representation of Fault and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of Residual generator – Residual specification and Implementation.

Design of Structured Residuals: Introduction- Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of Multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation.

Design of Directional structured Residuals: Introduction – Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation – Linearly dependent column.

Advanced level issues and design involved in FDD: Introduction of Residual generation of parametric fault – Robustness Issues –Statistical Testing of Residual generators – Application of Neural and Fuzzy logic schemes in FDD – Case study.

SUGGESTED READINGS:

1. Janos J. Gertler, “Fault Detection and Diagnosis in Engineering systems”, 2nd Edition, Macel Dekker
2. Sachin. C. Patwardhan, “Fault Detection and Diagnosis in Industrial Process”, Lecture Notes, IIT Bombay
3. Rami S. Mangoubi, “Robust Estimation and Failure detection”, Springer-Verlag-London

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD20	**HIGH VOLTAGE ENGINEERING**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- Able to understand the principles of Insulation and Dielectrics.
- Understand the insulation breakdown mechanism.
- Understand liquid and solid dielectric property under high voltage condition

Introduction

Levels of voltages, Electrical Insulation and Dielectrics, Importance of Electric Field Intensity in the Dielectrics, Typ of Electric Fields, Degree of Uniformity of Fields (Schwaiger Factor), Stress Control.

Gaseous Dielectrics

Properties of atmospheric air and SF_6, Related ionization Process, Properties of vacuum, Related ionization Proce Development of Electron Avalanche, Breakdown Mechanisms, Townsend's Mechanism, Streamer Mechanis Breakdown in Uniform Fields (Paschen's Law), Breakdown of gaseous dielectrics in Weakly Non-uniform and t limiting value of η, Development of 'Partial Breakdown' (PB) in Extremely Non-Uniform Fields, Breakdo characteristics’ in air with stable PB (corona).

Liquid and Solid Dielectrics

Classification and Properties of Liquid Dielectrics, Classification and Properties of Solid Dielectrics, Permittivity a

Polarization in Dielectrics, Insulation Resistance, Conductivity and Losses in Dielectrics, Partial Breakdov Phenomenon in Dielectrics, Partial Breakdown Phenomenon on the Surfaces of Soild and Liquid Dielectrics a degradation due to PB.

Breakdown in Liquid and Solid Dielectrics

Measurement of Intrinsic Breakdown in solid dielectrics, Thermal and other Breakdown Mechanisms in extremely no uniform fields, Comparison of the development of breakdown in extremely and weakly non-uniform fields and t requirement of time for breakdown in solid dielectrics.

Generation of High Test Voltages

Methods of generation of Power Frequency high test voltage, Transformers in Cascade, Resonance Transforme Generation of high dc voltage, Voltage Multiplier Circuits and Ripple Minimization, Sources of over voltages a Standard Lightning and Switching wave shapes, Impulse Voltage Generator, Analysis of Single Stage Circu Multistage Impulse Generator and their Triggering Methods.

Measurement of High Test Voltages

Peak High Voltage measurement techniques, Sphere gap; Construction; Effects of earthed objects and atmospher conditions, Electrostatic Voltmeters, Principle and Construction, Potential Dividers, their types and applications,

Non-destructive High Voltage Testing and Quality Control

Measurable properties of dielectrics, Measurement of Dielectric properties with Schering Bridge and Megaohm mete Parital Breakdown (PB) Measurement Techniques in Dielectrics/ Equipment. Vo

Insulation Coordination and Over Voltages in Power Systems

Over voltages and Basic insulation level design.

SUGGESTED READINGSS:

1. M.S.Naidu and V.Kamaraju, "High Voltage Engineering", Tata McGraw Hill
2. E.Kuffel and M. Alldullah, "High Voltage Engg", Pergamon Press, Oxford
3. E.Kuffel and Zaengal, "High Voltage Engineering", Second edition, Butterworth-Heinemann

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD21	**INSTRUMENTATION IN ELECTRIC DRIVES**	**4**	3-0-2	Electronic Instrumentation

COURSE OUTCOME (CO):

- Students will be able to develop the understanding about the instrumentation related to electric drive parameters and their signal conditioning circuits using linear/analog and digital integrated circuits.

COURSE CONTENTS:

Transducers and sensors, definitions, classification of errors. Review of characteristics and parameters of transducers: tachometers, shaft-encoders, torque sensors, Hall-effect sensors, and magnetic pick-ups. Devices for instrumentation, design characteristics and typical applications of instrumentation, operational trans-conductance, isolation amplifiers, analog multipliers and dividers, function generators, timers, analog multiplexers. Sample and hold, optical and magnetic isolators; Frequency to voltage converters, temperature to current converters. Review of A/D and D/A converters, specifications, multiplexed ADC, multiplying ADC; Data acquisition system. Instrumentation and signal processing. Basic concept of PLL system, definitions of lock-in-range, capture range, loop gain, design aspects of phase detector, loop filter, PLL based motor speed control Drive related signals and their instrumentation and conditioning. Data acquisition system, basic structure, data acquisition of voltage, currents, speed, temperature, torque and flux.

SUGGESTED READINGS:

1. Cerni, R. H. and Foster L. E., "Instrumentation for Engineering Measurement", John Wiley and Sons.
2. Coughlin R. F. and Driscoll F. F., "Operational Amplifier and Linear Integrated Circuits", Prentice Hall of India Private Limited.
3. Norton N., "Handbook of Transducers", Prentice Hall International Edition.
4. Hamilton T. D. S., "Handbook of Linear Integrated Electronics", McGraw-Hill International Book Company.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD22	**INTELLIGENT CONTROL**	**4**	3-0-2	Control systems-I

COURSE OUTCOME (CO):

- Student will be able to understand various artificial intelligence techniques such as Fuzzy logic and neural network.
- Student will be able to apply the artificial intelligence techniques in solving the control problems

COURSE CONTENTS:

UNIT 1. Biological foundations to intelligent Systems : Artificial Neural Networks, Single layer and Multilayer Feed Forward NN, LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks.Fuzzy Logic, Knowledge Representation and Inference Mechanism, Defuzification Methods, FuzzyNeural Networks and some algorithms to learn the parameters of the network like GA

UNIT 2. System Identification using Fuzzy and Neural Network

UNIT 3. Fuzzy logic and Neural Network Controller design for Direct and Indirect Adaptive Control

UNIT 4. Applications of above mentioned techniques to Non-Linear Dynamical Systems.

SUGGESTED READINGS:

1. J M Zurada, "An Introduction to ANN".
2. Simon Haykins, "Neural Networks".
3. Timothy Ross, "Fuzzy Logic with Engg.Applications".
4. Driankov and Dimitra, "An Introduction to Fuzzy Control".
5. Golding, "Genetic Algorithms".

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD23	**LARGE SCALE SYSTEMS**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- Able to understand the large scale systems
- Able to apply order reduction techniques

COURSE CONTENTS:

UNIT I – Large Scale Systems:

Introduction:, Hierarchial structures ,Decentralised control, Large scale system Modeling

UNIT II -Model Order Reduction of *L*arge Scale Systems: Frequency Domain Based Methods:

Introduction, Moment matching, Pade approximation, Routh approximation, continued fraction method, error minimization methods, mixed methods and unstable systems, Pade model method, Pade-Routh method, multi input and multi output systems, reduction, matrix continued fraction method, Model continued fraction method, Pade model method, frequency comparison method.

UNIT III –Model Order Reduction: Time Domain Based Methods:

Aggregation method,Singular Perturbation method,Balanced Realization method,Hankel norm approximation.

UNIT IV - Stable Routh –Pade Model Reduction of Interval systems:

Introduction, Interval Routh table computation, Stable Routh-Pade model reduction of interval system: the Pade approximation, Kharitonov robust stability theory, problem formulation, moment matching in the stable Routh-Pade model reduction interval systems, stable reduction of interval denominator using kharitonov polynomials, the procedure for stable Routh-Pade model reduction of interval systems; numerical examples related to study.

SUGGESTED READINGS:

1. Mohammad Jamshidi,"Large Scale Systems Modelling and Control", North Hollard (Series in systems science and engineering, vol.9).
2. Magdi S. Mohamoud and Madan G. Singh, "Large Scale Systems Modelling", Pergamon Press (International series on Systems and Control)
3. Prashant Shingare, B.Bandyopadhyay & H.L. Abhyankar, " Model Reduction Techniques using Interval Analysis and Optimization with control system applications", VDM Verlag Dr. Muller publisher Germany.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD24	**LOGIC AND DISTRIBUTED CONTROL SYSTEMS**	**4**	3-0-2	Control System-I

COURSE OUTCOME (CO):

- Student will be able to identify the role of computers / controllers in the control system
- Student will be able to understand the role of data loggers and the data acquisition system in a process control

COURSE CONTENTS:

UNIT 1: Review of computers in process control: Data loggers, Data Acquisition Systems (DAS),Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA),sampling considerations.Functional block diagram of computer control systems.

UNIT 2: Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies and isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions, PLC Basic Functions, register basics, timer functions, counter functions.PLC intermediate functions: Arithmetic functions, comparison functions, Skip and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance.

UNIT 3: Design of interlocks and alarms using PLC. Distributed Control Systems (DCS): Definition, Local Control Unit (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, redundancy concept. Introduction – Evolution of signal standards – HART communication protocol –communication modes – HART networks. Introduction – General field bus architecture –basic requirements of field bus standard. Case studies of PLC and DCS with industrial applications.

SUGGESTED READINGS:

1. John.W. Webb Ronald A Reis, "Programmable Logic Controllers - Principles andApplications", 4th Edition, Prentice Hall Inc., New Jersey
2. Lukcas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York

3. Frank D. Petruzella, "Programmable Logic Controllers", 2nd Edition, McGraw Hill, NewYork
Reference Books:
1. Deshpande P.B and Ash R.H, "Elements of Process Control Applications", ISA Press,New York
2. Curtis D. Johnson, "Process Control Instrumentation Technology", 7th Edition,Prentice Hall, New Delhi
3. Krishna Kant, "Computer-based Industrial Control", Prentice Hall, New Delhi

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD25	**MECHATRONICS**	**4**	3-0-2	Electronics

COURSE OUTCOME (CO):

- Able to understand the fundamentals of fluid power Principles, characteristics of the fluid power system components.
- Able to Analyze the fluid power system components for various application
- Able to Design and develop fluid power circuits to various mechatronic systems.
- Apply the knowledge of fluid power in to various mechatronic applications.

COURSE CONTENTS:

UNIT I - HYDRAULIC COMPONENTS: Introduction to fluid power system-Pascal's Law- Hydraulic fluids- Hydraulic pumps- Gear, Vane and Piston pumps- Pump Performance- Characteristics and Selection-actuators- valves-pressure control- flow control and direction control valves- Hydraulic accessories- Hydraulic Accumulator.

UNIT II - PNEUMATIC COMPONENTS: Introduction to Pneumatics- Compressors- types-. Air treatment-FRL unit- Air dryer- Control valves- Logic valves-Time delay valve and quick exhaust valve-Pneumatic Sensors – types- characteristics and applications.

UNIT III - FLUID POWER CIRCUITS: Circuit Design Methodology- Sequencing circuits- Overlapping signals- Cascade method- KV Map method-Industrial Hydraulic circuits- Double pump circuits- Speed control Circuits- Regenerative circuits- Safety circuits- Synchronizing circuits- Accumulator circuits.

UNIT IV - ELECTRO- PNEUMATICS AND HYDRAULICS: Relay, Switches- Solenoid- Solenoid operated valves- Timer- Counter- Servo and proportional control- Microcontroller and PLC based control- Design of electro-pneumatic and hydraulic circuits

UNIT V – PLC: Evolution of PLC's - Sequential and programmable controllers - Architecture- Programming of PLC - Relay logic - Ladder logic - Gates, Flip flops and Timers.

UNIT VI - COMMUNICATION IN PLC's: Requirement of communication networks of PLC - connecting PLC to computer - Interlocks and alarms - Case study of Tank level control system and Sequential switching of motors.

SUGGESTED READINGS:

1. John Pippenger, Tyler "Hicks, Industrial Hydraulics*"*, McGraw Hill
International Edition
2. Andrew*Parr, "*Hydraulics and pneumatics", Jaico Publishing House
3. FESTO, "Fundamentals of Pneumatics*"*, Vol I, II, III.
4. Petrezeulla, *"*Programmable Controllers*"*, McGraw Hill
5. Hughes .T, "Programmable Logic Controllers", ISA Press
6. Curtis D. Johnson "Process Control Instrumentation" Tech 8TH Edition Prentice Hall
7. Anthony "*Esposito, "* Fluid Power with applications*"*, Prentice Hall international
8. Majumdar .S.R, "Oil Hydraulics*"*, Tata McGraw Hill

9. Majumdar S.R, "Pneumatic systems - principles and maintenance", Tata McGraw Hill

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD26	**MEMS**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- Able to understand the operation of micro devices, micro systems and their applications.
- Able to design the micro devices, micro systems using the MEMS fabrication process

COURSE CONTENTS:

Introduction, emergence, devices and application, scaling issues, materials for MEMS, Thin film deposition, lithography and etching.

Bulk micro machining, surface micro machining and LIGA process.

MEMS devices, Engineering Mechanics for Micro System Design, Micro Pressure Sensor, Micro accelerometer.

Electronic interfaces, design, simulation and layout of MEMS devices using CAD tools.

Introduction to Nanotechnology, Nano sensors, Molecular Nanotechnology, CNT Types, synthesis and applications.

SUGGESTED READINGS:

1. Tai Ran Hsu, "MEMS & Microsystem Design and Manufacture", Tata McGraw Hill, New Delhi
2. Marc Madou, "Fundamentals of Micro fabrication", CRC Press
3. Julian W. Gardner and Vijay K. Varadan, "Microsensors, MEMS, and Smart Devices", John Wiley & Sons Ltd
4. Michael Wilson, KamaliKannangara, Geoff Smith, Michelk Simon, "Nanotechnology: Basic Science and Emerging technologies".
5. Bharat Bhushan, "Handbook of Nanotechnology", 1st Edition, Springer

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD27	**MICRO SYSTEM DESIGN**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- To develop fundamental concepts and techniques used in design and fabrication of nano/micro-systems are introduced from an engineering perspective.
- Engineered micro-scale systems are compared with meso-scale systems and their mechanical, electrical, and optical properties are discussed.
- In addition to nano/micro-physics needed for design and analysis, commonly used fabrication and manufacture processes and techniques are included. Testing, verification and metrology methods employed in nano/micro-systems and nano-structured materials are covered and discussed.

