REGULATIONS,
COURSE STRUCTURE
AND SYLLABUS

Aligned with AICTE model Curriculum 2018-2019

SITE 2018 (M) REGULATION
for

B. Tech.

Electrical & Electronics Engineering

With Effective from the academic year

2020-2021

REGULATIONS, COURSE STRUCTURE
AND
SYLLABUS

(Aligned with AICTE Model Curriculum 2018-19)

Chapter-I

UG
Regulations

Chapter – I

B. Tech. Regulations

1.1 Short title and Commencement

The regulations listed under this head are common for all degree level under graduate programs (B. Tech.) offered by the college with effect from the academic year 2020-21 and they are called as "SITE18M" regulations.

The regulations here under are subject to amendments as may be made by the Academic Council of the college from time to time, keeping the recommendations of the Board of Studies in view. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the program, as may be decided by the Academic Council.

1.2. Definitions

a. "Commission" means University Grants Commission (UGC)
b. "Council" means All India Council for Technical Education (AICTE)
c. "University" Means Jawaharlal Nehru Technological University Kakinada (JNTUK)
d. "College" means Sasi Institute of Technology & Engineering, Tadepalligudem.
e. "Program" Means any combination of courses and /or requirements leading to award of a degree
f. "Course" Means a subject either theory or practical identified by its course title and code number and which is normally studied in a semester.
g. For example, (Data Structures) is a course offered at third semester of B.Tech (CST) and its code is (18MCSCST3020)
h. "Degree" means an academic degree conferred by the university upon those who complete the undergraduate curriculum
i. "Regular Student" means student enrolled into the four year program in the first year
j. "Lateral entry Students" Means student enrolled into the four year program in the second year

1.3. Academic Programs

1.3.1. Nomenclature of Programs

The nomenclature and its abbreviation given below shall continue to be used for the degree programs under the University, as required by the Council and Commission. The name

of specialization shall be indicated in brackets after the abbreviation. For e.g. UG engineering degree in Mechanical Engineering program is abbreviated as B. Tech. (ME). Bachelor of Technology (B. Tech.) degree program offered in:

1. Civil Engineering(CE)
2. Computer Science and Engineering(CSE)
3. Computer Science and Technology(CST)
4. Electronics and Communication Engineering(ECE)
5. Electronics and Communication Technology(ECT)
6. Electrical and Electronics Engineering(EEE)
7. Information Technology(IT)
8. Mechanical Engineering(ME)

- Curriculum framework is important in setting the right direction for a Degree program as it takes into account the type and quantum of knowledge necessary to be acquired by a student to qualify for a award in his/her chosen branch or specialization.
- Besides, this also helps in assigning the credits for each course, sequencing the courses semester-wise and finally arriving at the total number of courses to be studied and the total number of credits to be earned by a student to fulfill the requirements for conferment of degree.
- Each theory course shall consist of five units.

1.3.2. Curriculum Structure

The curriculum structure is designed in such a way that it facilitates the courses required to attain the expected knowledge, skills and attitude by the time of their graduation as per the needs of the stakeholders. The curriculum structure consists of various course categories (as described in 1.6.3 to 1.6.9) to cover the depth and breadth required for the program and for the attainment of program outcomes of the corresponding program. Each Program of study will be designed to have 40-45 theory courses and 16-18 laboratory courses. The distribution and types of courses offered from the above is indicated in the following table 3.

1.3.3. Induction Program

The Induction Program for two weeks is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students and building of character. Induction program covers:

- Physical activity
- Creative arts
- Universal human values
- Literary and Proficiency modules
- Lectures by Eminent peoples

1.4Admission Criteria

The eligibility criteria for admission into UG engineering programs are as per the norms approved by government of Andhra Pradesh from time to time. The sanctioned seats in each program in the college are classified into CATEGORY-A and CATEGORY-B at first year level and Lateral Entry at second year level.

- **CATEGORY – A Seats:** These seats will be filled as per the norms approved by the Government of Andhra Pradesh.
- **CATEGORY – B Seats:** These seats will be filled by the College as per the norms approved by the Government of Andhra Pradesh.
- **CATEGORY – Lateral Entry Seats:** Lateral entry candidates shall be admitted into the Third semester directly as per the norms approved by government of Andhra Pradesh. The percentages of Category-A, Category-B and Lateral Entry Seats are decided time to time by the Government of Andhra Pradesh.

2. Award of B. Tech. Degree

a) A student will be declared eligible for the award of B. Tech. Degree if he fulfils the following academic regulations:
   i. A student shall be declared eligible for the award of B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years. After eight academic years from the year of their admission, he/she shall forfeit their seat in B.Tech course and their admission stands cancelled.
   ii. The candidate shall register for 160 credits and secure all the 160 credits.

b) The medium of instruction for the entire under graduate program in Engineering &Technology will be in **English** only.

3. Program Pattern:

a) Total duration of the of B. Tech (Regular) Program is four academic years
b) Each Academic year of study is divided into Two Semesters.
c) Minimum number of instruction days in each semester is 90.

d) Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).

e) The total credits for the Program is 160.

f) Three week induction program is mandatory for all first year UG students and shall be conducted as per AICTE/UGC/APSCHE guidelines.

g) Student is introduced to "Choice Based Credit System (CBCS)".

h) A pool of interdisciplinary and job-oriented mandatory skill courses which are relevant to the industry are integrated into the curriculum of concerned branch of engineering (total five skill courses: two basic level skill courses, one on soft skills and other two on advanced level skill courses)

i) A student has to register for all courses in a semester.

j) All the registered credits will be considered for the calculation of final CGPA.

k) Each semester has - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and course structure as suggested by AICTE are followed.

l) A 10 months industry/field mandatory internship, both industry and social, during the summer vacation and also in the final semester to acquire the skills required for job and make engineering graduates to connect with the needs of the industry and society at large.

m) All the students shall be mandatorily registered for NCC, NSS activities and Community Service Project as per the Government and University norms.

n) Each college shall assign a faculty advisor/mentor after admission to each student or group of students from same department to provide guidance in courses registration/career growth/placements/ opportunities for higher studies/GATE/other competitive exams etc.

4. Registration for Courses:

a) In each semester a student shall mandatorily register courses which he/she wishes to pursue within a week from the starting of the class work with the advice of Head of the Department and mentor of the student of the concerned department of the college.

b) If any student wishes to withdraw the registration of the course, he/she shall submit a letter to the Principal of the college through the Head of the Department and mentor within fifteen days.

c) The concerned college shall thoroughly verify and upload the data/courses registered by each student in the university examination center within 20 days. The Principal of the concerned college shall ensure that there no wrong registration courses by the student. The university registration portal will be closed after 20 days.

5. (a) Award of B. Tech. Degree: A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:

i. A student shall be declared eligible for award of the B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years. After eight academic years from the year of their admission, he/she shall **forfeit** their seat in B. Tech course and their admission stands cancelled.

ii. The student shall register for 160 credits and must secure all the 160 credits.

iii. All students shall mandatorily register for the courses like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc., shall be included in the curriculum as non-credit mandatory courses. Environmental Sciences is to be offered compulsorily as mandatory course for all branches. A student has to secure at least 40% of the marks allotted in the internal evaluation for passing the course and shall maintain 75% of attendance in the subject.

iv. All students shall mandatorily register for NCC/NSS activities and will be required to participate in an activity specified by NSS officer during second and third semesters. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet on the basis of participation, attendance, performance and behavior. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

v. Credits are defined as per AICTE norms.

(b) Award of B. Tech. (Honor)/B. Tech. (Minor): B. Tech. with Honors or a B. Tech. with a Minor will be awarded if the student earns 20 additional credits are acquired as per the regulations/guidelines. The regulations/guidelines are separately provided. Registering for an Honors/Minor is optional.

6. Attendance Requirements

a) A student is eligible to write the University examinations if he acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the subjects.

b) Condonation of shortage of attendance in aggregate up to 10% (65% and above, and below 75%) may be granted by the College Academic Committee. However, this Condonation concession is applicable only to any two semesters during the entire program.

c) Shortage of Attendance below 65% in aggregate shall not be condoned.

d) A student who is short of attendance in a semester may seek re-admission into that semester when offered within 4 weeks from the date of commencement of class work.

e) Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.

f) A stipulated fee of Rs. 1000/- in the concerned semester shall be payable towards Condonation of shortage of attendance. Students availing Condonation on medical ground shall produce a medical certificate issued by the competitive authority.

g) A student will be promoted to the next semester if he satisfies the (i) attendance requirement of the present semester and (ii) minimum required credits.

h) If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

i) For induction program attendance shall be maintained as per AICTE norms.

j) For non-credit mandatory courses the students shall maintain the attendance similar to credit courses

7. Evaluation-Distribution and Weightage of marks

i. Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the University Examination section from time to time.

ii. To maintain the quality, external examiners and question paper setters shall be selected from reputed institutes like IISc, IITs, IIITs, IISERs, NITs and Universities.

iii. For non-credit mandatory courses, like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, the

student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

iv. A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/practical design/drawing subject/ project etc by securing not less than 35% of marks in the end semester exam and minimum 40% of marks in the sum total of the internal marks and end semester examination marks together.

v. **Distribution and Weightage of marks:**

The assessment of the student's performance in each course will be as per the details given:

S.No.	Components	Internal	External	Total
1	Theory	30	70	100
2	Engineering	30	70	100
3	Practical	15	35	50
4	Mini Project/Internship/Industrial Training/ Skill Development programs/Research Project	-	50	50
5	Project Work	60	140	200

vi. **Continuous Internal Theory Evaluation:**

a) For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one online objective examination (20 multiple choice questions) for 10 marks for duration of 20 minutes (ii) one descriptive examination (3 full questions for 5 marks each) for 15 marks for duration of 90 minutes and (iii) one assignment for marks. All the internal exams shall be conducted as per university norms from first 50% of the syllabi.

b) In the similar lines, the second online, descriptive examinations assignment shall be conducted on the rest of the 50% syllabus.

c) The total marks secured by the student in each mid-term examination are evaluated for 30 marks. The first mid marks (Mid-1) consisting of marks of online objective examination, descriptive examination and assignment shall be submitted to the University examination section within one week after completion of first mid examination.

d) The mid marks submitted to the University examination section shall be displayed in the concerned college notice boards for the benefit of the students.

e) If any discrepancy found in the submitted Mid-1 marks, it shall be brought to the notice of university examination section within one week from the submission.

f) Second mid marks (Mid-2) consisting of marks of online objective examination, descriptive examination and assignment shall also be submitted to University examination section within one week after completion of second mid examination and it shall be displayed in the notice boards. If any discrepancy found in the submitted mid-2 marks, it shall be brought to the notice of university examination section within one week from the submission.

g) Internal marks can be calculated with 80% Weightage for better of the two mids and 20% Weightage for other mid exam.