COURSE CONTENTS:

Introduction, An approach to MEMS design, Basic introduction to fabrication, Process Integration

Energy conserving transducer, Mechanics of membranes and beams

Electrostatic Actuation and Sensing, Effects of electrical excitation

Design of Micro pressure sensor and Micro accelerometer

Electronic Integration and Packaging

SUGGESTED READINGS:

1. Peter D. Senturia, "Microsystem Design", Kluwer Academic Publishers, Boston

2. MinhangBao, "Analysis and Deisgn Principles of MEMS Devices", Elsevier
3. M. Elwenspoek, R. Wiegerink, "Mechanical Microsensors", Springer, Berlin
4. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture", McGraw-Hill, Boston

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD28	**MODELING AND ANALYSIS OF ELECTRICAL MACHINES**	**4**	3-0-2	Power Apparatus

COURSE OUTCOME (CO):

- The students will be able to model all types of rotation machines including special machines. They will have complete knowledge about electromagnetic energy conversion and application of reference frame theories for modeling of machines.

COURSE CONTENTS:

Principles of Electromagnetic Energy Conversion, General expression of stored magnetic energy, co-energy and force/torque, example using single and doubly excited system. Basic Concepts of Rotating Machines-Calculation of air gap mmf and per phase machine inductance using physical machine data; Voltage and torque equation of dc machine. Three phase symmetrical induction machine and salient pole synchronous machines in phase variable form; Application of reference frame theory to three phase symmetrical induction and synchronous machines, dynamic direct and quadrature axis model in arbitrarily rotating reference frames, Determination of Synchronous Machine Dynamic Equivalent Circuit Parameters, Analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine. Special Machines - Permanent magnet synchronous machine: Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines. Construction and operating principle, dynamic modeling and self controlled operation; Analysis of Switch Reluctance Motors.

SUGGESTED READINGS:

1. Charles Kingsley,Jr., A.E. Fitzgerald, Stephen D.Umans, "Electric Machinery", Tata Mcgraw Hill
2. R. Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India
3. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, 1 st Edition

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD29	**NON LINEAR CONTROL**	**4**	3-0-2	Control System-I

COURSE OUTCOME (CO):

- Student will have the understanding about Reinforcement Learning
- Students will be able to develop the algorithms and AI based models.

COURSE CONTENTS:

Introduction: Reinforcement Learning, Elements of Reinforcement Learning, History of Reinforcement Learning

The Reinforcement Learning Problem: The Agent-Environment Interface, Goals and Rewards, Returns, Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation

Elementary Solution Methods: Dynamic Programming, Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming

Temporal-Difference Learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-Policy TD Control, Q-Learning: Off-Policy TD Control, Actor-Critic Methods

Eligibility Traces: One Step TD Prediction, The Forward View of TD, The Backward View of TD, Equivalence of

Forward and Backward Views, Sarsa, Q, Eligibility traces

Generalization and Function Approximation: Value Prediction with Function Approximation, Neural network based RL, Fuzzy Q Learning

Game theory based RL: Noise or disturbance as opponent, Markov games, Game theory, Neural Markov game control, Fuzzy RL based controllers

Control Problems: Inverted Pendulum, Standard Two link Robotic Manipulator, Mobile Robot, SCARA robotic manipulator and other control problems

SUGGESTED READINGS:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", The MIT Press, Cambridge, Massachusetts London, England

2. Jennie Si, A. G. Barto, W. B. Powell, and D. Wunsch, "Handbook of Learning and Approximate Dynamic Programming", Willey-IEEE Press

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD30	**OPTIMIZATION TECHNIQUES**	**4**	3-0-2	Undergraduate level mathematics

COURSE OUTCOME (CO):

- After learning the techniques they can apply to engineering and other problems.

COURSE CONTENTS:

Linear programming – formulation - Graphical and simplex methods - Big-M method - Two phase method - Dual simplex method - Primal Dual problems Unconstrained one dimensional optimization techniques - Necessary and sufficient conditions – Unrestricted search methods - Fibonacci and golden section method - Quadratic Interpolation methods, cubic interpolation and direct root methods Unconstrained n dimensional optimization techniques – direct search methods – Random search – pattern search and Rosen brock's hill climbing method - Descent methods - Steepest descent, conjugate gradient, quasi - Newton method Constrained optimization Techniques - Necessary and sufficient conditions – Equality and inequality constraints - Kuhn-Tucker conditions - Gradient projection method - cutting plane method - penalty function method Dynamic programming - principle of optimality - recursive equation approach - application to shortest route, cargo - loading, allocation and production schedule problems

SUGGESTED READINGS:

1. Rao S.S., "Optimization :Theory and Application", Wiley Eastern Press

2. Taha,H.A., "Operations Research –An Introduction", Prentice Hall of India

3. Fox, R.L., "Optimization methods for Engineering Design", Addition Wiely

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD31	**PARAMETER ESTIMATION AND SYSTEM IDENTIFICATION**	**4**	3-0-2	Control System-II

COURSE OUTCOME (CO):

- To make student familiar with system identification
- Able to understand adaptive control
- Able to understand parameter estimator

COURSE CONTENTS:

UNIT1. Introduction and overview of System Identification, Adaptive Control and Applications, Parameter Estimation; Least Square , Generalised and Recursive Least Square Estimation, Estimator Properties including error bounds and Convergence,MES,ML and MAP estimators,Non-Linear Least Squares.

UNIT2. Model structures and Predictors, Recursive identification of Linear dynamic System: RLS,ELS,RML, stochastic approximation,Kalman filter and Extended Kalman filter

UNIT3. ARMA, NARMA and State Models, Convergence analysis, Time varying Parameters

SUGGESTED READINGS:

1. L. Jung, "Non-Linear System Identification".

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD32	**PHYSIOLOGICAL CONTROL SYSTEMS**	**4**	3-0-2	Control System-I

COURSE OUTCOME (CO):

- Student will have the understanding about human anatomy and physiology
- Students will be able to develop the mathematical model of physiological systems

COURSE CONTENTS:

Brief introduction to human Anatomy and physiology: Basic human anatomy and physiology of the cardiovascular, nervous, muscular, and respiratory systems and their interactions; Transport mechanisms: Emphasis on the physical and engineering principles governing the systems, various transport mechanisms of ions and molecules, concept of action potential.

Mathematical Modeling: Generalized system properties, Linear model of physiological systems, Laplace transform and concept of T.F., impulse response and convolution concept, computer analysis and simulation, differences between engineering and physiological control systems.

Static Analysis of Physiological Systems: Open loop Vs closed loop systems, steady-state operating point, and regulation of cardiac output.

Time Domain Analysis of Linearized Physiological Systems: Open loop and closed loop – transient responses, Descriptions of impulse and step responses for a generalized second order systems, Transient response , Effect of external disturbances and parameter variation,

Frequency Domain Analysis: Steady state response to sinusoidal inputs, graphical representation of frequency response, frequency response of a model of circulatory system, frequency response of general human body.

Stability Analysis: Stability and transient response, various approaches of linear system stability analysis, Root locus plots, RH – stability criterion, Nyquist criterion for stability.

SUGGESTED READINGS:

1. Khoo, Michael C K, "Physiological Control Systems – Analysis, Simulation and Estimation", EMB, IEE Press Series in Biomedical Engineering, Metin Akay, PHI Publishers, New Delhi
2. Graff K M VanDe and Rhees R Ward, "Scham's Outlines", TMH Publishing Co. Ltd., New Delhi
3. Ogata K, "Modern Control Engineering", 4th Ed., PHI, New Delhi

4. Nagrath I J and Gopal M, "Control System Engineering", Wiley Eastern Ltd., New Delhi
5. Friendland B, "Advanced Control System Design", PH-NY

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD33	**POWER APPARATUS DESIGN**	**4**	3-0-2	Power Apparatus

COURSE OUTCOME (CO):

- Student will be able to identify the various parameters to be selected for a particular electrical machi designing
- Student will be able to apply the various designing concepts of electrical machines.

COURSE CONTENTS:

Principles of Design of Machines: Specific loadings, choice of magnetic and electric loadings, Real and apparent fl densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines a synchronous machines.

Heating Cooling and Ventilation: Heating and cooling of machines, types of ventilation, continuous and intermitte rating.

Design of Transformers: General considerations, output equation, emf per turn, choice of flux density and curre density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, calculation of loss efficiency and regulation, forces winding during short circuit.

Three Phase Induction Motors: General considerations, output equation, choice of specific electric and magne loadings, efficiency, power factor, number of slots in stator and rotor, elimination of harmonic torques, Design of stat and rotor winding, slot leakage flux, leakage reactance, equivalent resistance of squirrel cage rotor, magnetizing curre efficiency from design data.

Alternators: Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions.

Introduction to Computer Aided Electrical Machine Design.

SUGGESTED READINGS:

1) Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2) M.G. Say, "The Performance and Design of A.C. Machines", Pitman
3) Sawhney A.K., "A course in Electrical Machine Design", Dhanpat Rai & Sons

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD34	**POWER CONVERTERS**	**4**	3-0-2	Industrial Electronics

COURSE OUTCOME (CO):

- The student will be able to comprehensively understand and carry out transient and steady state analysis of different power converters of different types of loads and switching sequences.

COURSE CONTENTS:

Single-Phase and Three-Phase AC to DC converters- half controlled configurations- operating domains of three phase full converters and semi-converters – Reactive power considerations. Analysis and design of DC to DC converters- Control of DC-DC converters, Buck converters, Boost converters, Buck-Boost converters, Cuk converters Single phase and Three phase inverters, Voltage source and Current source inverters, Voltage control and harmonic minimization in inverters. AC to AC power conversion using voltage regulators, choppers and cyclo-

converters, consideration of harmonics, introduction to Matrix converters.

SUGGESTED READINGS:

1. Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and design", John Wiley and sons.Inc, Newyork
2. Rashid M.H., "Power Electronics-Circuits, Devices and Applications", Prentice Hall India, New Delhi
3. P.C Sen., "Modern Power Electronics", Wheeler publishing Company, 1 st Edition, New Delhi

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD35	**POWER QUALITY AND HARMONICS**	**4**	3-0-2	Power Apparatus

COURSE OUTCOME (CO):

- Student will be familiar with the concept of power and voltage quality guidelines of IEEE.
- Student will be able to apply the harmonic device modelling
- Student will be able to understand the need of grounding.

COURSE CONTENTS:

Introduction: Introduction to power quality, voltage quality. Overview of power quality, Power quality phenomena and classification of power quality issues.

Power quality measures and standards-THDTIF-DIN-message weights-flicker factor-transient phenomena-occurrence of power quality problems-power acceptability curves-IEEE guides, EMC standards and recommended practices.

Harmonic Device Modeling: Harmonics background, basic concepts, Fourier analysis. Harmonics-individual and total harmonic distortion-RMS value of a harmonic waveform-triplex harmonic-important harmonic introducing devices-Transformer, Three phase power converters-arcing devices-saturable devices. Harmonic distortion due to fluorescent lamps. Effect of power system harmonics on power system equipment and loads.

Modeling of networks and components under non-sinusoidal conditions-transmission and distribution systems-shunt capacitors-transformers-electric machines-ground systems-loads that cause power quality problems-power quality problems created by drives and impact on drives.

Harmonic Mitigation: Harmonic resonance, Impedance Scan Analysis- Passive filtering. Introduction to active power filtering. Control methods for single phase APFC.

Grounding: Grounding and wiring–introduction-NEC grounding requirements-reasons for grounding-typical grounding and wiring problems-solutions to grounding and wiring problems.

SUGGESTED READINGS:

1. G. T. Heydt, "Electric Power Quality".
2. J. Arrillaga, B. C. Smith, N. R. Watson & A. R. Wood, "Power System Harmonic Analysis".
3. Math H. Bollen, "Understanding Power Quality Problems".
4. J. Arrillaga, "Power System Quality Assessment".
5. IEEE standard on electrical grounding.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD36	**Principles of Cryptography**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- To introduced with the basics of cryptography and its algorithmic structures
- To be familiar with algebraic structures

COURSE CONTENTS:

1. Introduction to Cryptography–Cryptography: Definition, applications, Cryptanalysis, Issues, Codes & Ciphers-Classical Encryption Techniques-Substitution Cipher, Application etc.
2. Some Elementary topics in Number theory-Modular Arithmetic, GCD, Fermat's theorem-Euler's theorem-Chinese Remainder Theorem- Statements only.
3. Algebraic Structures- Groups, Rings, Integral Domain, Fields(Finite field- Z/pZ), Properties of Group, Fields etc., Theorems on Groups and Fields and their related applications.
4. Symmetric Key Cryptography- Introduction to Symmetric key cryptography, Application, Basic principles of Block Cipher, DES.
5. Public Key Cryptography- Introduction, Application, Discrete logarithm, RSA, Authentication using public key cryptography- introduction, method and Application; Digital Signatures, Digital Signation Applications.

SUGGESTED READINGS:

- A. J. Menezes, P. Van Oorschot , and S. Vanstone, "Handbook of Applied Cryptography", CRC Press.
- William Stallings, "Cryptography and Network Security", Pearson Education

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD37	**Advanced Process Control**	**4**	**3-0-2**	Process Dynamics and Control

COURSE OUTCOME (CO):

- Student will have the understanding of open loop and closed loop systems
- Student will be able to analyze the multivariable process control systems
- Student will be able to design controller for multivariable system.

COURSE CONTENTS:

Sample Data Controllers: Basic review of Z transforms, Response of discrete systems to various inputs. Open and closed loop response to step, impulse and sinusoidal inputs, closed loop response of discrete systems. Design of digital controllers.

Model Based control: Controller design by direct synthesis for minimum and non-minimum phase system, Internal Model Control (IMC) concept, IMC designs Procedure. IMC-based PID controller. Feed-forward IMC.

Digital model-based control - IMC and Dahlin's method.

Concept of multivariable process control: Study of interactions and it's effects, Modelling and transfer functions, Influence of Interaction on the possibility of feedback control, important effects on Multivariable system behaviour. Relative Gain Array, effect of Interaction on stability and Multi-loop Control system.

Multi-loop control Performance through: Loop Paring, tuning, Enhancement through Decoupling, Single Loop

Enhancements. Design of multivariable controllers. Some case studies.
Introduction to model predictive control (MPC).
Introduction to Statistical Process Control.
Process Control System Synthesis- Some Case Studies.
Some advanced studies in Process Control.