Example:

Mid-1 marks = Marks secured in

(Online examination-1 + descriptive examination-1 +one assignment-1)

Mid-2 marks = Marks secured in

(Online examination-2+descriptive examination-2+one assignment-2)

Final internal Marks = (Best of (Mid-1/Mid-2) marks x 0.8 + Least of (Mid-1/Mid-2) marks x 0.2)

h) With the above criteria, university examination section will send mid marks of all subjects in consolidated form to all the concerned colleges and same shall be displayed in the concerned college notice boards. If any discrepancy found, it shall be brought to the notice of university examination section through proper channel within one week with all proofs. Discrepancies brought after the given deadline will not be entertained under any circumstances.

vii. Semester End Theory Examinations Evaluation:

a) The semester end examinations will be conducted university examination section for 70 marks consists of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

b) For practical subjects there shall be continuous evaluation during the semester for 15 internal marks and 35 end examination marks. The internal 15 marks shall be awarded as follows: day to day work - 5 marks, Record-5 marks and the remaining 5 marks to

be awarded by conducting an internal laboratory test. The end examination shall be conducted by the teacher concerned and external examiner appointed.

c) For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (15 marks for continuous Assessment (day–to–day work) and 15 marks for internal tests) and 70 marks for end examination. There shall be two internal tests in a Semester for 15 marks each and final marks can be calculated with 80% Weightage for better of the two tests and 20% Weightage for other test and these are to be added to the marks obtained in day to day work.

d) Evaluation of the summer internships: It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs in the area of concerned specialization of the UG program. Students shall pursue this course during summer vacation just before its offering as per course structure. The minimum duration of this course is at least 6 weeks. The student shall register for the course as per course structure after commencement of academic year. A supervisor/mentor/advisor has to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. Attendance requirements are as per the norms of the University. After successful completion, students shall submit a summer internship technical report to the concerned department and appear for an oral presentation before the departmental committee consists of an external examiner; Head of the Department; supervisor of the internship and a senior faculty member of the department. A certificate from industry/skill development center shall be included in the report. The report and the oral presentation shall carry 40% and 60% Weightage respectively. It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the University.

e) The job oriented skill courses may be registered at the college or at any accredited external agency. A student shall submit a record/report on the on the list skills learned. If the student completes job oriented skill course at external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of

the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external and internal examiner (course instructor or mentor). There are no internal marks for the job oriented skill courses.

f) Mandatory Course (M.C): Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the college internally. Two internal examinations shall be conducted for 30 marks and a student has to secure at least 40% of the marks for passing the course. There is no online internal exam for mandatory courses. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only Completed (Y)/Not-completed (N) will be specified.

g) **Procedure for Conduct and Evaluation of MOOC:** There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM /NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be pass.

h) Major Project *(*Project - Project work, seminar and internship in industry):

In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work

carried out during the internship. The project report shall be evaluated with an external examiner.

Evaluation: The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner and is evaluated for 140 marks.

8 Results Declaration:

i. Before results declaration, an academic council meeting shall be conducted and results shall be placed before the academic council for approval.

ii. With the approval of academic council, the results shall be submitted to the University to get the Approval from Honorable Vice-Chancellor.

iii. The University may normalize the result, if required, before declaration of the result (Guidelines for normalization will be provided separately)

iv. A copy of approved results in a CD shall be submitted to the University Examination Center.

9. Academic Audit: Academic audit in each semester will be conducted as per norms.

10. Recounting or Re-evaluation of Marks in the End Semester Examination: A student can request for recounting of revaluation of his/her answer book on payment of a prescribed fee as per norms.

11. Supplementary Examinations: A student who has failed to secure the required credits can appear for a supplementary examination, as per the schedule announced by the University.

12. Malpractices in Examinations: Disciplinary action shall be taken in case of malpractices during Mid/End examinations as per the rules framed by the University.

13. Promotion Rules: The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.5 for promotion to higher classes

a) A student shall be promoted from first year to second year if he fulfills the minimum attendance requirement as per University norm.

b) A student will be promoted from II year to III year if he fulfills the academic requirement of 40% of credits up to either II year I-Semester or II year II-Semester

from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.

c) A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

14. Course Pattern

a) The entire course of study is for four academic years; all years are on semester pattern.

b) A student eligible to appear for the end semester examination in a subject, but absent from it or has failed in the end semester examination, may write the exam in that subject when conducted next.

c) When a student is detained for lack of credits / shortage of attendance, he may be re-admitted into the same semester/year in which he has been detained. However, the academic regulations under which he was first admitted shall continue to be applicable to him.

15. Earning of Credit:

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range A+ to E as given below. Letter grade 'F' in any course implies failure of the student in that course and no credits earned. Absent is also treated as no credits earned. For project same % percentages will be followed for grading.

Marks Range Max:100	**Marks range Max:50**	**Level**	**Letter Grade**	**Grade point**
≥ 90	≥ 45	Outstanding	A+	10
≥80 to <89	≥40 to <44	Excellent	A	9
≥70 to <79	≥35 to <39	Very Good	B	8
≥60 to <69	≥30 to <34	Good	C	7
≥50 to <59	≥25 to <29	Fair	D	6
≥40 to <49	≥20 to <24	Satisfactory	E	5
<40	<20	Fail	F	0
-		Absent	AB	0

16. Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	Remarks
First Class with Distinction	≥7.75 (Without any supplementary appearance)	From the CGPA secured from 160 Credits
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	
Pass Class	≥ 5.00 to < 5.75	

17. Minimum Instruction Days:

The minimum instruction days for each semester shall be 90 working days. There shall be no branch transfers after the completion of the admission process. There shall be no transfer from one college/stream to another within the Constituent Colleges and Units of Jawaharlal Nehru Technological University Kakinada.

18. Withholding of Results:

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

19. Transitory Regulations

a) Discontinued or detained candidates are eligible for re-admission as and when next offered.

b) The re-admitted candidate will be governed by the rules & regulations under which the candidate has been admitted.

c) In case of transferred students from other Universities, credits shall be transferred to JNTUK as per the academic regulations and course structure of JNTUK.

d) The students seeking transfer to colleges affiliated to JNTUK from various other Universities / Institutions have to obtain the credits of any equivalent subjects as prescribed by JNTUK. In addition, the transferred candidates have to pass the failed subjects at the earlier Institute with already obtained internal/sessional marks to be conducted by JNTUK.

20. Gap – Year:

Gap Year concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I/II/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at university level shall

be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.

21. General:

a) Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

b) The academic regulation should be read as a whole for the purpose of any interpretation.

c) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

d) The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

ACADEMIC REGULATIONS (SITE18M) FOR B. Tech

(LATERAL ENTRY SCHEME)

Applicable for the students admitted into II year B. Tech. from the Academic Year 2021-22 onwards

1. Award of B. Tech. Degree

A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:

a) A student shall be declared eligible for the award of the B. Tech Degree, if he pursues a course of study in not less than three academic years and not more than six academic years. After six academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.

b) The candidate shall register for 122 credits and secure all the 122 credits.

2. The attendance regulations of B. Tech. (Regular) shall be applicable to B. Tech (lateral entry)

3. **Promotion Rules:** A student shall be promoted from second year to third year if he fulfills the minimum attendance requirement.

A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

4. **Award of Class**

After a student has satisfied the requirement prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	Remarks
First Class with Distinction	≥ 7.75 (Without any supplementary appearance)	From the CGPA secured from 121 Credits from II Year to IV Year
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	
Pass Class	≥ 5.00 to < 5.75	

The Grades secured, Grade points and Credits obtained will be shown separately in the memorandum of marks.

5. All the other regulations as applicable to **B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme)**

COMMUNITY SERVICE PROJECT

Introduction

1. Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development
2. Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
3. Community Service Project is meant to link the community with the college for mutual benefit. The community will be benefited with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and also emerge as a socially responsible institution.

Objective

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships. The specific objectives are;

1. To sensitize the students to the living conditions of the people who are around them,
2. To help students to realize the stark realities of the society.
3. To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
4. To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.
5. To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
6. To help students to initiate developmental activities in the community in coordination with public and government authorities.
7. To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Project

1. Every student should put in a minimum of **180 hours** for the Community Service Project during the summer vacation
2. Each class/section should be assigned with a mentor.
3. Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, house-wives, etc
4. A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded. The log book has to be countersigned by the concerned mentor/faculty in charge.
5. Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
6. The final evaluation to be reflected in the grade memo of the student.
7. The Community Service Project should be different from the regular programs of NSS/NCC/Green Corps/Red Ribbon Club, etc.
8. Minor project report should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
9. Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

Procedure

1. A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable them to commute from their residence and return back by evening or so.
2. The Community Service Project is a twofold one –
   a) First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.
   b) Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –
      - Agriculture

- Health
- Marketing and Cooperation
- Animal Husbandry
- Horticulture
- Fisheries
- Sericulture
- Revenue and Survey
- Natural Disaster Management
- Irrigation
- Law & Order
- Excise and Prohibition
- Mines and Geology
- Energy
- Internet
- Free Electricity
- Drinking Water

EXPECTED OUTCOMES **BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS**

Learning Outcomes

1. Positive impact on students' academic learning.
2. Improves students' ability to apply what they have learned in "the real world".
3. Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development.
4. Improved ability to understand complexity and ambiguity.

Personal Outcomes

1. Greater sense of personal efficacy, personal identity, spiritual growth, and moral development.
2. Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

Social Outcomes

1. Reduced stereotypes and greater inter-cultural understanding
2. Improved social responsibility and citizenship skills
3. Greater involvement in community service after graduation

Career Development

1. Connections with professionals and community members for learning and career opportunities
2. Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

Relationship with the Institution

1. Stronger relationships with faculty
2. Greater satisfaction with college
3. Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS

1. Satisfaction with the quality of student learning
2. New avenues for research and publication via new relationships between faculty and community
3. Providing networking opportunities with engaged faculty in other disciplines or institutions
4. A stronger commitment to one's research

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES

1. Improved institutional commitment
2. Improved student retention
3. Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY

1.Satisfaction with student participation

2.Valuable human resources needed to achieve community goals

3.New energy, enthusiasm and perspectives applied to community work

4.Enhanced community-university relations.

SUGGESTIVE LIST OF PROGRAMS UNDER COMMUNITY SERVICE PROJECT

The following the recommended list of projects for engineering students. The lists are not exhaustive and open for additions, deletions and modifications. Colleges are expected to focus on specific local issues for this kind of projects. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and

benefits of this kind of projects. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting shall be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programs
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programs and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation
27. Floury culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture

32. Study of species
33. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilization of free electricity to farmers and related issues
40. Gender ration in schooling level- observation.

Complementing the community service project, the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested lists of programs are;

Programs for School Children:

1. Reading Skill Program (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Program on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Program on Socially relevant themes.

Programs for Women Empowerment

1. Government Guidelines and Policy Guidelines
2. Women's' Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharat
7. AIDS awareness camp

8. Anti Plastic Awareness
9. Programs on Environment
10. Health and Hygiene
11. Hand wash programs
12. Commemoration and Celebration of important days

Programs for Youth Empowerment

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programs

1. Awareness on RTI
2. Health intervention programs
3. Yoga
4. Tree plantation
5. Programs in consonance with the Govt. Departments like –
    i. Agriculture
    ii. Health
    iii. Marketing and Cooperation
    iv. Animal Husbandry
    v. Horticulture
    vi. Fisheries
    vii. Sericulture
    viii. Revenue and Survey
    ix. Natural Disaster Management
    x. Irrigation
    xi. Law & Order
    xii. Excise and Prohibition
    xiii. Mines and Geology
    xiv. Energy

Role of Students:

1. Students may not have the expertise to conduct all the programs on their own. The students then can play a facilitator role.
2. For conducting special camps like Health related, they will be coordinating with the Government agencies.
3. As and when required the College faculty themselves act as Resource Persons.
4. Students can work in close association with Non-Governmental Organizations like Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
5. And also, with the Governmental Departments. If the program is rolled out, the District Administration could be roped in for the successful deployment of the program.
6. An in-house training and induction program could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Project Activity

Duration: 8 weeks

1. Preliminary Survey (One Week)

a) A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.

b) A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.

c) The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.

2. Community Awareness Campaigns (Two Weeks)

Based on the survey and the specific requirements of the habitation, different awareness campaigns and programs to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

3. Community Immersion Program (Four Weeks)

Along with the Community Awareness Programs, the student batch can also work with any one of the below listed governmental agencies and work in tandem with them. This community involvement program will involve the students in exposing themselves to the experiential learning about the community and its dynamics. Programs could be in consonance with the Govt. Departments.

4. Community Exit Report (One Week)

During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks works to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that particular habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.

Throughout the Community Service Project, a daily log-book need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.

Course Numbering Scheme

The Course number code consists of 11 alphabets. A typical course number code is illustrated in the following Figure-1.

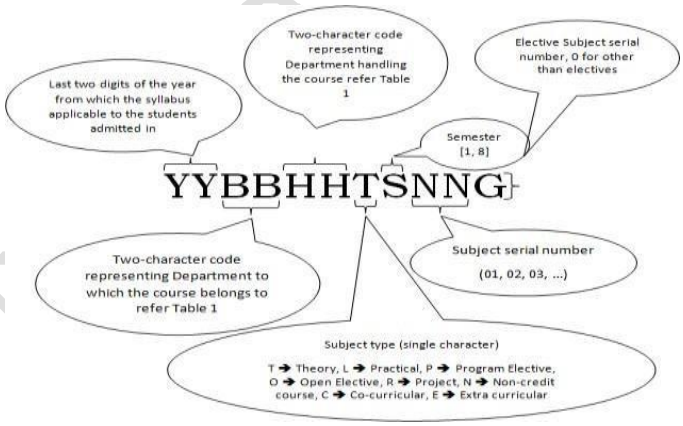


Figure 1: Course Numbering Scheme

The department codes are in given in following table 1.

Table 1: Department Codes

Department	**Two-character code**
Civil Engineering	CE
Electrical & Electronics Engineering	EE
Mechanical Engineering	ME
Electronics & Communication Engineering	EC
Electronics & Communication Technology	ET
Computer Science and Engineering	CS
Computer Science and Technology	CT

Information Technology	IT
Management Science	MS
Mathematics	MA
Physics	PH
Chemistry	CH
English	EG
Biology	BI
Common to All Branches	CM

Example: STLD in 3rd semester for ECE with S. No 2

Course Code: 18ECECT3020

Table 2: Comparison of Number of credits given by AICTE and Approved credits

S. No.	Category	No. of Credits									
		ECE/ ECT		EEE		CSE/IT/CST		ME		CE	
		AICTE	Approved	AICTE	Approved	AICTE	Approved	AICTE	Approved	AICTE	Approved
1	Humanities and Social Sciences	12	11	12	11	12	11	12	11	12	08
2	Basic Science courses	25	23	25	25	24	26	25	26	26	26
3	Engineering Science courses	24	23	24	20	29	29.5	24	23	29	24.5
4	Professional Core courses	48	56	48	62	49	48.5	48	55	47	56.5
5	Professional Elective Courses	18	20	18	15	18	18	18	18	23	21
6	Open elective courses	18	12	18	12	12	12	18	12	11	9
7	Project work , Seminar and Internship	15	15	15	15	15	15	15	15	12	15

8	Mandatory Courses	-	-	-	-	-	-	-	-	-	-
Total Credits		160	160	160	160	160	160	160	160	160	160

DISCIPLINARY ACTION FOR MALPRACTICES /IMPROPER CONDUCT IN EXAMS

S. No.	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
1. (b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.

3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University

		examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining

		examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

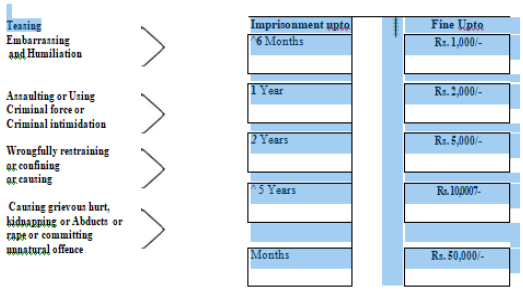
MALPRACTICES

- The Principal shall refer the cases of malpractices in Continuous Evaluation and Semester-End Examinations, to Malpractice Enquiry Committee, constituted by him/her for the purpose. Such committee shall follow the approved scales of punishment. The Principal shall take necessary action, against the erring students based on the recommendations of the committee.
- Any action on the part of student at an examination trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the Staff, who are in charge of conducting examinations, valuing examination papers and preparing/keeping records of documents relating to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

Ragging

Prohibition of ragging in educational institutions Act 26 of 1997 Salient Features

- Ragging within or outside any educational institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student.



In Case of Emergency call Toll Free Number : 1800-425-1288

LET US MAKE JNTU-K A RAGGING FREE UNIVERSITY

Program Outcomes for an Engineering Graduates:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

COURSE STRUCTURE AND SYLLABUS

SITE-18M REGULATIONS

For

I, II, III & IV B. Tech.

Electrical and Electronics Engineering

GENERAL COURSE STRUCTURE

Total credits (4yearcourse) - 160

I -B. Tech I- Semester Approved Course structure Common for ME/CE/EEE

S. No	Subject Code		Subject title	L	T	P	C
1	18CMEGT1010	HSMC	Technical English	3	1		3
2	18CMMAT1020	BSC	Engineering Mathematics-I	3	1		4
3	18CMCHT1030	BSC	Engineering Chemistry	2			4
4	18CMEET1040	ESC	Basic Electrical Engineering	3	1		4
5	18CMEGL1050	HSMC	English Communication Skills Lab			2	1
6	18CMCHL1060	BSC	Engineering Chemistry Lab			3	1.5
7	18CMEEL1070	ESC	Basic Electrical Engineering Lab			3	1.5
8	18CMMSM1080	MC	Constitution of India, Professional Ethics &Human Rights(MC)	2			
			Total	**13**	**3**	**8**	**19**

I B. Tech II Semester Approved Course structure Common for ME/CE/EEE

S. No	Subject Code		Subject title	L	T	P	C
1	18CMMAT2010	BSC	Engineering Mathematics II	3	1		4
2	18EEPHT2020	BSC	Engineering Physics	3	1		4
3	18CMCST2030	ESC	Programming for Problem solving	3			3
4	18CMMEL2040	ESC	Engineering Graphics	1		4	3
5	18EEPHL2050	BSC	Engineering Physics Lab			3	1.5
6	18CMCSL2060	ESC	Programming for Problem Solving Lab			4	2
7	18CMMEL2070	ESC	Work Shop /Manufacturing practice			3	1.5
8	18CMCHN2080	MC	Environmental Science(MC)	2			
			Total	**12**	**2**	**14**	**19**

II-B. Tech EEEI-Semester Approved Course structure

S. No	Subject Code		Subject title	L	T	P	C
1	18CMMAT3010	BSC	Engineering Mathematics III	3	1		4
2	18EEEET3020	PCC	Analog Electronics	3			3
3	18EEEET3030	PCC	Electromagnetic fields	3	1		4
4	18EEEET3040	PCC	Electrical Circuit Analysis	3	1		4
5	18EEEET3050	PCC	Electrical Machines I	3			3
6	18EEEEL3060	PCC	Analog Electronics Lab			3	1.5
7	18EEEEL3070	PCC	Electrical Circuit Analysis Lab			3	1.5
8	18EEEEL3080	PCC	Electrical Machines I Lab			3	1.5
			Total	**15**	**3**	**9**	**22.5**

II B. Tech EEE II Semester Approved Course structure

S. No	Subject Code		Subject title	L	T	P	C
1	18EEEET4010	ESC	Signals & Systems	2	1		3
2	18CMMET4020	ESC	Engineering Mechanics	3	1		4
3	18EEEET4030	PCC	Digital Electronics	3			3
4	18EEEET4040	PCC	Control Systems	3			3
5	18EEEET4050	PCC	Electrical Machines II	3			3
6	18EEEEL4060	PCC	Digital Electronics Lab			3	1.5
7	18EEEEL4070	PCC	Control Systems Lab			3	1.5
8	18EEEEL4080	PCC	Electrical Machines II Lab			3	1.5
			Total	**14**	**2**	**9**	**20.5**

III -B. Tech EEEI-Semester Approved Course structure

S. No	Subject Code		Subject title	L	T	P	C
1	18EEEET5010	PCC	Microprocessors& Microcontrollers	3			3
2	18EEEET5020	PCC	Power Generation, Transmission & Distribution	3			3
3	18CMMST5030	HSMC	Management Science	3			3
4	18EEEET5040	PCC	Power Electronics	3			3
5	18EEEET5050	PCC	Electrical Measurements &Instrumentation	3			3
6	18EEXXO506X	OE	Open Elective – 1	3			3
7	18EEEEL5070	PCC	Power Systems Lab			3	1.5
8	18EEEEL5080	PCC	Power Electronics Lab			3	1.5
9	18CMAHS5090	SOC	Soft Skills& Aptitude Builder - 1	1		2	2
			Total	**19**		**8**	**23**

III B. Tech EEE II Semester Approved Course structure

S. No	Subject Code		Subject title	L	T	P	C
1	18EEEET6010	PCC	Power Systems Operation & Control	3			3
2	18CMMST6020	HSMC	Engineering Economics & Financial management	3			3
3	18EEEEP603X	PE	Program Elective–1	3			3
4	18EEXXO604X	OE	Open Elective – 2	3			3
5	18EEXXO605X	OE	Open Elective – 3	3			3
6	18EEEEL6060	PCC	Microprocessors & Microcontrollers Lab			2	1
7	18EEEEL6070	PCC	Measurements and Instrumentation Lab			3	1.5
8	18CMAHS6080	SOC	Soft Skills &Aptitude Builder – 2	1		2	2
9	18CMBIN6090	MC	Biology for Engineers	2			
	Total			**18**		**7**	**19.5**

Program Elective–1

18EEEEP603A	Line Commutated and Active Rectifiers
18EEEEP603B	HVDC Transmission Systems
18EEEEP603C	Control Systems Design

IV –B. Tech EEEI-Semester Approved Course structure

S. No	Subject Code		Subject title	L	T	P	C
1	18EEEET7010	PCC	Power System Protection	3			3
2	18EEEEP702X	PE	ProgramElective-2	3			3
3	18EEEEP703X	PE	ProgramElective-3	3			3
4	18EEEEP704X	PE	ProgramElective-4	3			3
5	18EEEEP705X	PE	ProgramElective-5	3			3
6	18EEXXO706X	OE	Open Elective – 4	3			3
7	18EEEEL7070	PCC	Power System Analysis Lab			3	1.5
8	18EEEES7080	SOC	Design of Photovoltaic Systems	1		2	2
9	18EEEEI7090	II	Industry Internship(During Summer vacation)				3
			Total	**19**		**5**	**24.5**