SUGGESTED READINGS:

1. B. A. Ogunnaike and W. H. Ray, "Process Dynamics, Modeling and Control", New York: Oxford University Press
2. B. Roffel and B. H. L. Betlem, "Advanced Practical Process Control", Springer-Verlag Berlin Heidelberg, New York
3. B.W. Bequette, "Process Control: Modeling, Design and Simulation", Prentice Hall
4. G. Stephanopoulos, "Chemical Process Control. An Introduction to Theory and Practice", Prentice Hall India
5. D. E. Seborg, T. F. Edgar, and D. A. Mellichamp, "Process Dynamics and Control"
6. B. Roffel and B. H. L. Betlem, "Process Dynamics and Control", John Wiley & Sons Ltd
7. B. G. Liptak, "Process Control and Optimization", 4th edition. Instrument Engineer's Hand Book, CRC press, London
8. K. J. Åström, and T. Hägglund, "Advanced PID Controllers"
9. K. J. Åström, and T. Hägglund, "PID Controllers: Theory Design and Tuning"
10. J. P. Corriou, "Process Control: Theory and Applications", Springer-Verlag Berlin Heidelberg, New York
11. B.W. Bequette, "Process Dynamics**:** Modeling", Analysis and Simulation**.** Prentice Hall
12. M. Johnson and M. H. Moradi, "PID Control", Springer-verlang, London

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD38	**RANDOM PROCESSES IN CONTROL AND ESTIMATION**	**4**	3-0-2	Control System-I

COURSE OUTCOME (CO):

- Student will be able to understand random process applications in control and estimation
- Student will be able to do modeling of Non-linear systems.

COURSE CONTENTS:

UNIT1. Introduction to Probability, Various definitions of Probability, Joint and Conditional probability, Independence, Total Probability,Baye's Theorem.

UNIT2. Random Variables, continuous and discrete random variables, Cumulative distribution function, Probabilty distribution and density function and their properties. Joint distribution and density functions.

UNIT3. Functions of random variable, pdf of the function of random variable, Functions of two random variables.Expectation mean, variance and moments of a random variable, Joint moments, conditional expectation, covariance and correlation, Some special distribution: Uniform, Gaussian and Rayleigh distributions, Binomial and Poisson Distributions.

UNIT4. Random Process: Realisations, discrete and continuous time processes, examples, Probabilistic structure of a random process; mean, autocorrelation and autocovariance functions, Stationarity: SSS Process and WSS Process, Autocorrelation function of a real WSS Process and its Properties, Cross-correlation function, Ergodicity and its importance, Spectral representation of a real WSS Process, power spectral density and its properties, Spectral density; Cross-Power Spectral density and properties ,Autocorrelation function and power spectral density of a WSS

random sequence

UNIT5. Linear time invariant system with a WSS Process ,autocorrelation and power –spectral density of the output, white noise as input, Examples of Random Process, Random Sequence, Gaussian Process, Markov Process and Markov Chain, Wiener filter, Application of Wiener's theory in the Compensator design for feedback control systems, Kalman filtering and prediction for continuous and discrete time systems

UNIT6. Modeling of Non-linear systems.

SUGGESTED READINGS:

1. Papoulis, Athanasios, and S. Unnikrishna Pillai. *Probability, random variables, and stochastic processes*. Tata McGraw-Hill Education, 2002.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD39	**REACTIVE POWER CONTROL & FACTS DEVICES**	**4**	3-0-2	Power Apparatus

COURSE OUTCOME (CO):

- Student will be able to understand the concept of FACTS devices
- Student will be able to understand the application of FACTS devices
- Student will be able to do enhance the power quality using FACTS devices.

COURSE CONTENTS:

Fundamentals of ac power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.

Principles of shunt compensation – Variable Impedance type & switching converter type- Static Synchronous Compensator (STATCOM) configuration, characteristics and control.

Principles of static series compensation using GCSC, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC).

Principles of operation-Steady state model and characteristics of a static voltage regulators and phase shifters- power circuit configurations.

UPFC -Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters.

SUGGESTED READINGS:

1. Song, Y.H. and Allan T. Johns,"Flexible ac transmission systems (FACTS)", Institution of Electrical Engineers Press, London

2. Hingorani ,L.Gyugyi, "Concepts and Technology of flexible ac transmission system", IEEE Press New York, 2000 ISBN –078033 4588.

3. IEE Tutorials on, "Flexible ac transmission systems", published in Power Engineering Journal, IEE Press

SCHEME OF COURSES - B.E. Instrumentation & Control Engineering

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC40	**Electric Drive**	**4**	**3-0-2**	Industrial Electronics

COURSE OUTCOME (CO):

- Specify the appropriate power circuit configuration amongst the phase controlled rectifiers and choppers for the speed control of DC motor drives for four-quadrant operation with current limit
- Design static Scherbius and Kramer drives to implement slip power recovery schemes
- Implement synchronous motor drives with fixed frequency and variable frequency sources
- Implement speed control schemes for Brushless D.C. motors and Permanent Magnet Synchronous motors

COURSE CONTENTS:

UNIT – I Introduction to Electrical drives Introduction, advantages of electrical drives, parts of electrical drives, choice of electrical drives, status of dc and ac drives, dynamics of electrical drives, fundamental torque equation, components of load torque, nature and classification of load torques, speed-torque conventions and multi-quadrant operation, equivalent values of drive parameters.

UNIT - II DC Drives Basic Concepts: Speed torque characteristics, starting, braking and speed control techniques of shunt/separately excited dc motor (theory only). Rectifier controlled dc drives: Types of rectifiers- review, fully controlled rectifier fed dc drives, half controlled rectifier fed dc drives, multi-quadrant operation of rectifier controlled dc drives. Chopper controlled dc drives: Types of choppers – review, chopper controlled dc drives – motoring and braking operation, multi-quadrant operation of chopper controlled dc drives.

UNIT - III AC Drives Basic Concepts: Speed-Torque characteristics of induction motors. Concept of induction motor starting. Types of starter - star delta, auto transformer, reactor, part winding, rotor resistance. Concept of induction motor braking. Methods of braking - regenerative, plugging, dynamic braking (theory only) Speed control techniques : Rotor resistance control, Stator voltage control, stator frequency control, V/f control. Static converter control of induction motors: ac voltage regulator control, voltage source inverter control, cycloconverter control.

UNIT – IV Special Machine Drives Synchronous motors: Construction, operation from fixed frequency supply – starting, pulling in, braking. Synchronous motor variable speed drives. Self-controlled synchronous motor drive employing load commutated thyristor inverter. DC brushless motors: Construction, speed-torque characteristics, brushless dc motor controllers – rotor position measurement, commutation logic, speed controller.

UNIT – V Stepper Motor Drives: Principle of operation of stepper motor, single stack variable reluctance motors, speed torque characteristics, control of stepper motors, unipolar and bipolar drive circuits Selection of motor power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating. Selection of parts, control technique for a given drive specification.

SUGGESTED READINGS:

1. G.K Dubey, “Fundamentals of Electrical Drives”, Narosa publishing house Chennai
2. Mohamed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Learning

3. Dave Polka , "Motors and Drives : A Practical Technology Guide", The Instrumentation, Systems and Automation Society
4. N.K De and P.K. Sen, "Electrical Drives", PHI
5. M.H.Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD41	**ROBUST CONTROL**	**4**	3-0-2	Control system-II

COURSE OUTCOME (CO):

- To make student familiar with norms, random spaces and robustness measures
- Able to understand optimal control and estimation techniques
- Able to understand Hinfinity optimal control techniques
- Able to understand LMI approach of H-infinity control

COURSE CONTENTS:

UNIT I INTRODUCTION: Norms of vectors and Matrices – Norms of Systems – Calculation of operator Norms – vector Random spaces- Specification for feedback systems – Co-prime factorization and Inner functions – structured and unstructured uncertainty- robustness

UNIT II H2 OPTIMAL CONTROL: Linear Quadratic Controllers – Characterization of H2 optimal controllers – H2 optimal estimation-Kalman Bucy Filter – LQG Controller

UNIT III H-INFINITY OPTIMAL CONTROL-RICCATI APPROACH: Formulation – Characterization of H-infinity sub-optimal controllers by means of Riccati equations – H-infinity control with full information – H-infinity estimation

UNIT IV H-INFINITY OPTIMAL CONTROL- LMI APPROACH: Formulation – Characterization of H-infinity sub-optimal controllers by means of LMI Approach – Properties of H-infinity sub-optimal controllers – H-infinity synthesis with poleplacement constraints

UNIT V SYNTHESIS OF ROBUST CONTROLLERS & CASE STUDIES: Synthesis of Robust Controllers – Small Gain Theorem – D-K –iteration- Control of Inverted Pendulum- Control of CSTR – Control of Aircraft – Robust Control of Second-order PlantRobust Control of Distillation Column TOTAL : 40 PERIOD

SUGGESTED READINGS:

1. U. Mackenroth, "Robust Control Systems: Theory and Case Studies", Springer International Edition
2. J. B. Burl, " Linear optimal control H2 and H-infinity methods", Addison W Wesley
3. D. Xue, Y.Q. Chen, D. P. Atherton, "Linear Feedback Control Analysis and Design 26 with MATLAB, Advances In Design and Control", Society for Industrial and Applied Mathematics
4. I. R. Petersen, V.A. Ugrinovskii and A. V. Savkin, "Robust Control Design using H- infinity Methods", Springer
5. M. J. Grimble, "Robust Industrial Control Systems: Optimal Design Approach for Polynomial Systems", John Wiley and Sons Ltd., Public

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD42	**SELECTED TOPICS IN CONTROL**	**4**	3-0-2	Control System-II

COURSE OUTCOME (CO):

- Student will be able to understand the Fuzzy Logic, artificial neural network, optimization techniques.
- Student will be able to understand the application of artificial intelligence techniques.

COURSE CONTENTS:

UNIT1. Introduction to Fuzzy Logic and NN, Knowledge representation in Fuzzy,Inference Mechanism, Defuzzification.

UNIT2. Feedforward and Feedback Networks, RBF Networks , Back-Propagation and LMS Algorithm

UNIT3. Fuzzy Logic and NN Control for Non-Linear Dynamical Systems

UNIT4. Introduction to Evolutionary Algorithms: GA, PSO and ACO.Using evolutionary algorithms in Fuzzy Logic and Neural Network Control

UNIT5. Stabilty Analysis of the systems using Fuzzy and Neural Control.

SUGGESTED READINGS:

1. Brogan W. L, "Modern Control Theory", 3rd Edition, Prentice Hall Inc., New Jersey
2. Raymond A. DeCarlo, "Linear Systems, A state variable approach with numerical implementation", Prentice Hall Inc., New Jersey
3. D.E Kirk , "An Introduction to Optimal Control Theory",
4. M. Gopal, "State Variable Analysis and Design", TMH Publication.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD43	**SENSOR NETWORKS**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- Familiar with the features of different technologies involved in Ad hoc and Sensor Networking and their performance.
- Students will get an Introduction about Blue tooth and WPAN.
- Able to undersatnd the construction and working of Directional Antennas
- Able to understand the techniques involved to support sink mobility and network management

COURSE CONTENTS:

Introduction to Sensor networks: Introduction to wired and wireless networks, Challenges of sensor networks, Network topologies, Performance analysis of Network. Applications of sensor networks.

Hardware and software for wireless sensor platform: Smart dust, Embedded sensor board - microcontroller, RF antennas, and signal conditioning circuits. Software- Tiny OS, NesC programming, different simulating Tools.

Energy Efficient Medium access: Energy consumption and life time, Energy efficient MAC- Channelization

based, contention based and hybrid protocols, cellular network concepts.
Positioning and localization: Self organization network, local positioning, Global positioning with no distances estimates, Different localization techniques, GPS.
Data security, Advances in WSN- MEMS- Micro sensor, RF-MEMS- Micro radios.

SUGGESTED READINGS:

1. C.S.Ragavendra, Krishna M.Sivalingam &TaiebF.Znati, "Wireless sensor Networks", Springer, ISBN: 1402078838.
2. Laurie Kelly, Mohammad Ilyas & ImadMahgoub, "Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems",CRC Press ISBN:0849319684
3. NirupamaBulusu and Sanjay Jha, "Wireless Sensor Networks", ISBN:1580538673
4. Holger Karl and Andreas Willig, "Protocols and Architecture for Wireless Sensor Networks" John Wiley and Sons, ISBN:0470095105

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD44	**SPECIAL MACHINES**	**4**	3-0-2	Power Apparatus

COURSE OUTCOME (CO):

- Students will be able to develop the understanding about the advancement in drives such as permanent magnet brushless motor drive, switched reluctance motor, linear induction motors and stepper motors.

COURSE CONTENTS:

Review of adjustable speed drives, motor requirement for drives, induction motor and synchronous motor drives; Vector control and Field Oriented Control methods Permanent- magnet materials, characteristics, energy density and equivalent circuits, losses and efficiency of PM motors. Principle and construction of permanent magnet brushless dc motor drives (PMBDCM); Operation with sinusoidal, square and trapezoidal waves; Vector control of PM synchronous motor; Control strategies; Flux weakening operation; Modeling of drive; Converter topologies for PMBDCM drive. Sensor-less control of AC drives, parameter identification in PM BDCM and induction motor drive, speed and position estimation, parameter sensitivity; Robust motion control. Principle and construction of synchronous reluctance based drive, operating condition and power factor of synchronous reluctance motors, constant power operation, PM reluctance motors. Principle, construction and operation of switched reluctance motors, torque developed, losses and efficiency; Design and application considerations. Principle, construction and operation of linear induction motors, Goodness factor, short stator and short rotor effect; High speed and low speed applications. Principle, construction and operation of stepper motors, variable reluctance and permanent magnet stepping motors, hybrid stepping motors, drive circuits. Energy efficient motors.

SUGGESTED READINGS:

1.Murphy J.M.D. and Turnbull F.G., "Power Electronics Control of AC Motors", Pergamon Press, New York.
2. Miller T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Oxford Clarender Press.
3. Bose B.K., "Power Electronics & Variable Frequency Drives – Technology & Applications", IEEE Press,

Standard Publisher Distribution.
4. Nasar S.A., "Linear Induction Machine"
5. Andreas J.C., "Energy Efficient Electric Motors", Springer.

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD45	**UTILIZATION OF ELECTRICAL ENERGY**	**4**	3-0-2	Nil

COURSE OUTCOME (CO):

- Able to maintain electric drives used in an industries
- Able to identify a heating/ welding scheme for a given application
- Able to maintain/ Trouble shoot various lamps and fittings in use
- Able to figure-out the different schemes of traction schemes and its main components
- Able to design a suitable scheme of speed control for the traction systems

COURSE CONTENTS:

Illumination -lighting calculations - Design of lighting schemes - factory lighting - flood lighting - electric lamps. Electric Heating-Electric furnaces and welding - Resistance, inductance and Arc Furnaces -Construction and fields of application. Electric drives and control - Group drive - Individual drive - selection of motors - starting characteristics - Running characteristics. Traction system - tractive effort calculations - electric braking - recent trend in electric traction. Refrigeration and Air-Conditioning-Various types of air conditioning system, domestic refrigerator and wiring system.

SUGGESTED READINGS:

1. Uppal, S.L., "Electrical Power", Khanna publishers, New Delhi
2. Gupta, J.B., "Utilisation of Electrical Energy and Electric Traction", S.K.Kataria and sons
3. Partab, . H., "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Sons, New Delhi

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICD46	**VIRTUAL INSTRUMENTATION**	**4**	3-0-2	Electronic Instrumentation

COURSE OUTCOME (CO):

- Ability to understand the basics concepts and programming in virtual instrumentation
- Ability to apply virtual instrumentation tool set for a given problem
- Ability to apply virtual instrumentation concept for a given application

COURSE CONTENTS:

Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA

software, Active X programming.

VI programming techniques: VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

SUGGESTED READINGS:

1. Gary Johnson, "LabVIEW Graphical Programming", 2nd Edition, McGraw Hill, New York
2. Lisa K. wells & Jeffrey Travis, "LabVIEW for everyone", Prentice Hall, New Jersey
3. Jane W. S. Liu, "Real-time Systems", Pearson Education India
4. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-to-use Modules in C", 2nd Edition, CMP Books
5. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes
6. Jean J. Labrosse, "MicroC/OS-II. The Real-time Kernal", CMP Books

Web Resources:

1. www.ni.com
2. www.ltrpub.com

Course No.	Title of the Course	Credits	Course Structure	Pre-Requisite
ICC47	**POWER ELECTRONICS**	**4**	**3-0-2**	Electronics

COURSE OUTCOME (CO):

- To introduce to students the theory and applications of power electronics systems for high efficiency, renewable and energy saving conversion systems
- To prepare students to know the characteristics of different power electronics switches, drivers and selection of components for different applications
- To develop students with an understanding of the switching behaviour and design of power electronics circuits such as DC/DC, AC/DC, DC/AC and AC/AC converters.

COURSE CONTENTS:

Power semiconductor switches: SCRs - series and parallel connections, driver circuits, turn-on characteristics, turn

off characteristics.

AC to DC converters: Natural commutation, single phase and three phase bridge rectifiers, semi controlled and fully controlled rectifiers, dual converters, inverter operation.

DC to DC converters: Voltage, Current, load commutation, thyristor choppers, design of commutation elements, MOSFET/IGBT choppers, AC choppers.

DC to AC converters: Thyristor inverters, McMurray-Mc Murray Bedford inverter, current source inverter, voltage control, inverters using devices other than thyristors, vector control of induction motors.

AC to AC converters: Single phase and three phase AC voltage controllers, integral cycle control, single phase cyclo-converters - effect of harmonics and Electro Magnetic Interference (EMI).

Applications in power electronics: UPS, SMPS and Drives.

SUGGESTED READINGS:

1. Rashid M. H, "Power Electronics - Circuits, Devices and Applications", 4th Edition, Prentice Hall, New Delhi
2. Dubey G. K, Doradla S.R, Joshi and Sinha R.M, "Thyristorised Power Controllers", New Age International Publishers, New Delhi
3. John G. Kassakian, "Principles of Power electronics", Addison Wesley
4. Vedam Subramanyam K, "Power Electronics", 2nd Edition, New Age International Publishers, New Delhi
5. Mohan, Undeland and Robbins, "Power Electronics: Converters, Applications, and Design", John Wiley and Sons, New York
6. Joseph Vithyathil, "Power Electronics", McGraw Hill, New York

Syllabus of Foundation Electives

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

(Any Two out Of 4 Components)

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

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

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

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

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

1. Demonstrate Stretching and Strengthening Exercises for Kyphosis, Scoliosis, Lordosis, Knock Knees, Bow Legs, Flat Foot, Back Pain and Neck Pain
2. Illustration and Demonstration of Active and Passive Exercises
3. Asanas with Therapeutic Value (Any five asanas): Karnapeedasana, Padmasana, Dhanurasana, Sarvangasana, Paschimottanasana, Chakrasana, Halasana, Matsyasana, Ardhmatsyendrasana, Usthrasana, Mayurasana, Shirshasana, Vajrasana.
4. Practice P.R.I.C.E. in First Aid.

D. SPORTS ADMINISTRATION & MANAGEMENT (Any Two)

1. Demonstration of Supervision activities in Sports Management.
2. Demonstration of skills of Management.
3. Demonstration of fixtures of various kinds in sports competitions.
4. Demonstration of technical and non-technical purchase procedure.

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

(Any Two out Of 4 Components)

A. Sports for all (Any Two)

1. To participate in any intramural Tournaments (one team game and one Individual Game) of choice.

2. To participate/ attend at least 15 hours in Fitness training at Field or at Gymnasium.
3. Participate in at least one track and one field event on Annual Sports day.
4. To participate in Inter College Tournament

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

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

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

1. Measurement of Fitness Components – Leg-raise for Minimal Strength (Muscular Strength); Sit-ups (Muscular Endurance); Harvard Step Test or Run and Walk Test (Cardiovascular Endurance); Sit and Reach Test (Flexibility)
2. Measurement of Pulse Rate / Heart Rate at Radial Artery and Carotid Artery, Calculation of Target Heart Rate
3. Developing a 5-10 minute routine of aerobics with appropriate music for each component of health related physical fitness

D. SPORTS INDUSTRY & MARKETING (Any Two)

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

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

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

Unit – IV N.S.S. Regular Activities

A) College campus activities

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

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

i) Red Cross

ii) Rotary

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

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

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

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

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

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

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

(ii) Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and

decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and function of different ecosystem

(iii) Bio-diversity and its Conservation: Introduction to biodiversity —definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity : Habitat loss, Poaching of wildlife, man wildlife conflicts, rare endangered and threatened species(RET) endemic species of India, method of biodiversity conservation: In-situ and ex-situ conservation.

UNIT II: Natural Resources: problems and prospects

(i) Renewable and Non-renewable Natural Resources

Concept and definition of Natural Resources and need for their management

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

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

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

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

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

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

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

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

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

COURSE CONTENT:

UNIT I. Basic Issues and Approaches

a. Importance of the study of ecology and society
b. The relation between Environment and Development
c. Conceptual clarifications: social ecology; sustainable development; sustainability.
d. Approaches: Realism, Appropriate Technology, Ecofeminism

UNIT II. People and Natural Resources: Unequal Access and Shrinking Commons

a. Water: depleting water resources & pollution; unequal distribution of water –(utilization of water for commercial crops, industrial use, power generation), the big dams debate.

b. Forest: Colonial policy, diverting resources for mining and other commercial and industrial use, monoculture and loss of biodiversity, rights of forest dwelling communities.

c. Land: modern technology, green revolution, biotechnology and impact on land, shrinking commons and its effects on rural poor.

UNIT III. Environmental issues and Problems.

a. Environmental Pollution: Air, Water, Noise, Land and Radioactive Pollution
b. Problems of urban environment (pollution, health, industrial accidents (e.g. Bhopal), occupational hazards)
c. Climate change/Global warming.

UNIT IV. Role of Environmental Movements and the State.

a. Environmental Movements in India – Chipko, Narmada Bachao Andolan, Chilka Lake Orissa, are some examples.

SUGGESTED READINGS:

1. Chandna R.C,`` Environmental Awareness," Kalyani Publishers.
2. Agarwal S.K,`` Environmental Issues and Themes," APH Publishing corporation.
3. Barry John,`` Environment and social theory," Routledge.
4. Gadigil, Madhav and Ramachandra Guha,`` Ecology and Equity: The use and Abuse of Nature in contemporary India," OUP.
5. Gole Prakash,`` Nature conservation and sustainable development in India," Rawat publications .

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE008	Spoken Skills in English	2L-0T-0P	None

COURSE OUTCOMES (CO):

1. This course will focus on oral & presentation skills of students with practice sessions in the language lab.
2. This course will develop confidence building in oral skills of learners.
3. It will seek to encourage the day to day conversations/dialogues and communicative needs of learners with ample practice in the lab.
4. The theory class will boost practice in ample language exercises to encourage oral skills.
5. This will also involve practice sessions in interview skills, group discussions & pair work.
6. Basics of communication

COURSE CONTENT:

- Practice on listening and reading comprehension

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

SUGGESTED READINGS:

Everyday English I & II Cambridge University Press/Foundation books

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

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

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

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

SUGGESTED READINGS:

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

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

FE010	**Introduction to Indian Society**	**2L-0T-0P**	**None**

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

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

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

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

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

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

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

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

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

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

Unit-I:

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

Unit-II

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

Unit-III

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

Unit-IV

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

SUGGESTED READINGS:

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

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

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

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

Unit 4 : Acting consistently for different takes, acting scenes out of order, Auditions, acting exercises. Art of Dubbing.

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

SUGGESTED READINGS:

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

Course No.	Title of the Course	Course Structure	Pre-Requisite
FE015	**Yoga**	**0L-0T-4P**	**None**

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

UNIT-I

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

UNIT- II

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

UNIT –III

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

UNIT -IV

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

Unit 1 – History of Cinema, Research & Script

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

Unit 2 – Pre-Production

Digital Video Cinematography: Introduction to Digital Video Cinematography

Cinematography, Interactivity and emotions through Cinematography,

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

Unit 3- Digital Video Editing

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

Unit-4Advanced Editing Techniques

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

Mechanical Workshop Experiments

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

Electrical workshop Experiments

1. STUDY & PERFORMANCE OF DIFFERENT TYPES OF WIRE JOINTS
2. STUDY AND PERFORMANCE OF STAIRCASE WIRING
3. STUDY AND PERFORMANCE OF SERIES AND PARALLEL CONNECTION OF FLOURESCENT TUBE LIGHT
4. STUDY AND PERFORMANCE OF GODOWN WIRING

5. SERIES AND PARALLEL CONNECTION OF BULBS AND POWER SOCKETS BY SINGLE SWITCH AND MULTI SWITCHES.

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

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

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

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

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

b. Writing of Bhatkhande Swarlipi Paddhati.

c. Writing of Tãlasand Compositions in Notation.

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

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

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

General study of Natyashastra, SangeetRatnakar.

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

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

SUGGESTED READINGS:

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

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

COURSE OUTCOMES (CO):

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

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

2. Inculcation of Self Reflection.

Human action is governed by various internal factors primarily the beliefs one holds, and therefore 'looking-in'

becomes essential, to see what beliefs one is holding, whether they are really true or not, if they are not true, then what could be the process to get the "right" belief and then further validate it.

Most of the young people are somehow trained to look only ―outside‖. The motivation and the skill to look inside are missing. Inculcation of self reflection in students will result in them becoming more responsible, honest and trustworthy. Lack of such dualities in individuals is major concern of organizations, institutions and society in general.

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

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

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

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

5. Development of Commitment and Courage to Act.

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

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

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

COURSE CONTENT:

1. Motivation and Objectives of Human Values Course.

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

2. Purpose of Education How human being has a need for Knowledge, what should be the content of knowledge, how the content should be discussed in education. Complimentarily of skills and values, how the current education system falls short.

3. Peers Pressure, Social Pressure In various dimensions of life, how do these things work. What is the way out? In the context of education, peer pressure etc. movie ―TaareZameen Par‖ can be used.

4. Concept of Competition and Excellence How competition leads to degradation of self and relationships. How excellence is the basic need of a human being. What is excellence? Movie ―Fearless‖ can be used to discuss the concept.

5. Time Management:

How does one deal with myriads of activities in college? Focus of the mind.

6. Concept of Preconditioning. How preconditioning affects our thinking, behavior, work, relationships, society and nature. How do we develop pre-conditioning?
What are the various sources of preconditioning? How do we evaluate our Preconditioning? How do we come out of it?
7. Concept of Natural Acceptance in Human Being. What is natural acceptance? How can the concept of natural acceptance be used to evaluate our preconditioning. Universal nature of natural acceptance. Are anger, jealousy, hatred natural? How do we feel when we experience them? Which feelings are natural for a human being and which are not?
8. Understanding Relationships.
a) Are relationships important? What is the role of relationships in our life? If relationships are important then why they are important? If they are important then why it is the case that we are not discussing them?
What are the notions/conditions and factors which stop us to explore more into relationships. Relationships in family and extended family. Dealing with anger. Show film ―Right Here, Right Now‖.
b) Basic expectations in relationships. Seven types of relations.
c) Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.
d) Nine universal values in human relationships. Trust as the founding value.
e) Concept of acceptance. Unconditional acceptance in relationships.
f) Our preconditioning affecting our relationships. Our relationships with subordinate staff, with people of opposite gender, caste, class, race. Movie ―Dharm‖(set in Varanasi) can be used to show the conflict between reconditioning and relationships. How relationships have the power to force a person to change his preconditioning.
9. Concept of prosperity
Material goods and knowledge of one's physical needs is essential for feeling of prosperity. What role others have played in making material goods available to me: Identifying from one's own life.
10. Idea of Society. What is a society? What constitutes a society? What systems are needed for a society to work? What is the purpose of society and various systems which are working in it? How understanding of Human Nature is important in order to understand the purpose of Society and various social systems? And what happens when this understanding is lacking?
11. Idea of decentralization of politics, economics, education, justice etc. Its comparison with centralized systems. The idea of Swaraj. Various social initiatives by NGOs, social organizations and other people. (If time permits)
12. Balance in nature
a) Balance which already exists in nature.
b) How human beings are disturbing the balance. Resource depletion and pollution.
Our own role in wastage of electricity, water and in use of plastics. Waste management. (Show episode on city waste from SatyamevaJayate 2.)
c) Issues like global warming, animal extinction. Show ―Story of Stuff‖ documentary film. ―Home‖ film can also be used.