Program Elective–2

18EEEEP702A	Modeling and Control of DC Drives
18EEEEP702B	Smart Grid
18EEEEP702C	Optimization Techniques

Program Elective–3

18EEEEP703A	Electrical & Hybrid Vehicles
18EEEEP703B	Power System Dynamics &Stability
18EEEEP703C	Digital signal Processing

Program Elective– 4

18EEEEP704A	Modeling and Control of AC Drives
18EEEEP704B	Electrical Energy Conservation & Auditing
18EEEEP704C	Intelligent Control & Its Applications

Program Elective– 5

18EEEEP705A	Flexible Alternating Current Transmission Systems
18EEEEP705B	Power Quality
18EEEEP705C	Digital Control Systems

IV B. Tech EEE II Semester Approved Course structure

S. No	Subject Code	Subject title	L	T	P	C
1	18EEEER8010	Project			14	12
		Total			**14**	**12**

Open Electives offered by EEE department

S. No	Subject Code	Subject title
1	18XXEEOM0XA	Control system design
2	18XXEEOM0XB	Optimization techniques
3	18XXEEOM0XC	Electrical Energy Conservation And Auditing
4	18XXEEOM0XD	Electrical &Hybrid Vehicles
5	18XXEEOM0XE	Intelligent control & its applications
6	18XXEEOM0XF	Electrical materials
7	18XXEEOM0XG	Industrial Electrical Systems
8	18XXEEOM0XH	Modern Control Theory

CREDIT COMPARISON WITH AICTE AND DEVAITION

S. No.	Category	No. of Credits		
		Suggested by AICTE	Proposed	Deviation in%
1	Humanities and Social Sciences	12	10	-16.67
2	Basic Sciences	25	23	-8
3	Engineering Science courses	24	22	-8.33
4	Professional Core courses	48	57	18.75
5	Professional Elective Courses	18	15	-16.67
6	Open electives	18	12	- 33.33
7	Project work, Seminar and Internship	15	15	0
8	Mandatory Courses	-	-	-
9	Skill Oriented Courses	-	6	-
Total Credits		**160**	**160**	**-**

CREDIT DISTRIBUTION FOR B.TECH. EEE PROGRAM

S. No.	Categories	EEE											
		AICTE	Approved	Modified	Deviation	I-I	I-II	II-I	II-II	III-I	III-II	IV-I	IV-II
1	Humanities and Social Sciences	12	11	10	-2	4				3	3		
2	Basic Science courses	25	26	23	-2	9.5	9.5	4					
3	Engineering Science courses	24	23	22	-2	5.5	9.5		7				
4	Professional Core courses	48	55	57	+9			18.5	13.5	15	5.5	4.5	
5	Professional Elective Courses	18	18	15	-3						3	12	
6	Open elective courses	18	12	12	-6					3	6	3	
7	Project work , Seminar and Internship	15	15	15	0							3	12
8	Mandatory Courses												
9	Skill Oriented Courses			6						2	2	2	
Total Credits		**160**	**160**	**160**		**19**	**19**	**22.5**	**20.5**	**23**	**19.5**	**24.5**	**12**

I B. Tech I Semester Approved Course structure Common for ME/CE/EEE

S. No	Subject Code		Subject title	L	T	P	C
1	18CMEGT1010	HSMC	Technical English	3	1		3
2	18CMMAT1020	BSC	Engineering Mathematics-I	3	1		4
3	18CMCHT1030	BSC	Engineering Chemistry	2			4
4	18CMEET1040	ESC	Basic Electrical Engineering	3	1		4
5	18CMEGL1050	HSMC	English Communication Skills Lab			2	1
6	18CMCHL1060	BSC	Engineering Chemistry Lab			3	1.5
7	18CMEEL1070	ESC	Basic Electrical Engineering Lab			3	1.5
8	18CMMSM1080	MC	Constitution of India, Professional Ethics &Human Rights(MC)	2			
			Total	**13**	**3**	**8**	**19**

I B. Tech II Semester Approved Course structure Common for ME/CE/EEE

S. No	Subject Code		Subject title	L	T	P	C
1	18CMMAT2010	BSC	Engineering Mathematics II	3	1		4
2	18EEPHT2020	BSC	Engineering Physics	3	1		4
3	18CMCST2030	ESC	Programming for Problem solving	3			3
4	18CMMEL2040	ESC	Engineering Graphics	1		4	3
5	18EEPHL2050	BSC	Engineering Physics Lab			3	1.5
6	18CMCSL2060	ESC	Programming for Problem Solving Lab			4	2
7	18CMMEL2070	ESC	Work Shop /Manufacturing practice			3	1.5
8	18CMCHN2080	MC	Environmental Science(MC)	2			
			Total	**12**	**2**	**14**	**19**

TECHNICAL ENGLISH			
Subject Code	18CMEGT1010	IA Marks	30
Number of Lecture Hours/ Week	2(T)	Exam Marks	70
Total Number of Lecture Hours	30	Exams Hours	03
Credits -02			

Unit-1 (Principles of Scientific Vocabulary)	**Hours**
Short and simple words, compact substitutes for wordy phrases, redundant words and expressions, Avoid hackneyed and stilted phrases, verbosity and incorrect use of words, role of roots in word building, prefixes and suffixes, confusing wordsand expressions. 1-4 chapters of Karmayogi non-detail text book (N1)	**10**
Unit-2 (Writing Skills)	
Distinguishing between academic and personal styles of writing, use of clauses in technical phrases and sentences, Techniques of Sentence and paragraph writing**,** Measuring the clarity of a text through Fog Index or Clarity Index 5-8 chapters of Karmayogi non-detail text book (N1)	**10**
Unit-3 (Common Errors in Writing)	
Subject-verb agreement, concord of nouns, pronouns and possessive adjectives, Common errors in the use of articles, prepositions, adjectives and adverbs, Punctuation, Technical Guidelines for Communication, Avoiding the pitfalls 9-12 chapters of Karmayogi non-detail text book (N1)	**10**
Unit-4 (Nature and Style of Sensible Technical Writing)	
Academic Writing Process, Describing, processes and products, Defining, Classifying, Effective use of charts, graphs, and tables 13-16 chapters of Karmayogi non-detail text book (N1)	**10**
Unit-5 (Report writing and Letter writing)	
Writing Technical Reports, Précis writing, Letter Writing, Essay writing 17-20 chapters of Karmayogi non-detail text book (N1)	**10**

Text(T) / Reference(R) Books:	
T1	Effective Technical Communication by Barun K Mitra, Oxford University Publication
N1	Karmayogi: A Biography of E Sreedharan, M S Ashokan
R1	Communication Skills, Sanjay Kumar &PushpaLatha, OUP
R2	Study Writing, Liz Hamp-Lyons and Ben Heasly, Cambridge University Press
R3	Remedial English Grammar, F T Wood, Macmillan 2007
R4	Practical English Usage, Michael Swan, Oxford University Press
R5	English Collocations in Use, Michael McCarthy & Felicity O'Dell
R6	Effective Technical Communication, Arsahf Rizvi
R7	Essential English Grammar, Raymond Murphy, CUP, 2017

Course Outcomes: On completion of this course, students can	
CO1	Use scientific vocabulary confidently
CO2	Apply basic principles of writing clear sentences and paragraphs
CO3	Write error free simple technical passages
CO4	Frame sentences corresponding to different writing styles
CO5	Confidently write clear and coherent letters and technical reports
CO6	Convert inspirations in the form of achievements and values upheld by renowned technocrats to write ups

ENGINEERING MATHEMATICS-I			
Subject Code	18CMMAT1020	IA Marks	30
Number of Lecture Hours/Week	3(L) + 1(T)	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 04			

Unit -1	**Hours**
First order and first degree Ordinary Differential Equations Exact, reducible to exact, linear and Bernoulli's differential equations. Orthogonal trajectories in Cartesian and polar form. Simple problems on Newton's law of cooling. Law of natural growth and decay.	**10**
Unit -2	
Linear differential equations with constant coefficients: Solutions of second and higher order differential equations - inverse differential operator methods, Method of variation of parameters. Application: LCR Circuits	**08**
Unit – 3	
Partial derivatives – Definition and Euler's theorem (without proof), total derivatives, partial differentiation of composite functions. Jacobian - Functional dependence. Taylor's and Maclaurin's theorems for function of two variables (statement only). Maxima and minima- LaGrange's method of undetermined multipliers	**10**
Unit – 4	
First order Partial differential equations: Formation of Partial differential equations by elimination of arbitrary constants and arbitrary functions – solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations **Higher order Partial differential equations:** Solutions of Homogeneous and Non Homogeneous partial differential equations with constant coefficients –Classification of partial differential equations.	**10**
Unit – 5	
Double and triple integrals: Evaluation of double and triple integrals.Evaluation of double integrals by changing the order of integration and bychanging into polar co-ordinates. Beta and gamma functions and their properties **Vector Calculus** – Gradient – Divergence - Curl - Line integrals-definition and problems, surface and volume integrals definition, Green's theorem in a plane, Stokes and Gauss-divergence theorems (without proof) and problems.	**12**

Text(T) / Reference(R) Books:	
T1	Higher Engineering Mathematics, B S Grewal, Khanna Publishers, 44th edition, 2016
T2	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley, 9th edition, 2013
R1	Higher Engineering Mathematics, B V Ramana, Tata Mc Graw-Hill, 2006
R2	A Text Book of Engineering Mathematics, NPBali and Manish Goyal, Laxmi publications
R3	Higher Engineering Mathematics, HKDass and Er. RajnishVerma, S.Chand publishing, 1st edition, 2011.

Course Outcomes: On completion of this course, students can	
CO1	Solve first order differential equations
CO2	Solve linear differential equations with constant coefficients
CO3	Find the extrema of a function
CO4	Solve partial differential equations
CO5	Evaluate multiple integrals
CO6	Verify vector integral theorems

ENGINEERING CHEMISTRY			
Subject Code	18CMCHT1030	IA Marks	30
Number of Lecture Hours/Week	3(T) + 1(T)	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 04			

Unit -1	**Hours**
Periodic Properties Effective nuclear charge of chlorine and magnesium, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro negativity, oxidation states, coordination numbers 2 & 3and geometries, hard soft acids and bases.	**10**
Unit -2 (Use of Free Energy in Chemical Equilibria)	
Thermodynamic functions State and Path functions, First and second laws of thermodynamics, Gibbs Helmholtz Equation, concept of entropy and enthalpy. **Electro chemistry** Introduction, electrode potential, standard electrodes: Hydrogen and Calomel electrodes, Nernst equation and applications. **Water chemistry** Surface and subsurface water quality parameters: turbidity, pH, total dissolvedsalts, chloride content, break point chlorination. **Corrosion** Wet chemical theory, control methods: proper designing, cathodic protection, Sacrificial anodic and impressed current cathodic protection.	**10**
Unit – 3	
Stereochemistry Principles of stereochemistry, representations of 3-dimensional structures of organic compounds, geometrical and stereoisomers, configuration and symmetry, enantiomers. **Organic Reactions and Synthesis of a Drug Molecule** Introduction to reactions involving Substitution: SN^1& SN^2 with mechanism, Addition, Free radical, Elimination: E1 & E2 with examples (mechanism is not involved), Synthesis of aspirin drug molecule.	**10**
Unit – 4	
Atomic, Molecular Structure and Advanced Materials Schrodinger equation. Particle in a box solution and their applications forconjugated molecules. **Nanoparticles** Introduction, preparation methods: Sol-gel method, Chemical reduction method, properties and applications.	**10**

Surface properties Determination of surface tension and viscosity of liquids. **Ceramics** Classification, examples and applications. Crystal field theory and the energy level diagrams for transition metal ions.	
Unit – 5	
Spectroscopic Techniques Regions of electromagnetic spectrum, Principles of vibrational and rotational spectroscopy, Vibrational and rotational spectroscopy of diatomic molecules: Rigid diatomic molecules, selection rule, simple Harmonic Oscillator, diatomic vibrating rotator, Nuclear magnetic resonance, Principle and Instrumentation, Principles of chromatography, TLC & Paper.	**10**

Text(T) / Reference(R) Books:	
T1	Stereochemistry of Carbon Compounds, Ernest Eliel, McGraw Hill Education
T2	Fundamentals of Molecular Spectroscopy, C N Banwell
T3	Concise Inorganic Chemistry, J.D.Lee, 5th Edition; Wiley India
T4	Engineering Chemistry – Fundamentals and applications, Shikha Agarwal, CUP
T5	Organic Chemistry: Structure and Function, K P C Volhardt and N E Schore, 5thEdition
T6	Engineering Chemistry, Jain &Jain,Dhanpat Rai Publishing Company
R1	Engineering Chemistry (NPTEL Webbook), B L Tembe, Kamaluddin and MSKrishnan
R2	Physical Chemistry, P. W. Atkins
R3	Physical Chemistry, Glasstone S
R4	Advanced Inorganic Chemistry, Wilkinson G and Cotton FA

Course Outcomes: On completion of this course, students can	
CO1	Rationalize periodic properties like ionization potential, electro negativity and oxidation states
CO2	Describe the nature and working of various electrodes
CO3	Analyze bulk properties and processes using thermodynamic considerations
CO4	Synthesize organic molecules using different types of chemical reactions
CO5	Explain the concepts of atomic and molecular orbitals
CO6	Gain knowledge on spectroscopic techniques and the ranges of the electromagnetic spectrum used for exciting different molecular energy levels

BASIC ELECTRICAL ENGINEERING			
Subject Code	18CMEET1040	IA Marks	30
Number of Lecture Hours/week	3(L) +1(T)	Exam Marks	70
Total Number of Lecture Hours	60	Exam Hours	03
Credits – 04			

Unit -1	**Hours**
DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems (Simple numerical problems). Time-domain analysis of first-order RL and RC circuits.	**12**
Unit – 2	
AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.	**12**
Unit – 3	
Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers,OC and SC tests, regulation and efficiency. Auto transformer and three-phase transformer connections.	**12**
Unit – 4 **Electrical Machines: AC machines** Generation of rotating magnetic fields, construction details and working of threephase induction motor, significance of torque – slip characteristics. Loss components and efficiency, starting and speed control of induction motor. Single phase induction motor. Construction and working of synchronous generators. **DC machines** Construction, working, torque- speed characteristics and speed control of dc shunt motor.	**14**
Unit – 5	
Power Converters and Electrical Installations DC Buck and boost converters, duty ratio control, PWM techniques, single phase voltage source inverters. Classification of batteries and Low Voltage switch gear.	**10**

Text(T) / Reference(R) Books:	
T1	Electrical and Electronics Technology, E Hughes, Pearson, 2010
T2	Basic Electrical Engineering, DC Kulshreshtha, McGraw Hill, 2009
T3	Basic Electrical Engineering, DP Kothari, IJ Nagrath
T4	Basic Electrical Engineering, J P Tewari, New Age International Publishers, 2003
R1	Power Electronics, M D Singh, 2nd Edition
R2	Battery Energy Storage for Smart Grid Applications, Eurobat, 2013
R3	Fundamentals of Electrical Engineering, L S Bobrow, OUP, 1996
R4	Electrical Engineering Fundamentals, V D Toro, PHI, 1989
R5	Understanding Batteries, RM Dell, DAJ Rand, 2001
R6	Protection and Switchgear, Bhavesh Bhalja, RP Maheshwari, Nilesh G Chothani, 5th impression, OUP, 2014

Course Outcomes: On completion of this course, students can	
CO1	Analyze DC circuits by using KCL, KVL and Network theorems
CO2	Analyze AC circuits
CO3	Explain the operation and compute performance of transformer
CO4	Explain the construction and working of rotating electrical machines
CO5	Describe DC-DC and DC-AC converters
CO6	Explain about types of LV switch gear and types of batteries

ENGLISH & COMMUNICATION SKILLS LABORATORY			
Subject Code	18CMEGL1050	IA Marks	15
Number of Practice Hours/Week	2(P)	Exam Marks	35
Total Number of Practice Hours	24	Exam Hours	03
Credits – 1			

List of Experiments

Exercise 1

Listening Comprehension.

Exercise 2

Pronunciation, Stress, Intonation & Rhythm.

Exercise 3

Common Everyday Situations: Conversations & Dialogues.

Exercise 4

Communication at Workplace: Job Application letter, Email & Resume.

Exercise 5

Interpersonal Communication Skills.

Exercise 6

Formal Presentations.

Learning Resources:	
R1	Interact – English Lab Manual for Undergraduate Students by Orient BlackSwan
R2	Ted Talks, Interviews with Achievers and select movies, https://www.ted.com/talk
R3	Toastmaster's speeches and table topics
R4	Book Reviews and movie reviews
R5	Exercises in Spoken English Parts: I-III, CIEFL, Hyderabad
R6	Oxford Guide to Effective Writing and Speaking by John Seely

Course Outcomes: On completion of this course, students can	
CO1	Improve listening comprehension
CO2	Pronounce words and sentences correctly
CO3	Dialogue with others
CO4	Upgrade interpersonal communication skills
CO5	Present ideas/concepts to audience

ENGINEERING CHEMISTRY LABORATORY			
Subject Code	18CMCHL1060	IA Marks	15
Number of Practice Hours/Week	3(P)	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

List of Experiments

(Any 10 experiments must be conducted)

Exercise 1

Determination of surface tension

Exercise 2

Determination of viscosity of a liquid by Ostwald viscometer

Exercise 3

Thin layer chromatography

Exercise 4

Determination of chloride content of water

Exercise 5

Determination Hardness of water by EDTA

Exercise 6

Determination of the rate constant of first order reaction (Ester hydrolysis)

Exercise 7

Determination of strength of strong acid using conductometric titration.

Exercise 8

Determination of strength of weak acid using conductometric titration.

Exercise 9

Determination of Ferrous iron using potentiometer.

Exercise 10

Synthesis of a drug – Aspirin

Exercise 11

Determination of the partition coefficient of a substance between two immiscible liquids

Exercise 12

Determination of strength of acetic acid using charcoal adsorption.

Exercise 13

Preparation of lattice structure and determination of atomic packing factor.

Exercise 14

Chemical oscillations- Iodine clock reaction

Exercise 15

Synthesis of Phenol formaldehyde resin.

Exercise 16

Saponification of oil

Course Outcomes: On completion of this course, students can	
CO1	Measure molecular properties like surface tension and viscosity
CO2	Determine chloride content of water of given water sample
CO3	Synthesize a drug
CO4	Determine rate constant as a function of time
CO5	Determine strength of acids using conductivity meter
CO6	Determine amount of Fe (II) using potentiometer

BASIC ELECTRICAL ENGINEERING LAB			
Subject Code	18CMEEL1070	IA Marks	15
Number of Practice Hours/Week	2(P)	Exam Marks	35
Total Number of Practice Hours	24	Exam Hours	03
Credits – 01			

List of Experiments

(Any 12 experiments must be conducted)

Exercise 1

Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors andinductors.

Exercise 2

Measuring the steady-state and transient time-response of R-L, R-C, and R-L-Ccircuits to a step change in voltage (transient may be observed on a storageoscilloscope).

Exercise 3

Series and Parallel resonance of RL and RC circuits.

Exercise 4

No-load and load test on single phase Transformer (measurement of primaryand secondary voltages and currents, and power).

Exercise 5

Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phasecurrents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.

Exercise 6

Torque Speed Characteristic of dc shuntmotor.

Exercise 7

Break test on single phase induction motor.

Exercise 8

Field excitation control of Synchronous Machine.

Exercise 9

OC & SC tests on a single-phase transformer.

Exercise 10

Characteristics of PN junction diode.

Exercise 11

Half and Full wave rectifier with and without filter.

Exercise 12

Demonstration of

dc-dc converters

dc-ac converters – PWM waveform

the use of dc-ac converter for speed control of an induction motor

Components of LTswitchgear.

Course Outcomes: On completion of this course, students can	
CO1	Know the importance of measuring instruments
CO2	Determine the response and resonance of given RL, RC and RLC circuits
CO3	Determine the voltage, current and performance characteristics of a single-phase transformer
CO4	Determine the speed torque characteristics of dc shunt motor
CO5	Determine the breakdown voltage of PN junction diode
CO6	Determine the ripple factor for half wave and full wave rectifier with and without filter

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS & HUMAN RIGHTS (Common to all)			
Subject Code	18CMMSN1080	IA Marks	30
Number of Lecture Hours/Week	3(L)	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 00			

Unit -1	**Hours**
Lesson: Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.	**10**
Unit -2	
Lesson: Directive Principles of State Policy & Relevance of Directive PrinciplesState Policy Fundamental Duties. Union Executives – President, Prime Minister Parliament Supreme Court of India.	**10**
Unit – 3	
Lesson: State Executives – Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th &91st Amendments.	**10**
Unit – 4	
Lesson: Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights –Meaning and Definitions, Legislation Specific Themes inHuman Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchayats and Co-Operative Societies.	**10**
Unit – 5	
Lesson: Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.	**10**

Text(T) / Reference(R) Books:

T1	Introduction to the Constitution on India, Durga Das Basu, (Students Edn.) Prentice –Hall EEE, 19th / 20th Edn., 2001
T2	Engineering Ethics, Charles E. Haries, Michael S Pritchard and Michael J. Robins Thompson Asia, 2003-08-05.
R1	An Introduction to Constitution of India, M.V.Pylee, Vikas Publishing, 2002.
R2	Engineering Ethics, M.Govindarajan, S.Natarajan, V.S.Senthilkumar, Prentice –Hall of India Pvt. Ltd. New Delhi, 2004
R3	Introduction to the Constitution of India, Brij Kishore Sharma, PHI Learning Pvt. Ltd., New Delhi, 2011.
R4	Latest Publications of Indian Institute of Human Rights, New Delhi