SUGGESTED READINGS:

1. Annie Leonard, `` The Story of Stuff,'' Free Press
2. Mohandas Karamchand Gandhi,`` The Story of My Experiments with Truth," Beacon Press
3. J Krishnamurthy,`` On Education," Official repository
4. Hermann Hesse ,`` Siddhartha," Bantam Books
5. ThichNhatHanh,`` Old Path White Clouds," Parallex Press

6. On Education - The Mother Aurobindo Ashram Publication
7. Anne Frank,`` Diaries of Anne Frank ,"
8. G S Banhatti`` Life and Philosophy of Swami Vivekananda," Atlantic
9. Swami Vivekanand`` Swami Vivekananda on Himself," Advaita Ashram
10. E. F Schumacher,`` Small is Beautiful: Economics as if people mattered,"Harper Pereinnial.
11. Cecile Andrews ,`` Slow is Beautiful," New society publishers
12. A.Nagaraj,`` JeevanVidya: EkParichaya," Jeevan Vidya Prakashan.
13. A.N. Tripathi,`` Human Values," New Age Intl. Publishers.
14. Dharampal,`` Rediscovering India," Other India Press
15. Mohandas K. Gandhi,`` Hind Swaraj or Indian Home Rule," Navjeevan publication house
16. Maulana Abdul Kalam Azad,`` India Wins Freedom," Stosius Inc
17. Ramakrishna kijeevani ,`` Romain Rolland
18 Romain Rolland , "Vivekananda" Advait ashram.
19. Romain Rolland , "Gandhi" Srishti Publishers & Distributors.
20. ParamhansaYogananda,`` Autobiography of a Yogi," ," Rider publication.
21. Sahasrabudhe, "Gandhi and Question of Science,"Other India Press.

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

COURSE OUTCOMES (CO):

1. Sensitization of student towards issues in society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
3. Strengthening of self reflection.
4. Development of commitment and courage to act.

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

COURSE CONTENT:

In Universal Human Values 2 course, the focus is more on understanding society and nature on the basis of self and human relationships. and motivation for the course.-conditioning, and natural acceptance.
-existence of self and body. Identifying needs and satisfying needs of self and body. Self observations. Handling peer pressure family. Hostel and institute as extended family. Real life examples.
-student relationship. Shraddha. Guidance. Goal of education.
– material order, plant order, animal order and human order.
Salient features of each. Human being as cause of imbalance in nature. (Film "Home" can be used.)

– water, food, mineral resources.
Pollution. Role of technology. Mutual enrichment not just recycling.
on of needs of the self and
needs of the body. Right utilization of resources. Understanding the purpose they try to fulfil.
Recapitulation on society. Five major dimensions of human society. Fulfilment of the individual as major goal.
Justice in society. Equality in human relationships as naturally acceptable. Establishment of society with abhaya (absence of fear). being through holistic education in just order.

SUGGESTED READINGS:

Text Book

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

Reference Books

2 . A Nagaraj , "Jeevan Vidya: EkParichaya, " Jeevan VidyaPrakashan, Amarkantak.
3 . A.N. Tripathi , "Human Values," New Age Intl. Publishers, New Delhi, .
4. Annie Leonard, "The Story of Stuff" Simon and Schuster.
5. Mohandas Karamchand Gandhi, " The Story of My Experiments with Truth " Becon Press.
6. J Krishnamurthy, " On Education " Official repository.
7. Hermann Hesse, "Siddhartha " Bantan press.
8. ThichNhatHanh, " Old Path White Clouds " parallax press.
9. On Education - The Mother Aurobindo Ashram Publication.
10 . Diaries of Anne Frank – Anne Frank
11. G.S Banhatti, "Life and Philosophy of Swami Vivekananda," Atlantic publisher.
12. Swami Vivekananda , "Swami Vivekananda on Himself," Advait publication.
13. E. F Schumacher , "Small is Beautiful: Economics as if people mattered,"Harper Pereinnial.
14. Cecile Andrews , "Slow is Beautiful" New society publishers.
15. J C Kumarappa, "Economy of Permanence" Serve seva sangh prakashan.
16. Pandit Sunderlal , "Bharat Mein Angreji Raj"
17. Mahatma and the Rose plant
18 . M.Gandhi, "The Poet and the Charkha" Mani Bhavan
19. Dharampal, "Rediscovering India" other India press.
20 .Mohandas K. Gandhi , "Hind Swaraj or Indian Home Rule," Navjeevan publication house.
21. Arvind Kejriwal , "Swaraj" Harper publication.
22 . Maulana Abdul Kalam Azad, "India Wins Freedom."Stosius Inc.
23. Romain Rolland , "Ramakrishna kijeevani,"Advait Ashram.
24. Romain Rolland , "Vivekananda" Advait ashram.
25. Romain Rolland , "Gandhi" Srishti Publishers & Distributors.
26 . ParamhansaYogananda, " Autobiography of a Yogi," Rider publication.
27. Sahasrabudhe, "Gandhi and Question of Science,"Other India Press.

SYLLABUS OF OPEN ELECTIVES

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO001	**Technical Communication**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

1. The course will improve writing and documentation skills of students with emphasis on the importance of effective communication with focus on choice of words, formation of proper sentence structures and writing styles.
2. This will enhance the students capability to prepare technical documents and correspondence.
3. The course will equip the student with good communications skills for placements, preparing SOPs and CVs.
4. The course will sensitize the students towards research ethics, copyright and plagiarism.

COURSE CONTENT:

- Definition of communication, meaning, importance & process of communication, objectives, types, C's of communication, barriers to communication
- human & non -human communication, distinctive features of human languages
- Business correspondence-definition, meaning and importance of business communication, business letters-purchase, enquiry, quotation, order, followup, acceptance-refusal
- Emphasis on (i) paragraph writing, its kinds, coherence & cohesion
  (ii)writing a paragraph/thesis: selection of topic and its development
  (iii) writing reports, manuals, notices, memos, agendas, minutes
  (iv)Interviews, speeches, presentations,
- research ethics, methodologies, copyright, plagiarism

SUGGESTED READINGS:

1. Martin Hewing, ``Advanced English Grammar,'' Cambridge University Press
2. Meenakshi Raman and Sangeeta Sharma, ``Technical Communication,'' Oxford University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO002	**Disaster Management**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

1. Demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and

programming in different countries, particularly their home country or the countries they work in.

COURSE CONTENT:

Unit -I: Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit -II: Disaster Prone Areas In India

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Unit -III: Disaster Preparedness And Management

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit -IV: Risk Assessment

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Unit -V: Disaster Mitigation

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK,`` Disaster Management in India: Perspectives, issues and strategies,'' New Royal book Company

2. Sahni, Pardeep, ``Disaster Mitigation Experiences And Reflections,'' Prentice Hall Of India

3. Goel S. L., ``Disaster Adminastration And Management Text And Case Studies,'' Deep & Deep Publication

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO003	**Basics of Financial Management**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

The course's objective is to provide a theoretical framework for considering corporate finance problems and issues and to apply these concepts in practice. In this course, you will enhance your knowledge and understanding of financial management. You will learn how managers should organize their financial transactions effectively and with integrity and how to give everybody the ability and confidence to tackle common financial problems in practice. It will also provide adequate preparation for future finance classes.

COURSE CONTENT:

Unit I

Nature, scope and objectives of financial management, Time value of money, Risk and return (including Capital

Asset Pricing Model).

Unit II

Long term investment decisions: The Capital Budgeting Process, Cash Flow Estimation, Payback Period Method, Accounting Rate of Return, Net Present Value (NPV), Net Terminal Value, Internal Rate of Return (IRR), Profitability Index.

Unit III

Financing Decisions: Sources of long-term financing, Estimation of components of cost of capital, Methods for calculating Cost of Equity, Cost of Retained Earnings, Cost of Debt and Cost of Preference Capital, Weighted Average Cost of Capital (WACC). Capital Structure- Theories of Capital Structure (Net Income, Net Operating Income, MM Hypothesis, Traditional Approach). Operating and Financial leverage. Determinants of capital structure

Unit IV

Dividend Decisions: Theories for Relevance and irrelevance of dividend decision for corporate valuation-Walter's Model, Gordon's Model, MM Approach, Cash and stock dividends. Dividend policies in practice.

Unit V

Working Capital Decisions: Concepts of Working Capital, Operating & Cash Cycles, sources of short term finance, working capital estimation, cash management, receivables management, inventory management.

SUGGESTED READINGS:

1. Khan, M.Y. and P.K. Jain,`` Financial Management: Text and Problems,'' Tata McGraw Hill
2. Srivastava, Rajiv, and Anil Mishra,`` Financial Management,'' Oxford University Press
3. Chandra, P., ``Financial Management-Theory and Practice,'' Tata McGraw Hill.
4. Horne, Van; James C., John Wachowicz, ``Fundamentals of Financial Management,'' Pearson Education.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO004	**Basics of Human Resource Management**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

This course is designed to provide students with an understanding of human resource management (HRM) functions within organizations, including an appreciation of the roles of both HRM specialists and line managers in designing and implementing effective HRM policies and practices.

COURSE CONTENT:

Unit - I

Evolution and growth of human resource management (with special reference to scientific management and Human relations approaches).Role of HR in strategic management.Nature.objectives, scope, and functions of HR management.

Unit - II

Challenges of HR (the changing profile of the workforce - knowledge workers, employment opportunities in BPOs, IT and service industries, Flexi options), Workforce diversity (causes, paradox, resolution of diversity by management).

Unit III

HRD; Human resource management as a profession.Concepts of line-staff in the structure of human resource department and the role of human resource manager.

Unit - IV

Manpower planning -objectives, elements, advantages, process. Job design - (simplification, rotation, enlargement, enrichment and approaches}.Job analysis.Job evaluation.

Unit - V

Recruitment (factors affecting, sources, policy, evaluation). Selection(procedure, tests, interviews). Placement and Induction.

SUGGESTED READINGS:

1. Aswathappa K., ``Human Resource and Personnel Management,'' Tata McGraw-Hill
2. Chhabra T.N., ``Human Resource Management,'' Dhanpat Rai and Co.
3. Saiyadain S. Mirza, `` Human Resource Management,'' Tata Mc-Graw Hill
4.Chadha, N.K, ``Human Resource Management-issues, case studies, experiential exercises,'' Sri Sai Printographers

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO005	**Project Management**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

In this comprehensive course, student will learn the fundamentals of project management: how to initiate, plan, and execute a project that meets objectives and satisfies stakeholders. This course provides a step-by-step guide to planning and executing a project and to develop a manageable project schedule.

COURSE CONTENT:

Unit-I

Objectives of Project Planning, monitoring and control of investment projects. Relevance of social cost benefit analysis, identification of investment opportunities. Pre-feasibility studies.

Unit-II

Project Preparation: Technical feasibility, estimation of costs, demand analysis and commercial viability, risk analysis, collaboration arrangements; financial planning; Estimation of fund requirements, sources of funds.Loan syndication for the projects.Tax considerations in project preparation and the legal aspects.

Unit-III

Project appraisal: Business criterion of growth, liquidity and profitability, social cost benefit analysis in public and private sectors, investment criterion and choice of techniques. Estimation of shadow prices and social discount rate.

Unit-IV

Project review/control-Evaluation of project. PERT/CPM.resource handling/leveling.

Unit-V

Cost and Time Management issues in Project planning and management , success criteria and success factors, risk management.

SUGGESTED READINGS:

1. Ravi Ravindran, `` Operations Research and Management Science Handbook,'' CRC Press
2. Harold Kerzner, ``Applied Project Management: Best Practices on Implementation,'' John Wiley & Sons
3. Goodpasture, J. C., ``Quantitative Methods in Project Management,'' J Ross Publishing
4. Meredith, J. R. and Mantel Jr., S. J., ``Project Management: A Managerial Approach,'' John Wiley
5. Clifford Gray, ``Project Management,'' Richard D. Irwin

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

EO006	Basics of Corporate Law	3L-1T-0P	None

COURSE OUTCOMES (CO):

The objective of this Course is to provide in-depth knowledge of the Corporate laws and process related to integrate these aspects of management studies in decision making within an organization; analyze and interpret management information; make decisions based on the information available; communicate information effectively; understand and apply the theoretical aspects of accounting methods used for collecting, recording and reporting financial information; explain and appraise the taxation laws which govern corporations and individuals.

COURSE CONTENT:

Unit I: Introduction : Administration of Company Law, characteristics of a company; common seal; lifting of corporate veil; types of companies including private and public company, government company, foreign company, one person company, small company, associate company, dormant company, producer company; association not for profit; illegal association; formation of company, promoters and their legal position, pre incorporation contract and provisional contracts; on-line registration of a company.

Unit II: Documents: Memorandum of association and its alteration, articles of association and its alteration, doctrine of constructive notice and indoor management, prospectus, shelf prospectus and red herring prospectus, misstatement in a prospectus; GDR; book building; issue, allotment and forfeiture of shares, calls on shares; public offer and private placement; issue of sweat capital; employee stock options; issue of bonus shares; transmission of shares, buyback and provisions regarding buyback; share certificate; D-Mat system; membership of a company.

Unit III: Management and Meetings: Classification of directors, additional, alternate and adhoc director; women directors, independent director, small shareholders' director; director identity number (DIN); appointment, who can appoint a director, disqualifications, removal of directors; legal position, powers and duties; key managerial personnel, managing director, manager; meetings of shareholders and board; types of meeting, convening and conduct of meetings, requisites of a valid meeting; postal ballot, meeting through video conferencing, e-voting; committees of board of directors – audit committee, nomination and remuneration committee, stakeholders relationship committee, corporate social responsibility committee; 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
6. Ramaiya, ``A Guide to Companies Act,'' Lexis Nexis Buttersworth wadhwa
7. Kannal, S., and V.S. Sowrirajan, ``Company Law Procedure,'' Taxman's Allied Services (P) Ltd.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO007	Biological Computing	3L-1T-0P	None

COURSE OUTCOMES (CO):

1. To understand computing in context of biological systems
2. To understand computing languages needed to solve biological problems
3. To acquire computational skills for analysis of biological processes through grid computing
4. To gain knowledge of different biological databases and their usage
5. To gain innovative insight into DNA computing

COURSE CONTENT:

Introduction, Orientation and UNIX,

Python: Introduction to Variables and Control flow, Python II - Parsing In and Output, Python III - Scripting and Functions, Python IV- Number Crunching and Plotting,

Grid computing, Biogrid, R basics and Visualization, Unix for fast text processing, SQL, Database

Biological databases, R for speed, R for fun, Local BLAST, Unit Testing and Code Correctness

DNA computing,

SUGGESTED READINGS:

1. H. Bolouri, R. Paton, `` Computations in cells & tissues,'' Springer

2. Haubold**,** Bernhard**,** Wiehe, Thomas, `` Introduction to Computational Biology: An Evolutionary Approach,'' Springer

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO008	**Basics of Social Sciences**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

Social science is a major category of academic disciplines, concerned with society and the relationships among individuals within a society. It in turn has many branches, each of which is considered a "social science".

COURSE CONTENT:

Unit I: Economics, political science, human geography, demography and sociology.

Unit II: Humanities, anthropology, archaeology, jurisprudence, psychology, history, and linguistic.

Unit III: Political science, economics, sociology, international politics and scientific methodology.