Course Outcomes: On completion of this course, students can	
CO1	Have general knowledge and legal literacy and thereby to take up competitive examinations.
CO2	Understand state and central policies, fundamental duties
CO3	Understand Electoral Process, special provisions
CO4	Understand powers and functions of Municipalities, Panchayats and Co-operative Societies
CO5	Understand Engineering ethics and responsibilities of Engineers
CO6	Understand Engineering Integrity & Reliability

ENGINEERING MATHEMATICS-II			
Subject Code	18CMMAT2010	IA Marks	30
Number of Lecture Hours/Week	3(L)+ 1(T)	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 04

Unit -1 (Linear Algebra)	**Hours**
Rank of a matrix by elementary transformations, solution of system of linear equations: Gauss-elimination method, Gauss-Jordan method, Jacobi method and Gauss-Seidel method, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors, Linear transformation, Diagonalization of a square matrix. Cayley-Hamilton theorem (without proof), Reduction of Quadratic form to Canonical form.	**10**
Unit -2 (Laplace Transforms)	
Laplace transforms of standard functions, shifting theorems, Transforms of derivatives and integrals, Unit step function, Dirac's delta function Inverse Laplace transforms, Convolution theorem (without proof) Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms	**10**
Unit – 3 (Numerical Methods-I)	
Numerical solution of algebraic and transcendental equations Regula-Falsi Method and Newton-Raphson method **Finite differences** Error functions, Forward, backward and central differences, Newton's forward and backward interpolation formulae. Gauss`s forward and backward interpolation formulae, Lagrange's interpolation formula (all formulae without proof)	**10**
Unit – 4 (Numerical Methods-II)	
Numerical integration Trapezoidal rule - Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules. **Numerical solutions of ordinary differential equations** Taylors series method, Picard's method, Euler's method, Modified Euler'smethod, Runge-Kutta method	**10**
Unit – 5 (Fourier Series and Transforms)	
Fourier Series Periodic functions, Dirichlet's condition, Fourier Series of periodic functions with period 2π and with arbitrary period. Fourier series of even and odd functions, Half range Fourier Series. **Fourier Transforms** Infinite Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier transforms.	**10**

Text(T) / Reference(R) Books:	
T1	Higher Engineering Mathematics, B S Grewal, 44th Edition, Khanna publishers, 2016
T2	Advanced Engineering Mathematics, Kreyszig, 9th Edition, Wiley, 2013
R1	Higher Engineering Mathematics, B V Ramana, Tata McGrawHill, 2006
R2	A text book of Engineering Mathematics, N P Bali and Manish Goyal, 7th edition, Laxmi publications
R3	Higher Engineering Mathematics, H. K Dass and Er. Rajnish Verma, 1st edition, S. Chand publishing, 2011
R4	Engineering Mathematics, Volume II, Dr.KVNageswara Reddy and Dr.BRamaBhupal Reddy, Scitech Publications, 2017

Course Outcomes: On completion of this course, students can	
CO1	Solve system of linear equations and find eigen values and eigen vectors of a matrix
CO2	Solve initial value problems by using Laplace transforms
CO3	Find the solution of algebraic/transcendental equations and also interpolate the functions
CO4	Evaluate numerical integration and to solve ordinary differential equations by using numerical methods
CO5	Find Fourier series of a periodic function and to determine the Fourier transform of a function

ENGINEERING PHYSICS Semiconductor Physics & Semiconductor Optoelectronics			
Subject Code	18ITPH2020	IA Marks	30
Number of Lecture Hours/Week	3(L) + 1(T)	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 04			

Unit -1	**Hours**
Electronic materials Free electron theory-Classical &Quantum theory, Density of states, Fermi level, Occupation probability, Bloch theorem, Kronig-Penny model (to introduce origin of band gap), E-k diagram and Effective mass. Types of electronic materials: metals, semiconductors, and insulators.	**10**
Unit -2	
Semiconductors Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Hall effect and its applications.	**10**
Unit – 3	
Light-semiconductor interaction Types of Semiconductor materials of interest for optoelectronic devices, band gap modification, Hetero structures, Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission, Joint density of states, Density of statesfor photons, Transition rates (Fermi's golden rule), Optical loss and gain, Photovoltaic effect.	**10**
Unit – 4	
Semiconductor light emitting diodes (LEDs) Direct and indirect band gap semiconductors, Injection Electro luminescence, LED: Device structure, materials, characteristics, Laser diode, Quantum-well, -wire, and -dot based lasers.	**10**
Unit – 5	
Photodetectors & Low-dimensional optoelectronic devices General properties of Photo detectors, Photo conductors, Types of semiconductor photo detectors -p-n junction, PIN, and Avalanche --- and their structure, materials, working principle, and characteristics, Noise limits on performance, Solar cells.	**10**

Text(T) / Reference(R) Books:	
T1	Solid State Physics, S O Pillai, New Age Publications
T2	Fundamentals of Photonics, B E A Saleh and M C Teich, John Wiley & Sons
R1	Engineering Physics, Ch Srinivas, Ch Seshubabu, Cengage learning publications
R2	Semiconductor Optoelectronic Devices, P Bhattacharya, Prentice Hall of India, 1997
R3	Semiconductor Optoelectronics, M R Shenoy, NPTEL Course
R4	Optoelectronic Materials and Devices, Monica Katiyar and Deepak Gupta, NPTEL Course

Course Outcomes: On completion of this course, students can	
CO1	Explain the conducting mechanism in metals
CO2	Estimate the concentration of charge carriers
CO3	Describe light-semiconductor interaction
CO4	Illustrate the working function of LEDs and diode lasers
CO5	Illustrate the working function ofphoto detectors
CO6	Illustrate the working function ofsolar cells

PROGRAMMING FOR PROBLEM SOLVING (Common for all programs)			
Subject Code	18CMCST2030	IA Marks	30
Number of Lecture Hours/Week	03	EA Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits - 03			

Unit-I: Introduction to computer systems and programming	**Hours**
History & Hardware Computer Hardware, Components, Types of Software, Memory Units. **Introduction to Problem solving** Algorithm, Characteristics of Algorithms, Basic operations of algorithms, Pseudocode, Flowchart, Types of languages, Relation between Data, Information, Input and Output. **Basics of C** History and Features of C, Importance of C, Procedural Language, Compiler versus Interpreter, Structure of C Program, Program development steps, programming errors.	**08**
Unit-II: C Expressions, evaluation and control statements	
Overview of C Character Set, C-Tokens, Data Types, Variables, Constants, Operators, Operator precedence and Associativity, converting mathematical expressions to C-expressions, evaluation of C-expressions, Input/output functions. **Conditional Branching** if statement, if...else statement, Nested if...else statement, if…else…if ladder, switch statement. **Unconditional Branching** goto **Control flow statements:** break, continue. **Looping Constructs:** do-while statement, while statement, for statement.	**12**
Unit-III: Arrays and Functions	
Arrays Introduction, 1-D Arrays, Character arrays and string representation, 2-D Arrays (Matrix), Multi-Dimensional Arrays. **Functions** Basics, necessity and advantages, Types of functions, Parameter passing mechanisms, Recursion, Storage Classes, Command Line Arguments, Conversion from Recursion to Iteration and vice-versa. **Strings** Working with strings, String Handling Functions (both library and user defined)	**10**

Unit-IV: Derived and User Defined Data types	
Pointers Understanding Pointers, Pointer expressions, Pointer and Arrays, Pointers and Strings, Pointers to Functions. **Dynamic Memory Allocation** Introduction to Dynamic Memory Allocation malloc, calloc, realloc, free. **Structures and Unions** Defining a Structure, typedef, Advantage of Structure, Nested structures, Arrays of Structures, Structures and Arrays, Structures and Functions, Structures and Pointers, Defining Unions, Union within union, Structure within union, Union within structure, self-referential structures, bitfields, enumerations.	**12**
Unit-V: Preprocessing and File Handling	
Preprocessing Directives Macro Substitution, File Inclusion, conditional compilation and other directives **File Management in C** Introduction to File Management, Modes and Operations on Files, Types of files, Error Handling During I/O Operations.	**08**

Text(T) / Reference(R) Books:	
T1	Computer Programing ANSI C, E Balagurusamy, McGraw Hill Education
T2	Programming in C, Reema Thareja, Second Edition, Oxford Higher Education
R1	Computer Basics and C Programming, V Raja Raman, Second Edition

Course Outcomes: On completion of this course, students can	
CO1	Formulate algorithms, translate them into programs and correct program errors
CO2	Choose right control structures suitable for the problem to be solved
CO3	Decompose reusable code in a program into functions (Iterative and recursive)
CO4	Use arrays, pointers, structures and unions appropriately
CO5	Explain Memory allocation strategies
CO6	Store and Retrieve data from permanent storage

ENGINEERING GRAPHICS			
Subject Code	18CMMEL2040	IA Marks	30
Number of Lecture Hours/Week	1(L)+4(P)	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Unit -1	**Hours**
Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections – Ellipse, Parabola, Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;	**10**
Unit -2	
Projections of Points and lines inclined to both planes; Projections of planes inclined to one plane	**08**
Unit – 3	
Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes	**10**
Unit – 4	
Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone	**10**
Unit – 5	
Isometric Projections Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions **Introduction to AUTOCAD** The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows	**12**

Text(T) / Reference(R) Books:	
T1	Engineering Drawing, NDBhatt, Chariot Publications
T2	Engineering Drawing + AutoCAD, K Venugopal, V. Prabhu Raja, New Age Publishers
R1	Engineering Drawing, Agarwal & Agarwal, Tata McGraw Hill Publishers
R2	Engineering Drawing, KLNarayana& P Kannaiah, SciTech Publishers
R3	Engineering Graphics for Degree, KC John, PHI Publishers
R4	Engineering Graphics, PI Varghese, McGrawHill Publishers

Course Outcomes: On completion of this course, students can	
CO1	Construct Polygons using general methods, inscribe and describe polygons on circles,draw curves (parabola, ellipse and hyperbola, cycloids, involutes) by general methods
CO2	Read, Interpret and Construct plain scales, diagonal scales and Vernier scales
CO3	Draw orthographic projections of points, lines, Planes & Solids inclined to one reference plane and apply these concepts to solve practical problems related to engineering
CO4	Draw sections and sectional views of Solids
CO5	Draw isometric view of lines, plane figures and simple solids, Convert given isometricviews into orthographic views, and apply these concepts to solve practical problems related to engineering
CO6	Draw objects using draw and modify toolbars of AutoCAD

ENGINEERING PHYSICS LABORATORY			
Subject Code	18ITPHL2050	IA Marks	15
Number of Practice Hours/Week	3(P)	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

List of Experiments

Exercise 1 Study the atomic levels in Neon- Argon gases-Franck- Hertz experiment.

Exercise 2 Determine the resistivity of wire using four probe methods.

Exercise 3 Determine the Boltzmann constant using PN junction diode.

Exercise 4 Determine the Energy band gap of P-N junction diode.

Exercise 5 Determine the Hall coefficient-Hall effect.

Exercise 6 Study the spectral response of photo diode-Planck's constant.

Exercise 7 Draw the LED current-voltage characteristics.

Exercise 8 Draw the diode laser (LD) current-voltage characteristics.

Exercise 9 Draw the Photo diode current-voltage characteristics.

Exercise 10 Measure the current-voltage characteristics of a solar cell (Photovoltaic cell) at differentlight intensities.