SUGGESTED READINGS:

1. A.C. Kapoor, "Principles of Political Science,'' S. Chand Publications
2. A.K. Sharma, "Issues in Social Demography,'' Mittal Publications
3. Kathy S. Stolley, "The Basics of Sociology,'' Greenwood Press.
4. Paul M. Muchinsky ,"Psychology Applied to Work,'' Thomson Learning Inc

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO009	**Entrepreneurship**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

This Course Aims at Instituting Entrepreneurial skills in the students by giving an overview of who the entrepreneurs are and what competences are needed to become an entrepreneur.

COURSE CONTENT:

Unit I-Introduction:

Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmes; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.

Unit II- Creating Entrepreneurial Venture:

Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Challenges in managing innovation; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership- components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection- Patents Trademarks and Copyrights – importance for startups, Legal Acts Governing Business in India.

Unit III-Functional plans:

Marketing plan– for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, pro forma cash budget, funds Flow and Cash flow statements; Pro forma balance sheet; Break Even Analysis; Ratio Analysis.

Unit IV- Entrepreneurial Finance:

Debt or equity financing, Sources of Finance- Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India.

Unit V- Enterprise Management:

Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations, Joint ventures, Mergers & acquisitions.

SUGGESTED READINGS:

1. Kumar, Arya,`` Entrepreneurship: Creating and Leading an Entrepreneurial Organization'', Pearson
2. Hishrich., Peters, ``Entrepreneurship: Starting, Developing and Managing a New Enterprise,'' Irwin
3. Taneja, ``Entrepreneurship,'' Galgotia Publishers.
4. Barringer, Brace R., and R. Duane, ``Entrepreneurship,'' Pearson Prentice Hall
5. Hisrich, Robert D., Michael Peters and Dean Shephered, ``Entrepreneurship,'' Tata McGraw Hill
6. Lall, Madhurima, and Shikha Sahai, ``Entrepreneurship,'' Excel Books
7. Charantimath, Poornima, ``Entrepreneurship Development and Small Business Enterprises,'' Pearson Education

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO010	**Social work**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

In this course students will learn about various methods of social work, about community organization, social welfare administration, Problems pertaining to Marriage, Family and caste

COURSE CONTENT:

Unit 1.Social work

Philosophy and Methods. Social work: Meaning, Objectives, Scope, Assumptions & Values; History of Social work in U.K. U.S.A.and India, philosophy of Social Work. Democratic (Equality, Justice Liberty & Fraternity) and Humanitarian (Human Rights) Matrix.Social works as a profession.

Unit 2. Methods of Social work

Meaning, Scope Principles, Processes (Psychosocial study, Assessments, treatment-goal formulation and techniques), Evaluation, Follow-up and Rehabilitation. Social Groups work: Meaning,Objective, Principles, Skills, Processes (Study, Diagnosis, treatment and evaluation), Programme, Planningand Development, Role of Social group worker, Leadership Development.

Unit 3 Community organization

Meaning, Objective, Principles, Approaches, Roles of Community Organization Worker.

Unit 4 Social Welfare Administration

Meaning Scope, Auspices-Private and Public, Principles, Basic Administrative Processes and Practice decision making communication, planning.organisation, budgeting and finacial control, reporting. Social work Research: Meaning objectives, types, scope, scientific method, Selection and formulation of the problem Research Design Sampling, Sources and Methods of Data Collection, Processing of Data, analysing and interpretation, Report writing. Social Action: Meaning,Scope, approaches (Sarvodays, Antyodaya etc.) and Strategies.

Unit 5 Work in India Problem pertaining to Marriage, Family and caste

Dowry- child Marriage, Divorce, Families with working couples, Disorganised Families, Families with Emigrant Heads of the Households, Gender Inequality, Authoritarian Family structure, Major Changes in Caste systems and problem of casteism. Problems Pertaining of Weaker Sections. Problems of Children, Women Aged. Handicapped and Backward Classes (SCs, STs, and other Backward Classes). Problems of Deviance**:** Truancy Vagrancy and Juvenile Delinquency, Crime, White Colla Crime, Organized Crime,Collective Violence, Terrorism, Prostitution and Sex Related Crimes. Social Vices: Alcohilism. Drug Addiction, Beggary, Corruption and communalism. Problems of Social Structure **:** Poverty, Unemployment, Bonded Labour, Child Labour. Fields of Soclal work India **:** Child Development, Development of Youth, Women's Empowerment, Welfare of aged, Welfare of Physically. Mentally and Social Handicapped, Welfare of backward Classes (Scs, STs and Other Backward Classes) Rural Development Urban Community Development, Medical And Psychiatric Social work, Industrial Social work, Social Security offender Reforms.

SUGGESTED READINGS:

1. Rajni Bedi, ``Social Work: An Introductory Text Book,'' Regal Publication
2. Sanjay Bhattacharya, ``Social Work: An Integrated Approach,'' Deep and Deep Publication
3. Nitesh Dhawan, ``Social work perspective Philosophy and Methods,'' Bharat Book Center
4. P. R. Gautam, ``Social Work: Methods Practices And Perspectives,'' Centrum Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO011	**Intellectual Property and Patenting**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

The objective of this Course is to provide in-depth knowledge of the laws and process related to Trademarks, Copyrights and other forms of IPs with focus on Patents, the Indian and International Patent filing procedure, drafting patent application and conducting prior art searches. Students will be exposed to the technical, management and legal aspects of IP and Patents.

COURSE CONTENT:

UNIT I: Introduction: Historical and philosophical background of patents and other intellectual property, Patent System: the Constitution, Congress, Patent Office (PTO), and courts; Analyzing and understanding judicial opinions

UNIT II: Comparative overview of patents, copyrights, trade secrets, and trademarks: Legal fundamentals of patent protection for useful inventions**,** Design and plant patents, Legal fundamentals of copyright protection, Similarity and access, Expression vs. ideas and information, merger, Fair use of copyrighted works (e.g., for classroom use), Contributory copyright infringement, Critical differences between patent and copyright protection, Copyright infringement distinguished from plagiarism, Legal fundamentals of trade-secret protection, Legal fundamentals of trademark protection

UNIT III: Requirements and limitations of patentability: New and useful: (A) The legal requirement of novelty (B) First to invent vs. first inventor to file, The legal requirement of non-obviousness.

UNIT IV: The process of applying for a patent ("patent prosecution"): Anatomy of a patent application, Adequate disclosure, The art of drafting patent claims, Patent searching: (A) Purposes and techniques, Actions for patent infringement, Interpretation of claims, Doctrine of equivalents, Product testing as a possibly infringing use, Doctrine of exhaustion

SUGGESTED READINGS:

1. Robert H. Rines, ``Create or Perish: The Case for Inventions and Patents,'' Acropolis.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO012	**Supply Chain Management-Planning and Logistics**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

Supply chain management consist of all parties (including manufacturer, marketer, suppliers, transporters, warehouses, retailers and even customers) directly or indirectly involved in fulfillment of a customer. The main objective is to acquaint the students with the concepts and tools of supply chain management and logistics as relevant for a business firm.

COURSE CONTENT:

Unit I

Introduction: Concept of supply chain management (SCM) and trade logistics; Scope of logistics; Logistic activities – an Overview; Contribution of logistics at macro and micro levels; SCM and trade logistics; Business view of SCM; Concept, span and process of integrated SCM; Demand management – methods of forecasting; Supply chain metrics (KPIs), performance measurement and continuous improvement; Product development Process and SCM; Strategic role of purchasing in the supply chain and total customer satisfaction; Types of purchases; Purchasing cycle.

Unit II

Managing Relationship: Role of Relationship marketing in SCM; Managing relationships with suppliers and customers; Captive buyers and suppliers; Strategic partnerships; Supplier-retailer collaboration and alliances.

Unit III

Focus Areas of Logistics and Supply Chain management: Transportation-Importance of effective transportation system; Service choices and their characteristics; inter-modal services; Transport cost characteristics and rate fixation; In-company management vs. out-sourcing; World sea borne trade; International shipping- characteristics and structure; Liner and tramp operations; Liner freighting; Chartering-Types, principles and practices; Development in sea transportation-Unitization, containerisation, inter and multimodal transport; CFC and ICD. Air transport: Set up for air transport and freight rates; Carriage of Goods by sea -Role and types of cargo intermediaries. Warehousing and inventory management: Reasons for warehousing; Warehousing evaluation and requirements; Warehousing location strategies; Inventory management principles and approaches; Inventory categories -EOQ, LT, ICC; Material management systems and techniques – JIT purchasing, manufacturing and in-bound logistics; Packing and marking; Control and communication.

Unit IV

IT Enabling Logistics and Supply Chain: Technology in logistics – EDI, bar Coding, RFID etc., data

warehousing, electronic payment transfers; Business management systems; TRADITIONAL ERP, SPECIAL ERP, MR, DRP, PDM, EIP, CPFR, WMS, TMS; Re-engineering the supply chain- Future directions.

Unit V

Trends and Challenges in logistics and supply chain management: Third party logistic outsourcing –challenges and future directions.

SUGGESTED READINGS:

1. M. Christopher, ``Logistics and Supply Chain Management,'' Prentice Hall.
2. Handfield and Nicholas, Jr, `` Introduction to Supply Chain Management,'' Prentice Hall.
3. Jhon J Coyle, C. Jhon and Langley, Brian J Gibs, ``Logistics approach to Supply Chain Management,'' Cengage Learning.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO013	**Organization Development**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

Organisation Development is a growing field of Human Resource Management. It has its foundations in a number of behavioural and social sciences .

COURSE CONTENT:

1. Organizational Systems and Human Behaviour - Developing a basic knowledge of how organizattons and groups function as systems; introducing and discussing various theoretical approaches and issues.
2. Interpersonal and Consulting Skills - Increasing effectiveness as a change agent by providing a variety of opportunities in order to increase self-awareness, practice alternative ways of approaching personal and interpersonal problem-solving and develop basic consulting and interviewing skills.
3. Introduction to Organization Development - Introducing some basic theories, models and methods in the field of organization development, especially those relating to the role of consultant and strategies for change.
4. Intervention and Change in Organizations - Consolidating and further developing consulting skills and strategies
5. Action Research Project - Carrying out a change activity in an organization, while also researching the effects and/or the process. This provides participants with an opportunity to consolidate and demonstrate skills and knowledge gained in other units of the course

SUGGESTED READINGS:

1. Wendell L. French, Cecil H. Bell Jr., Veena Bohra, "Organization development," Pearson Prentice Hall.
2. Donald L. Anderson, "Organization Development: The process of leading organizational change,'' Sage Publications, Inc.
3. W. Warner Burke, Debra A. Noumair, "Organization Development: A process of learning and changing,'' Pearson Education Ltd.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO014	**Industrial Organization 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
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
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

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO017	Biology For Engineers	3L-1T-0P	None

COURSE OUTCOMES (CO):

1. General understanding of organization in biological systems
2. Conceptual knowledge of functioning in biological systems
3. Clarity about relevance of Biology to engineering graduates
4. Understanding human body as a study-model for engineering students
5. Understanding electrical, chemical and magnetic forces, and communication networks in human body

COURSE CONTENT:

Unit I: Principles of Biology: Form and Function, Modularity and Incremental Changes, Genetic Basis, Competition and Selection, Biological Hierarchies, Biological complexity vs simplicity

Unit II: Biological Responses: Need for Water, Oxygen, Food, Nutrients, Heat Sources and Sinks, Adaptation to their Environments, Waste tolerance, Response to Chemical and Mechanical Stresses, Optimization to Save Energy and Nutrient Resources, **Allometric Relationships from Evolutionary Pressure**

Biology for Engineering Solutions: Systems Approach, Relationships between Engineering and Biology, The Completed Design

Biological Systems and Dynamics: Basic principles, Qualitative and quantitative description of Human Body, Modeling of Human Body: Compartments, Fluid streams, Production sources, The Hemodynamic System, Cheyne-Stokes Respiration,

Neural system: Action Potentials and Ion Channels, Ficks Law, Ohms Law and the Einstein Relation, Cellular Equilibrium: Nernst and Goldman, Equivalent Circuits, Dendrites; **Mathematical Neurodynamics:** Hodgkin, Huxley and the Squid Giant Axon FitzHugh-Nagumo Model, Fixed Points and Stability of a One-Dimensional Differential Equation, Nullclines and Phase Plane, Pitchfork and Hopf Bifurcations in Two Dimensions Excitability

Bioelectric and biomagnetic phenomena and their measurements

SUGGESTED READINGS:

1. T. Johnson,`` Biology for Engineers,'' CRC Press
2. Michael Small, `` Dynamics of Biological system,'' CRC Press
3. Johnny T. Ottesen, MS Olufsen, JK Larsen, ``Applied Mathematical Models and Human Physiology,'' Society for Industrial and Applied Mathematics

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO018	**Energy, Environment and Society**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

The objective is to aware students about various renewable resources, Basics of energy, environmental Impact of Energy sources. Students will also learn about the role of appropriate Technology in Transformation of Society

COURSE CONTENT:

Unit 1 Technology and Development

Introduction to Technology, Appropriate Technology, Role of Appropriate Technology in Transformation of Society, Importance of Technology Transfer, Impact of technology on Society.

Unit 2 Energy Basics

Importance of Energy in achieving Maslow's hierarchy of Needs, Human Development Index and Energy Consumption, Current Energy Trends, Demand and Supply of Energy in World and Nepal, Introduction to Global warming, Clean Development Mechanism, and Sustainability Issues, Conventional and Non-Conventional/Renewable Energy Sources,. Conventional Energy Sources: Fossil fuel, Nuclear Energy

Unit 3 Renewable Energy Sources

Solar radiation, Solar thermal energy, Solar Cell (Photovoltaic Technology), Hydropower Water sources and power , Water turbines and hydroelectric plants, Hydro Power Plant Classification (pico, micro, small, medium, large),

Wind Energy , Availability of Wind Energy sources, Wind turbines, wind parks and power control, Geothermal Energy, Sources of Geothermal Energy, Uses of Geothermal Energy, .Bio-mass and Bio-energy, Synthetic fuels from the biomass ,Thermo-chemical, physio-chemical and bio-chemical conversion, Bio-fuel cells , Hydrogen Energy and Fuel Cell , Basics of electrochemistry, Polymer membrane electrolyte (PEM) fuel cells, Solid oxide fuel cells (SOFCs) , Hydrogen production and storage.