Course Outcomes: On completion of this course, students can	
CO1	Understand the existence of the energy levels in gases
CO2	Study the resistivity variation with temperature in conductor
CO3	Determine the energy band gap of semiconductor diode
CO4	Understand the phenomenon of Hall Effect
CO5	Understand the interaction of the light with semiconductor
CO6	Study the characteristic curves of the LEDs, Laser diode & Solar cells

PROGRAMMING FOR PROBLEM SOLVING LAB

(Common for all branches)

Subject Code	18CMCSL2060	IA Marks	15
Number of Practice Hours/Week	4(P)	Exam Marks	35
Total Number of Practice Hours	48	Exam Hours	03

Credits - 02

List of Experiments Exercise 1 (Familiarization with programming environment)

Familiarization of CODE BLOCKS C++ Editor to edit, compile, execute, test and debugging C programs.

Familiarization of RAPTOR Tool to draw flow charts and understand flow of control.

Acquittance with basic LINUX commands.

Exercise 2 (Simple computational problems using arithmetic expressions)

Write a C Program to display real number with 2 decimal places.

Write a C Program to convert Celsius to Fahrenheit and vice versa.

Write a C Program to calculate the area of triangle using the formulaarea = where $s = \frac{a+b+c}{2}$

Write a C program to find the largest of three numbers using ternary operator.

Write a C Program to swap two numbers without using a temporary variable.

Exercise 3 (Problems involving if-then-else structures)

Write a C Program to check whether a given number is even or odd using bitwise operator, shift operator and arithmetic operator.

Write a C program to find the roots of a quadratic equation.

Write a C Program to display grade based on 6 subject marks using if…else…if ladder.

Write a C program, which takes two integer operands and one operator form the user, performs the operation and then

prints the result using switch control statement. (Consider the operators +, -, *, /, %)

Exercise 4 (Iterative problems)

Write a C Program to count number of 0's and 1's in a binary representation of a given number.

Write a C program to generate all the prime numbers between two numbers suppliedby the user.

Write a C Program to print the multiplication table corresponding to number suppliedas input.

Exercise 5 (Iterative problems)

Write a C Program to Find Whether the Given Number is

) Armstrong Number ii) Palindrome Number

Write a C Program to print sum of digits of a given number

Exercise 6 (Series examples)

a) Write a C Program to calculate sum of following series

b) 1+2+3+…. n

b)1+1/2+1/3+……+1/n

c)$1+x+x^2+x^3……+x^n$

Exercise 7 (1D Array manipulation)

a) Write a C program to interchange the largest and smallest numbers in the array.

b) Write a C program to search an element in an array (linear search).

c) Write a C Program to print the following pattern using a character array

S

SA

SAS

SASI

Exercise 8 (Matrix problems, String operations)

a) Write a C program to add two matrices.

b) Write a C program to multiply two matrices if they are compatible or print an errormessage "incompatible matrix sizes" otherwise.

c) Write a C program to check given matrix is symmetric or not.

d) Implement the following string operations with and without library functions.

i) Copy ii) concatenate iii) length iv) compare

Exercise 9 (Simple functions)

a) Write a C Program demonstrating the following function types

i. With arguments and with return value.

ii. With arguments and without return value

iii. Without arguments and without return value.

iv. Without arguments and with return value.

b) Write a C Program illustrating call by reference

Exercise 10 (Recursive functions)

Write a C Program illustrating the following with Recursion without Recursion

a) Factorial b) GCD c) Power d) Fibonacci

Exercise 11(Pointers and structures)

a) Write a C program to find sum of n elements entered by user. To perform this program,allocate memory dynamically using malloc () function.

b) Write a C program to find sum of n elements entered by user. To perform this program,allocate memory dynamically using calloc () function.

Note: Understand the difference between the above two programs.

c) Write a C Program to read and print student details using structures.

Exercise 12 (File operations)

a) Write a C program to open a file and to print its contents on screen.

b) Write a C program to copy files

c) Write a C program merges two files onto a new file.

d) Write a C program to delete a file.

Course Outcomes: On completion of this course, students can	
CO1	Attain knowledge on using CODE BLOCKS and RAPTOR tools in solving problems
CO2	Examine and analyze alternative solutions to a problem
CO3	Design a solution to a problem using problem decomposition and step-wise refinement
CO4	Demonstrate conversion of iterative functions to recursive and vice-versa
CO5	Demonstrate usage of arrays, structures and unions
CO6	Demonstrate reading from and writing to files along with simple file operations

WORKSHOP/MANUFACTURING PRACTICE			
Subject Code	18CMMEL2070	IA Marks	15
Number of Practice Hours/Week	3(P)	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

List of Experiments

Exercise 1 (lectures & Videos)

Manufacturing Methods: casting, forming, machining, Joining, Advanced methods

CNC machining, Additive manufacturing

Exercise 2 (lectures & Videos)

Fitting operations & power tools

Electrical & Electronics

Carpentry

Exercise 3(lectures & Videos)

Plastic molding, glass cutting

Metal casting

Welding (arc welding & gas welding), brazing

Exercise 4(Black smithy)

S-Hook

Square Rod to Round Rod

Exercise 4(Carpentry)

T-Lap Joint

Cross Lap Joint

Exercise 6(Foundry)

Mold for solid

Mold for split pattern

Exercise 7(Fitting)

Square fitting

V-fitting

Exercise 8(Welding)

Butt Joint

Lap Joint

Exercise 9(Machine Tools)

Turning

Knurling

Exercise 10(Plastic Molding)

Key Chain Molding

Course Outcomes: On completion of this course, students can	
CO1	Make use of basic carpentry joints to make furniture
CO2	Fabricate mechanical engineering assemblies using fitting joints
CO3	Produce various machine components by using foundry, black smithy, machining and plastic molding techniques

ENVIRONMENTAL SCIENCE			
Subject Code	18CMCHN2080	IA Marks	30
Number of Lecture Hours/Week	04	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 00			

Unit -1 (MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES)	**Hours**
Environment Definition, Introduction, Scope and Importance, Global environmentalchallenges, global warming & climate change, Acid rains, ozone layer depletion, Carbon credits, Sustainability, Stockholm & Rio Summit, Population growth & explosion, Role of Information Technology in Environment and human health. **Ecosystem** Concept, Structure and function, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the different ecosystems	**10**
Unit -2 (RESOURCES)	
Natural Resources Renewable and non-renewable resources, Natural resources and associated problems **Forest resources** Use and over exploitation, deforestation, Timber extraction, Mining, dams and other effects on forest and tribal people **Water resources** Use and over utilization of surface and ground water, Floods, drought, conflicts over water, dams – benefits and problems **Mineral resources** Use and exploitation, environmental effects of extracting and using mineral resources. **Food resources** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. **Energy resources** Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.	**12**
Unit – 3 (BIODIVERSITY AND ITS CONSERVATION)	
Introduction, Definition, genetic, species and ecosystem diversity,	**06**

Biogeographicalclassification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aestheticand option values, Biodiversity at global, National and local levels. India as a mega-diversity nation, Hot-spots ofbiodiversity, Threats to biodiversity: habitat loss, Endangered andendemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	
Unit – 4	
Environmental Pollution Definition, Cause, effects and control measures of :Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards **Solid waste Management** Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies.	**12**
Unit – 5	
Social Issuesand the Environment Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people its problems and concerns. **Environment Protection Acts** Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involvedin enforcement of environmental legislation, Public awareness. **Field work** Visit to a local area to document environmental assets: River/forest/grassland/hill/mountain Visit to a local polluted site: Urban/Rural/industrial/AgriculturalStudy of common plants, insects, birds Study of simple ecosystems: pond, river, hill slopes, etc.	**10**

Text(T) / Reference(R) Books:	
T1	Environmental Studies, E Bharucha, University Publishing Company, New Delhi, 2003
T2	Environmental Science and Engineering, JG Henry and GW Heinke, 2nd edition, Prentice Hall of India, New Delhi, 2004
T3	Introduction to Environmental Engineering and Science, G M Masters, 2nd edition, Prentice Hall of India, New Delhi, 2004
R1	Environmental Studies, Deeshita Dave & P Udaya Bhaskar, Cengage Learning
R2	Environmental Studies, KVSGMurali Krishna, VGS Publishers, Vijayawada
R3	Environmental Studies, PNPaliniswamy, P Manikandan, A Geeta and K Manjula Rani, Pearson Education

Course Outcomes: On completion of this course, students can	
CO1	Explain importance of Environmental studies and the measures to be taken to overcome global environmental challenges
CO2	Describe the concept of ecosystem and its diversity
CO3	Describe knowledge on natural resources
CO4	Explain concept of biodiversity
CO5	Explain knowledge on environmental pollution
CO6	Debate knowledge on environmental legislation and global treaties

ENGINEERING MATHEMATICS III SEMESTER III Common to all the branches			
Subject Code	**18CMMAT3010**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L + 1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**60**	**Exam Hours**	**03**
Credits-04			

Course Objectives:

To enable the students to apply the knowledge of Mathematics in various engineering fields by making them to learn the following:

1. To find the function of a complex variable
2. To evaluate complex integration and expand functions using Taylor & Maclaurin's series
3. To evaluate integrals using Residues
4. To find the statistical parameters for distributions
5. To test the hypothesis

Unit -1	
Function of a complex variable Introduction –continuity –differentiability, analyticity – properties – Cauchy – riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions – Milne – Thompson method.	**Hours – 10**
Unit ,2	
Integration and series expansions Complex integration: Line integral – Cauchy's integral theorem, Cauchy's in integral formula, generalized integral formula (all without proofs) Radius of convergence – expansion in Taylor's series, Maclaurin's series and Laurent series	**Hours – 12**
Unit – 3	
Singularities and Residue Theorem Zeros of an analytic function, Singularity, Isolated singularity, Removable singularity, Essential singularity, pole of order m, simple pole, Residues, Residue theorem, Calculation of residues, Residue at a pole of order m**,** Evaluation of real definite integrals: Integration around the unit circle**,** Integration around semi circle, Indenting the contours having poles on the real axis.	**Hours – 12**
Unit – 4	
Discrete Random variables and Distributions: Introduction, Random variables, Discrete Random variable, Distribution function, Expectation. Discrete distributions: Binomial, Poisson and Geometric distributions and their fitting to data. **Continuous Random variable and distributions:** Introduction, Continuous Random variable, Distribution function, Expectation, Continuous distribution: Uniform, Exponential and Normal distributions, Normal approximation to Binomial distribution	**Hours – 12**
Unit – 5	
Test of Significance: Introduction - Population and samples- Sampling distribution of means (σ-known) t-distribution- Sampling distribution of means(σ-unknown), chi-square and F- test Hypothesis-Null and Alternative Hypothesis- Type I and Type II errors –Level of significance - One tail and two-tail tests- Tests concerning one mean and proportion, two means- Proportions and their differences - ANOVA for one – way and two – way classified data	**Hours – 14**

Course outcomes:

On completion of this course, students are able to

1. Find the function of a complex variable
2. Evaluate complex integration and expand functions using Taylor & Maclaurin's series
3. Evaluate integrals using Residues
4. Find the statistical parameters for Discrete Random variables and Distributions
5. Find the statistical parameters for Continuous Random variables and Distributions
6. Test the hypothesis

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.
3. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. B.S. Grewal, **"Higher Engineering Mathematics"**, Khanna publishers, 44th edition, 2016.
2. Erwin Kreyszig, **"Advanced Engineering Mathematics** I, Wiley, 9th Edition, 2013.