Unit 4 Environmental Impact of Energy sources : Emission hazard, Battery hazard, Nuclear hazard

Unit 5 Energy Storage

Forms of energy storage, Hybrid vehicles, Smart grid systems, Batteries, Super-capacitors

SUGGESTED READINGS:

1) A. B. Saxena, ``A Textbook of Energy, Environment, Ecology and Society,'' New Age Publication

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO019	**Public Policy and Governance**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

Students will be introduced to Public Policy and Administrative governance. They will also learn about Administrative Governance.

COURSE CONTENT:

Unit 1 Introduction to Public Policy and Administrative Governance: Introduction to public policy, econometrics for policy research, policy analysis, economics for public decision making.

Unit 2 Public Bureaucracy in Theory and Practice: Benefit cost analysis, public budgeting, revenue and expenditures, managing and leading public service organisations.

Unit 3 Administrative Governance: The Challenge of Policy Implementation, public and non-profit programme evaluation.

Unit 4 Non-state Actors in Policy-making and Administrative Governance: governance in twenty-first century, Social Diversity and the Question of "Difference" in Policy-making and administrative Governance

SUGGESTED READINGS:

1. John Shields and B. Mitchell Evans., `` Shrinking the State: Globalization and Public administration reform,'' Halifax: Fernwood

2. Beryl Radin, Beyond Machiavelli, `` Policy Analysis Reaches Midlife,'' Georgetown University Press

3. Frank R. Baumgartner, Jeffrey M. Berry, Marie Hojnacki, and David C. Kimball, ``Lobbying and Policy Change: Who Wins, Who Loses, and Why,'' University of Chicago Press.

4. Timothy Conlan, Paul Posner, and David Beam, ``Pathways of Power: The dynamics of National Policymaking,'' Georgetown University press.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO020	**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

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.

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, Optimization Techniques**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO):

1. Know the concepts of Linear Programming
2. Know the concept of Non-linear Programming
3. Know the concepts of Dynamite Programming

COURSE CONTENT:

Linear programming, Duality Theory, dual Simplex method, Revised Simplex method, Sensitive analysis.

Integer Programming, Cutting plane algorithm.
Branch and bound technique, travelling salesman problem.
Nonlinear Programming, Kuhn-Tucker conditions, quadratic programming, Wolfe's algorithm.
Dynamite programming, Deterministic and stochastic examples. Advanced queuing Models, Finite source queues, Balking and Reneging, Priority queue disciplines.

SUGGESTED READINGS:

1. Hamdy Taha, ``Operations Research, An Introduction,'' Pearson Education
2. J R Fletcher, ``Practical Methods of Optimization,'' Wiley Publishing

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:

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
2. John C. Hull, ``Options, Futures and Other Derivatives,'' Prentice Hall India
3. Sheldon Ross, `` An Elementary Introduction to Mathematical Finance,'' Cambridge University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO026	Quantum Electronics	3L-0T-2P	None

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in semiconductor, laser, maser and optical fibre communication using quantum mechanics as fundamental tool. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies. This course is very useful in designing electronic and optical communication devices for using in optical communications, medicine, environment, industries and related fields.

COURSE CONTENT:

1. Semiconductor Laser

Homojunction laser: Population inversion at a junction; Emission spectra; The basic semiconductor laser; Heterojunction: Formation of ideal heterojunctions between (a) a p-type wide band-gap semiconductor and an n-type narrower band-gap semiconductor, (b) an n-type wide band-gap semiconductor and a p-type narrower band-gap semiconductor, (c) wide and lightly doped narrower band gap n-type semiconductors; Anderson's model of ideal heterojunction. Heterojunction laser: Single and double heterojunction laser; Analysis of carrier confinement in a single heterojunction laser.

2. Electrons in quantum structures

Energy level and wave functions for quantum well, quantum wire and quantum dot; Density of states for quantum well, quantum wire and quantum dot; Modulation | doped quantum well; Multiple quantum well; Coupling between quantum wells. Super lattice: The concept of a super lattice; Kronig-Penney model of a super lattice | zone folding, Tight binding approximation for a super lattice.

3. Quantum Semiconductor Laser

Light amplification in quantum well; Modulation bandwidth; Strained quantum well laser; Quantum wire laser; Blue quantum well laser.

4. Electro-optic effect in quantum structures

Franz-Keldysh effect in Semiconductor; Electro-optic effect in quantum wells; Electro-optic effect in super lattice.

5. Parallel and Perpendicular Transport in Quantum Structures

High field electron transport|Hot electrons in quantum structures; Double barrier resonant-tunneling structures;

Super lattices and ballistic injection devices.

6. Quantum Transistor

Resonant-tunneling unipolar and bipolar transistor; Velocity modulation and quantum interference transistor.

7. Guided wave optics

(a) Waveguide modes, Modes characteristics for a planar waveguide, Step index planar waveguide, Maxwell equations in inhomogeneous media: TE modes and TM modes, Radiation modes, Guided modes, Leaky modes, Quasi modes.

(b) Propagation in optical fibre, Numerical aperture, Pulse dispersion in fibres, Scalar wave equation and modes of the fibre, Modal analysis for a step index fibre.

8. Masers

Ammonia beam maser, Energy levels, Methods for population inversion, Maser operation.

9. Coherent interactions of a radiation field and an atomic system

(a) Induced resonant transitions, Inclusions of decay phenomena, Rotating wave approximation, Exact Rabi Solution in the strong field, Rabi flopping, Dressed state picture.

(b) Density matrix, Rate equation for density matrix, Optical Bloch equations, Vector model of density matrix, The Bloch sphere.

10. Semiclassical laser theory

Electromagnetic field equations, Expansion in normal modes of a cavity, Lambs self-consistency equations, Density matrix equations, Polarization of the medium, Single mode operation, Non-linear effect in polarization, Hole burning, Steady state power, Frequency pulling and pushing.

SUGGESTED READINGS:

1. Mitin, Kochelap and Stroscio, `` Quantum Heterostructures: Microelectronics and Optoelectronics,'' Cambridge University Press

2. Martinez-Duart, Martin-Palma, Agullo-Rueda, ``Nanotechnology for Microelectronics and Optoelectronics,'' Elsevier Science

3. A. Yariv, ``Quantum Electronics,'' John Wiley

4. A.K. Ghatak and K. Thyagarajan, ``Optical Electronics,'' Cambridge University Press

5. O. Svelto, ``Principles of Lasers,'' Springer

6. P. Bhattacharyya, ``Semiconductor Optoelectronics Devices,'' Prentice Hall

7. R. W. Boyd, ``Nonlinear Optics,'' Academic Press

8. B. G. Streetman and S. Banerjee, ``Solid State Electronic Devices,'' Prentice Hall India

9. T. Suhara, ``Semiconductor laser fundamentals,'' CRC Press

10. S. M. Sze, ``Physics of Semiconductor Devices,'' Wiley Publishing

11. J. Orton, ``The Story of Semiconductors,'' Oxford University Press

12. Rogers, Pennathur, Adams, ``Nanotechnology: Understanding Small Systems,'' CRC Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO027	**Laser Systems and Applications**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

The concept and understanding of laser action are helpful in designing and developing new devices used in optical communications, medicine, environment, industries and related physics. It also gives value addition in the students'

understanding of the basic principles involved. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D in the related field.

COURSE CONTENT:

Introduction: Review of elementary quantum physics, Schrodinger equation, concept of coherence, absorption, spontaneous emission and stimulated emission processes, relation between Einstein's A and B coefficients, population inversion, pumping, gain, optical cavities.

Lasers & Laser Systems: Main components of Laser, principle of Laser action, introduction to general lasers and their types. Three & four level Lasers, CW & Pulsed Lasers, atomic, ionic, molecular, excimer, liquid and solid state Lasers and systems, short pulse generation and Measurement.

Applications: Laser applications in medicine and surgery, materials processing, optical communication, metrology and LIDAR and holography(recording and reconstruction).

SUGGESTED READINGS:

1. K.R. Nambiar, "Laser Principles, Types and Application," New Age International.
2. S. A. Ahmad, "Laser concepts and Applications," New Age International.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO028	**Optoelectronics and Photonics**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in semiconductor laser, photonics and optical fibre communication. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies. This course is very useful in designing opto-electronic and optical communication devices for using in optical communications, medicine, environment, industries and related fields.

COURSE CONTENT:

Semiconductor lasers for optical fiber communications, Fabry-Perot cavity, heterostructure semiconductor lasers, single frequency semiconductor lasers, semiconductor lasers for coherent systems. Distributed feedback in Ga-As-P lasers. Device structure and fabrication, photodetectors for fiber optics, reverse bias photo-detectors, dark current, quantum efficiency, signal to notice ratio, types of detectors. Receivers for digital fiber optic communication systems: basic

components, detectors for digital fiber optic receivers, PIN diode, Avalanche photodiode, Fronts ends for digital fiber optic receivers, equalizer for optical communication, receivers, PIN-FET receivers for longer wavelength communication systems. Coherent optical fiber transmission systems, coherent detection principles, comparison of direct and coherent performance, homodyne and heterodyne systems. Non linear process in optical fibers, phase matching in

waveguide, phase matched harmonic generation in waveguides. Second harmonic generation (SHG) in integrated optics, Cerenkov configuration SHG. Optical fiber sensor and devices, intensity modulation through light interruption, distributed sensing with fiber optics. Basic principles of interferometric optical fiber sensor, signal processing in mono mode fiber optic sensor, photonic band gap materials.

SUGGESTED READINGS:

1. G. Keiser, ``Optical fiber communication,'' McGraw-Hill.
2. J. Senior, `` Optical fiber Communication,'' Prentice- Hall International
3. S.O. Kasap, `` Optoelectronics and Photonics: Principles and Practices,'' Pearson Education

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO029	**Electromagnetic Theory and Waveguides**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in the propagation of electromagnetic waves through space and wave guides. The understanding of various electromagnetic laws are helpful in designing and developing new devices used in optical communications, industries and related field. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies.

COURSE CONTENT:

Electrostatics; Boundary value problems Dielectrics, Steady currents, Magnetostatics; Time varying fields, Maxwell's equations, Lorentz force equation and motion of charges, Plane electromagnetic waves. Waveguides and resonant cavities, fields at the surface of and within a conductor, cylindrical cavities and waveguides, modes in a rectangular waveguide, energy flow and attenuation in waveguides, perturbation of boundary conditions, resonant cavities, power losses in a cavity, Earth and ionosphere as resonant cavity, dielectric waveguide.

SUGGESTED READINGS:

1. Griffiths D. J., ``Introduction to Electrodynamics,'' Prentice- Hall Pvt.Ltd.
2. J. D. Kraus, ``Electromagnetics,'' Tata McGraw Hill.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO030	**Polymer Science & Technology**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

1. To know about polymer science and technology.
2. To have an understanding of nanotechnology in polymers.

COURSE CONTENT:

Polymer Chemistry, Polymer Physics, Polymer Technology, Polymer Characterization, Polymer Engineering and Rheology, Polymer Processing, Polymer Testing and properties, Polymer Composites, Polymer Blends and Alloys, Rubber Technology, Polymer Processing, Polymers in Packaging, Nanotechnology in Polymers, Engineering Plastics and Specialty Polymers, New innovations in Polymers.

Practical related to above theory.

SUGGESTED READINGS:

1) P. J. Flory, ``Introduction to polymer Chemistry, '' Asian Books
2) Miles & Briston, ``Polymer Technology,'' J. G. Chemical Publishing Company
3) R. T. Fenner , ``Principle of Polymer Processing, '' Maxwell McMillan International Edn
4) Stephen L. Rosen, ``Fundamental principles of polymer materials practices for engineers, Plastics Materials,'' Barnes & Noble
5) Joel Frados, Van Nostrand, ``Plastics Engineering Handbook,'' Reinhold, New York
6) Morton & Jones, ``Polymer Processing,'' Chapman & Hall.

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

EO031	**Semiconductor Physics and Devices**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course is very helpful in understanding the various phenomena/mechanisms which are very useful in designing electronic devices, energy storage devices and other transistor based devices used in all sphere of life. It prepares students to take advanced courses in the related fields and finally equips them to take up R&D and higher studies.

COURSE CONTENT:

Semiconductor Physics; Semiconductor, Bonds in Semiconductors, Energy band, Effect of temperatures on Semiconductor, Hole currents, Intrinsic & extrinsic semiconductor, Majority and minority carriers, p-n junction, Volt- ampere characteristics of p-n junction. Semiconductor Diode: Semiconductor diode, Crystal diode rectifiers, Half wave rectifiers, Efficiency of half wave rectifier, Full wave rectifier, Centre tap full wave rectifier, Ripple factor, Filter Circuits,

Voltage stabilization, Zener diode, Zener diode as Voltage stabilizer. Transistors: Transistors, Transistors connections, Common base connection, Common emitter connection, common collector connection, Comparison of transistor connections, Transistor as an amplifier in CE arrangement, Transistor load line analysis, Operating point, Cut off and saturation points, Applications of Common base amplifier, Bipolar junction Transistors, Hybrid Parameters, Field effect Transistor: JFET/MESFET, MOSFET, Unipolar Devices.

SUGGESTED READINGS:

1. Joseph Lindmayer and Charles Y. Wrigly, ``Fundamentals of Semiconductor Devices,'' Litton Educational Publishing Inc.

2. S. M. Sze, ``Physics of Semiconductor Devices,'' John Wily & Sons.

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

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO032	**Elements of Fiber Optics**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in optical fibre communication. Concepts of Optical Fiber waveguides are helpful in designing and developing new devices used in optical communications, medicine, environment, industries and related physics. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies.

COURSE CONTENT:

Over view of optical fiber communications, the evolution of fiber optics systems, elements of an optical fiber transmission links. Electromagnetic analysis of optical waveguides, classification of modes for a planner waveguide, TE and TM modes in a symmetric step index planner waveguide, power associated with a mode, excitation of guided modes, Maxwell equations in inhomogeneous media: TE and TM modes in planner waveguide. Leaky modes, leakage of power from the core, bending loss in optical waveguides. Optical fiber waveguides, optical fiber types, numerical aperture, pulse dispersion in step index fibers, scalar wave equations and modes of a fiber, Modal analysis for a step index fiber and graded-index fiber. Linearly polarized modes, power flow, multi mode fibers with optimum profiles, single mode fiber, propagation modes in single mode fibers, fiber materials, fiber fabrication. Vapor-deposition methods, Fiber optic cables, optical fiber connections, joints and couplers, signal degradation in optical fiber, absorption loss, radiation loss, attenuation, signal distortion in optical waveguides, pulse broadening, mode coupling.

SUGGESTED READINGS:

1. G. Keiser and J. Seniar, ``Optical fiber communication'' McGraw Hill
2. A. K. Ghatak, ``Introduction to Optical fiber,'' Cambridge University Press

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO033	**Material Physics**	**3L-0T-2P**	**None**

1. COURSE OUTCOMES (CO):
2. Given a type of material, be able to qualitatively describe the bonding scheme and its general physical properties, as well as possible applications.
3. Given a type of bond, be able to describe its physical origin, as well as strength. Be able to qualitatively derive a material's Young's modulus from a potential energy curve.
4. Given the structure of a metal, be able to describe resultant elastic properties in terms of its 1D and 2D defects.
5. Given a simple set of diffraction data, be able to index the peaks and infer the structure.
6. Be able to describe a polymer's elastic behavior above and below the glass transition.
7. Be able to do simple diffusion problems.

COURSE CONTENT:

1. Overview of materials

Crystalline and amorphous materials, glasses, semiconductors, compound semiconductors, solar energy materials, luminescent and optolectronic materials, polymer, liquid crystals, ceramics, classification according to bonding | Pauling and Philips theories.

2. Synthesis and preparation of materials

Single crystal growth, zone refining, doping techniques of elemental and compound semiconductors, fabrication and control of thin films, PVD and CVD processes, principles of polymer processing, preparation of ceramics powders | mechanical and chemical methods.

3. Characterization of materials

Defects and microstructures; Diffraction techniques: X-ray diffraction | structure determination from XRD data; Neutron diffraction; Thermal methods: DTA, TGA, DSC; Microscopy: TEM, SEM; Optical spectroscopy: UV and IR; Nuclear techniques: NMR, ESR, Mossbauer and Positron annihilation. Heat treatments, quenching and annealing; Radiation damage.

4. Phase transition in materials

Thermodynamics and phase diagrams, statistical theories of phase transitions, critical phenomena, calculation of critical exponents for van der Waals gas and ferromagnets; Diffusion in solids, variation of diffusion constant with temperature.

5. Mechanical properties

Deformation and fracture, Deformation at low and high temperature, Intrinsically hard materials.

6. Spinodal decomposition

Spinodal curve, Free energy of composition fluctuations, Kinetics of Spinodal decomposition.

7. Electrical properties of alloys, ceramics, and conducting polymer

Resistivity variation of metals at low and high temperature, Kondo effect; Effect of pressure on resistivity, resistivity variation in ceramics and conducting polymer; Ferroelectricity, Landau-Ginzburg theory of ferroelectricity; Piezoelectricity.

8. Magnetic properties of different materials
Antiferromagnetism, ferrimagnetism, magnons, thermal properties of magnons, magnetic storage, applications as capacitors, transducers, sensors, memories, displays; Quantum Hall effect.
9. Glasses
Definitions, properties of glass transition, tunnelling states, calculation of specifc heat from tunneling states and from a model two level system having random energy gap, theories for glass transition.
10. Non-crystalline semiconductors
Classifcations, electrical properties, temperature variation of dc conductivity, ac conductivity, magnetoresistance, Colossal magnetoresistance (CMR).
11. Exotic solids
Structure and symmetries of liquids, liquid crystals, amorphous solids; Aperiodic solids and quasicrystals; Fibonacci sequence; Penrose lattices and their extensions in 3 dimensions; Special carbon solids, fullerenes and tubules, formation and characterization of fullerenes and tubules, single wall and multiwall carbon tubules; Electronic properties of tubules; Carbon nanotubule based electronic devices, Defnition and properties of nanostructured materials. methods of synthesis of nano-structured materials; Special experimental techniques for characterization of materials; Quantum size effect and its applications.

SUGGESTED READINGS:

1. C. Kittel, ``Introduction to Solid State Physics'' Wiley
2. R. Zallen, ``The Physics of Amorphous Solids'' Wiley Classic
3. N. F. Mott and E.A. Davies, ``Electronic Processes in Non-crystalline Materials'' Oxford Classic
4. C. N. R. Rao and B. Raveau, ``Colossal Magnetoresistance, Charge Density and Related Properties of Manganese oxides,'' World Scientific
5. J. M. Yeomans, ``Statistical Mechanics of Phase Transitions'' Claredon Press
6. R. E. Prange and S. M. Girvin (editors), ``The Quantum Hall Effect'' Springer
7. H. P. Klug and L. E. Alexander, `` X-ray Diffraction Procedures'' Wiley

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO034	**Advanced Electromagnetic Theory and Special Relativity**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

This course imparts understanding of various mechanisms in the propagation of electromagnetic waves through space and wave guides. The understanding of various electromagnetic laws are helpful in designing and developing new devices used in optical communications, industries and related field. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies.

COURSE CONTENT:

Maxwell's equations, wave equations in scalar and vector potential, solutions of scalar and vector wave equations by Fourier analysis. Relativistic motion in electromagnetism, postulates of special theory of relativity, Lorenz transformation, relativistic mechanics, contraction of length, dilation of time, magnetism as relativistic effect, four vector, co-variance of Maxwell's equations, Lienard-Wiechert potentials and the field of a uniformly moving electron, radiation from an accelerated charge, cyclotron synchrotron, Brensstrahlung and Cerenkov radiations.

Scattering and absorption of electromagnetic waves, antenna, radiated power and angular distribution of radiation, electric dipole radiation.
SUGGESTED READINGS: 1. R. Resnik, ``Introduction to Special Relativity,'' Wiley Eastern Ltd. 2. J. D. Jackson , ``Classical Electrodynamics'' John Wiley & Sons

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO035	**Fiber and Integrated Optics**	**3L-0T-2P**	**None**
COURSE OUTCOMES (CO): This course imparts understanding of various mechanisms in optical fibre communication. Concepts of Optical Fiber waveguides are helpful in designing and developing new devices used in optical communications, medicine, environment, industries and related physics. It prepares students to take advanced courses in the related fields and finally equips students to take up R&D and higher studies.			
COURSE CONTENT: Modes in an asymmetric planer waveguides. Ray analysis of planer waveguide, W. K. B. analysis of inhomogeneous planer waveguide, strip waveguides, periodic waveguide-coupled mode analysis, and rectangular core waveguides metal clad waveguides. Anisotropic polarizer, leaky modes in a planer structure. Polarization maintaining fibers and their applications different types of polarization maintaining fibers, high birefringent fibers, single polarization single mode fibers. Integrated optic devices: electro-optic effect, phase modulator, polarization modulators and wavelength filters. The Mach Zhender Interferometric modulator, logic operations, optical directional coupler, leaky mode, metal clad polarizer.			
SUGGESTED READINGS: 1. A. W. Snyder and J. D. Love, ``Optical Wave guide Theory'' Chapmann and Hall. 2. A. K. Ghatak, `` Introduction to optical fiber'', Cambridge University Press.			

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO036	**Condensed Matter Physics**	**3L-0T-2P**	**None**
COURSE OUTCOMES (CO): This course aims to establish fundamental concepts in condensed matter physics, and applies the physics you have learned previously (in particular quantum mechanics, classical mechanics, electromagnetism and statistical mechanics) to these real-world materials. The structure and properties of solids including thermal and electrical properties are described.			
COURSE CONTENT: 1. Symmetry in crystals Concepts of point group; Point groups and Bravais lattices; Crystal symmetry | space groups; Symmetry and degeneracy | crystal _eld splitting; Kramer's degeneracy; Quasicrystals: general idea, approximate translational and rotational symmetry of two-dimensional Penrose tiling, Frank-Casper phase in metallic glass. 2. Lattice dynamics Classical theory of lattice vibrations in 3-dimensions under harmonic approximation; Dispersion relation: accoustical and optical, transverse and longitudinal modes; Lattice vibrations in a monatomic simple cubic lattice;			

Frequency distribution function; Normal coordinates and phonons; Occupation number representation of the lattice Hamiltonian; Thermodynamics of phonons; The long wavelength limits of the acoustical and optical branches; Neutron diffraction by lattice vibrations; Debye-Waller factor; Atomic displacement and melting point; Phonon-phonon interaction, interaction Hamiltonian in occupation number representation; Thermal conductivity in insulators.

3. Density Functional Theory

Basics of DFT, Comparison with conventional wave function approach, Hohenberg-Kohn Theorem; Kohn-Sham Equation; Thomas-Fermi approximation and beyond; Practical DFT in a many body calculation and its reliability.

4. Electronic properties: I

The Boltzmann transport equation and relaxation time; Electrical conductivity of metals | impurity scattering, ideal resistance at high and low temperatures, U-processes; Thermo-electric effects;
Thermal conductivity; The Wiedemann-Franz law.

5. Electronic properties: II

Electronic properties in a magnetic field; Classical theory of magneto-resistance; Hall effect and magneto-resistance in two-band model; K-space analysis of electron motion in a uniform magnetic field; Idea of closed, open and extended orbits, cyclotron resonance; Azbel-Kaner resonance; Energy levels and density of states in a magnetic field; Landau diamagnetism; de Haas-van Alphen effect; Quantum Hall effect.

6. Optical properties of solids

The dielectric function: the dielectric function for a harmonic oscillator, dielectric losses of electrons, Kramers-Kronig relations; Interaction of phonons and electrons with photons; Interband transition | direct and indirect transition; Absorption in insulators; Polaritons; One-phonon absorption; Optical properties of metals, skin effect and anomalous skin effect.

SUGGESTED READINGS:

1. M. Tinkham, ``Group Theory and Quantum Mechanics,'' Dover Publications
2. M. Sachs, ``Solid State Theory'' McGraw Hill
3. A. O. E. Animalu, ``Intermediate Quantum Theory of Crystalline Solids'' Prentice Hall
4. N. W. Ashcroft and N. D. Mermin, ``Solid State Physics'' Brooks
5. J. M. Ziman, ``Principles of the Theory of Solids'' Cambridge University Press
6. C. Kittel, ``Introduction to Solid State Physics,'' Wiley

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO037	**Microwave**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

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

COURSE CONTENT:

1. Transmission line and waveguide

Interpretation of wave equations; Rectangular wave guide | TE and TM modes, power transmission, excitation of modes; Circular waveguide | TE, TM and TEM modes, power transmission, excitation of modes. Microstrip lines | characteristic impedance, loss and Q of microstrip lines, coplanar strip lines and shielded strip lines.

2. Component

Scattering parameter and scattering matrix, properties of S-parameter; Quality factor and Q-value of a cavity resonator, Q-value of a coupled cavity; Wave guide tees, magic tee, hybrid ring, couplers; Ferrites and Faraday's rotation, gyrator, circulator, isolator and terminator; λ/4 section filter, tuner and sliding short.

3. Measurement

Smith chart, single stub and double stub matching; Microwave bridge, measurement of frequency, attenuation and phase; Measurement of dielectric parameters of amorphous solids | dielectric constant, ac conductivity, resistivity, insertion loss, return loss, shielding coefficient. Measurement of microstrip line parameters.

4. Source

Conventional sources & their limitations.

(a) Vacuum tube sources | Klystron, reex klystron, travelling wave tubes and switching tubes;
Magnetrons, FWCFA and Gyrotrons.

(b) Microwave transistors and FETs, Gunn, IMPATT, TRAPATT and parametric devices.

(c) Laser | Laser processes, Pockels-Cell; Laser modulators, infrared radiation and sources.

5. Antenna

Transmitting and receiving antennas, antenna gain, resistance and bandwidth; Antenna dipoles, straight, folded and broadband dipoles; Beam width and polarisation; Antenna coupling.

6. Microwave integrated circuit

Materials and fabrication technique; MOSFET fabrication, memory construction, thin film formation, planar resistor, planar inductor and planar capacitor formation; Hybrid integrated circuit formation.

SUGGESTED READINGS:

1. Samyel Y. Liao, ``Microwave Devices and Circuits'' Prentice hall publication,
2. Herbert J. Reich, ``Microwave Principles,'' Van Nostrand
3. K. C. Gupta, ``Microwaves,'' New Age publisher.
4. M. L. Sisodia and G. S. Raghubanshi, ``Microwave Circuits and Passive Device'' New Age publisher.
5. N. Mercuvitz, ``Waveguide Handbook'' IET
6. S. M. Sze, ``Physics of Semiconductor Devices'' John Wiley publisher.
7. R. E. Collins, ``Foundations of Microwave Engineering'' Wiley publication.
8. J. D. Ryder, ``Network Lines and Fields'' Prentice Hall publication.
9. Royal Signals, ``Handbook of Line Communication'' The War Office
10. W. Frazer, ``Telecommunications'' Macdonald
11. J. D. Kraus, ``Antenna'' Tata Mc Graw Hill publication.

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO038	**Fundamentals of Instrumentation and experimental 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:

Physical Measurement: Sources of uncertainty and experimental error, Systematic and random error, Analysis of repeated measurements, Distribution functions, Propagation of error, Analysis of data. Optical measurements and the electromagnetic spectrum, Temperature transducers and linear position sensors.

Signal to noise considerations: Fluctuations and noise measurement systems, Noise in frequency domain, Signal to Noise and experimental design, Frequency and bandwidth considerations, Signal to noise enhancement, Digital and auto correlation methods.

Vacuum techniques: Characteristics and applications of vacuum, Vacuum systems-pumps and gauges, pumping speed, Thin film techniques, Film thickness monitors and measurements.

Optical Instruments: Spectroscopic Instrumentation, visible and infrared spectroscopy, Spectrometer design- lenses and refractive optics, Dispersive elements. Lasers and fibre optics.

X-ray Measurement: X-ray Fluorescence- line spectra, fine structure, Absorption and emission processes, X-ray production, X-ray diffraction and crystallography- powder diffraction spectra, information available from spectra.

Analytical Instrumentation: Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Environmental Scanning Electron Microscope (ESEM), Surface Analytical Methods-Auger Electron spectroscopy, X-ray photo electron spectroscopy (XPS) and secondary ion mass spectrometer (SIMS). X-ray fluorescence, Tunneling scanning microscope.

Occupational Health and Safety : Occupational health and safety, Chemical substances- Storage and Disposal, Work hazardous materials information system(WHMIS). Safety from electromagnetic radiation, General Electrical and testing standards- CSA approval, General laboratory and workshop practice.

SUGGESTED READINGS:

1. Michael Sayer and Abhai Mansingh, ``Measurement, Instrumentation and Experiment Design in Physics and Engineering'' Prentice-Hall India

Course No.	Title of the Course	Course Structure	Pre-Requisite
EO039	**Lasers and Photonics**	**3L-0T-2P**	**None**

COURSE OUTCOMES (CO):

The understanding of Laser, Photonics and Optical Fiber are helpful in designing and developing new devices used in optical communications, solar energy devices, medicine, environment, industries and related physics. It also gives value addition in the students' understanding of the basic principles involved. It prepares students to take advanced courses in the related fields and finally equips students to take up 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.