Reference Books:

1. B.V. Ramana, **"Higher Engineering Mathematics"**, Tata McGraw-Hill, 2006
2. N.P.Bali and Manish Goyal, **"A text book of Engineering mathematics"**, Laxmi publications, 7th Edition.
3. H.K. Dass and Er. RajnishVerma, **"Higher Engineerig Mathematics"**, S.Chand publishing, 1st edition, 2011.
4. Dr. B.Rama Bhupal Reddy**, "Probability and Statistics for Engineers",** Research India Publications (DELHI), 2015.

ANALOG ELECTRONICS SEMESTER III			
Subject Code	**18EEEET3020**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

COURSE OBJECTIVES:

This course will enable students:

1. To Understand the characteristics of Diode &Transistors
2. To Understand the working of various amplifier circuits
3. To Understand the characteristics of Practical Operational Amplifier
4. To Understand the Linear Applications of Operational Amplifier
5. To Understand the Non-Linear Applications of Operational Amplifier
6. To Understand the design nonlinear applications of op-amp.

Unit -1	
Diode & BJT circuits P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits, Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits; common-emitter, common-base and common- collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.	**Hours – 10**
Unit -2	
MOSFET circuits MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans- conductance, high frequency equivalent circuit.	**Hours –10**
Unit – 3	
Differential, multi-stage and operational amplifiers Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain band width product)	**Hours –08**
Unit – 4	
Linear applications of op-amp Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, current mirror circuit, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).Analog to Digital Conversion.	**Hours – 10**
Unit – 5	
Nonlinear applications of op-amp	**Hours – 07**
Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.	

COURSE OUTCOMES:

On completion of the course student will be:

1. Ability to Understand the characteristics of Diode &Transistors.
2. Ability to analyze amplifier circuits.
3. Ability to design and analyze amplifier circuits MOSFET's.
4. Ability to Understand the functioning of OP-AMP.
5. Ability to design P, PI and PID controllers and lead/lag compensator using an op-amp.
6. Ability to design nonlinear applications of op-amp.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

T1. Electronic Devices and Circuits – J. Millman, C.C. Halkias, Tata Mc-Graw Hill

T2. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press,1998.

T3.J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.

T4.J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education,1988.

T5. P.Horowitzand W.Hill,"The Art of Electronics", Cambridge UniversityPress,1989. T6. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

REFERENCE BOOKS:

R1.A Hand Book of Analog Electronics Circuit Design by Dennis L Feucht

R2.OP-AMPS & Linear integrated circuits by Ramakanth A Gayakwad (PHI)

R3.Linear integrated circuits by D Roy Chowdary, New age International

R4.OP-Amp's & Linear Integrated Circuit Concepts and Applications by Janet M.Fiore,Cenage learning

R5.Operational Amplifiers & Linear Integrated circuits by Robert F. Coughlin, Frederick F. Driscoll, Prentice-Hall

ELECTRO MAGNETIC FIELDS SEMESTER III			
Subject Code	**18EEEET3030**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**40**	**Exam Hours**	**03**
Credits-04			

COURSEOBJECTIVES:

This course will enable students to:

1. able to understand the basically of electromagnetism
2. able to obtain the electric and magnetic fields for simple configurations under static conditions
3. able to analyze boundary conditions
4. able to understand Maxwell's equation in different forms and different media
5. able to analyze time varying electric and magnetic fields

Unit1	
Review of Vector Calculus Vector algebra addition,subtraction,componentsofvectors,scalarandvectormultiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical).Vectoroperatordel,gradient,divergenceandcurl;integraltheoremsofvectors. Conversionofavector from one coordinate system to another.	**Hours-10**
Unit—2	
Static Electric Field Coulomb'slaw,Electricfieldintensity,Electricalfieldduetopointcharges.Line,SurfaceandVolumechargedistributions.Gausslawanditsapplications.AbsoluteElectricpotential,Potential difference, Calculationofpotentialdifferencesfordifferentconfigurations.Electric dipole, Electrostatic Energy and Energy density.	**Hours-06**
Unit–3	
Conductors, Dielectrics and Capacitance Currentandcurrentdensity,OhmsLawinPointform,Continuityofcurrent,Boundaryconditionsofperfectdielectricmaterials.Permittivityofdielectricmaterials,Capacitance,Capacitanceofatwowireline,Poisson'sequation,Laplace'sequation,SolutionofLaplaceand Poisson's equation, Application of Laplace's and Poisson's equations	**Hours-06**
Unit–4	
Static Magnetic Fields Biot Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors. Force on a moving charge, Force on a differential current element, Force between differential current elements	**Hours-08**
Unit–5	
Magnetic Forces, Materials and Inductance Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances. **Time Varying Fields and Maxwell's Equations, Electromagnetic Waves** Faraday's law for Electromagnetic induction, Displacement current, Pointform of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions Poynting theorem,	**Hours-10**

COURSEOUTCOMES:

At the end of the course, students will demonstrate the ability

1. To understand the basic laws of electromagnetism.
2. To obtaintheelectricandmagneticfieldsforsimpleconfigurationsunderstaticconditions.
3. To analyze boundary conditions
4. To understand Maxwell's equation in different forms and different media.
5. To analyze time varying electric fields
6. To analyze time varying magnetic fields.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

TEXTBOOKS:

1. M.N.O.Sadiku,"ElementsofElectromagnetics",OxfordUniversityPublication,2014.

REFERENCEBOOKS:

1. A.Pramanik,"ElectromagnetismTheoryandapplications",PHILearningPvt.Ltd,NewDelhi,2009.
2. A.Pramanik,"ElectromagnetismProblemswithsolution",PrenticeHallIndia,2012.
3. G.W.Carter,"Theelectromagneticfieldinitsengineeringaspects",Longmans,1954.
4. W.J.Duffin,"ElectricityandMagnetism",McGrawHillPublication,1980.
5. W.J.Duffin,"AdvancedElectricityandMagnetism",McGrawHill,1968.
6. E.G.Cullwick,"TheFundamentalsofElectromagnetism",CambridgeUniversityPress,1966.
7. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison Wesley Educational Publishers, International Edition,1971.
8. W.Hayt,"EngineeringElectromagnetics",McGrawHillEducation,2012.

ELECTRICAL CIRCUIT ANALYSIS SEMESTER III			
Subject Code	**18EEEET3040**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**60**	**Exam Hours**	**03**
Credits-04			

COURSE OBJECTIVES:

This course will enable students :

1. To understand the applications of network theorems for analysis of electrical networks.
2. To study the transient& steady state behavior of electrical networks
3. To understand the behavior of RLC networks for sinusoidal excitations.
4. To understand the application of Laplace transforms for analysis of electrical circuits.
5. To understand the realization of electrical network function into electrical equivalent passive elements.
6. To Analyze two port circuit behaviors

Unit -1	
Network Theorems: Circuit Analysis with dependent and independent current and voltage sources. Node and Mesh Analysis. Superposition theorem, Thevenin's theorem, Norton theorem, millimen's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem for AC Excitation. Concept of duality and dual networks.	**Hours-10**
Unit -2	
Solution of First and Second order networks: Solution of first and second order differential equations for Series and parallel R-L, R-C, R- L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.	**Hours-10**
Unit – 3	
Sinusoidal steady state analysis: Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.	**Hours-20**
Unit – 4	
Electrical Circuit Analysis Using Laplace Transforms: Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances	**Hours-10**
Unit – 5	
Two Port Network and Network Functions: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.	**Hours-10**

COURSE OUTCOMES:

On completion of the course student will be able to:

1. Apply network theorems for the analysis of electrical circuits.
2. Obtain the transient and steady-state response of electrical circuits.
3. Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).
4. Obtain transfer functions to various Electrical networks using laplace transforms.
5. Analyze behavior of transfer functions with poles and zeroes.
6. Analyze two port circuit behaviors.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, Third edition 2006.
2. D. Roy Choudhury, " Networks and Systems", New Age International Publications, 1998.
3. W. H. Haytand J. E. Kemmerly, " Engineering Circuit Analysis" , McGraw Hill Education,2013.

REFERENCE BOOKS:

1. C. K. Alexander and M. N. O. Sadiku, " Electric Circuits", McGraw Hill Education, 2004.
2. K. V. V. Murthy and M. S. Kamath, " BasicCircuit Analysis", Jaicoishers,1999.
3. Electrical circuit analysis by A. Sudhakar and Shyam Mohan S palli.

ELECTRICAL MACHINES-I SEMESTER III			
Subject Code	**18EEEET3050**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student to :

1. Understand the concepts of magnetic circuits.
2. Understand the operation of dc machines.
3. Understand the characteristics of different dc machine configurations.
4. Understand the operation of single phase transformer circuits.
5. Understand the operation of three phase transformer circuits.
6. Understand the control voltages with tap changing methods and to achieve three-phase to two-phase transformation

Unit-1	
Magnetic fields and magnetic circuits Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot-Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines. B- H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element.	**Hours-10**
Unit – 2	**Hours-09**
DC machines Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutators, lap and wave windings, construction of commutators, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.	
Unit – 3	**Hours-11**
DC machine - motoring and generation Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines	
Unit – 4	

Single Phase Transformers Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses, Parallel operation of single transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer	**Hours-08**
Unit – 5	**Hours-07**
Three Phase Transformers Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of three-phase transformers, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Cooling of transformers.	

Course outcomes:

On completion of the course student will be able to:

1. Assimilate the concepts electromagnetic circuits.
2. Mitigate the ill-effects of armature reaction and improve commutation in dc machines.
3. Analyze the characteristics of various DC motors.
4. Analyze the characteristics of various DC Generators.
5. Analyze the performance and to pre determine efficiency, regulation and losses of a single phase transformer.
6. Analyze the change in control voltages with tap changing methods and to achieve three-phase to two-phase transformation.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. E. Fitzgerald and C. Kingsley, "Electric Machinery" , New York, McGraw Hill Education,2013.
2. P.S.Bimbhra,"Electrical Machinery", Khanna Publishers,2011.

Reference Books:

1. E. Clayton and N. N. Hancock, "Performance and design of DC machines" , CBS Publishers,2004.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education,2010.

ANALOGELECTRONICSLAB SEMESTER III			
Subject Code	**18EEEEL3060**	**IA Marks**	**15**
Number of Practice Hours/Week	**3P**	**Exam Marks**	**35**
Total Number of Practice Hours	**36**	**Exam Hours**	**03**
Credits-1.5			

COURSEOBJECTIVES:

This course will enable student to:

1. ToUnderstandtheVIcharacteristicsofDiode&workingofvariousRectifier,clipping&Clamping circuits
2. To Understand VI characteristics of BJT & amplifier circuits
3. ToUnderstandVIcharacteristicsofMOSFET&FrequencyResponseofCommonsourceamplifier circuit
4. To Understand the Linear Applications of Operational Amplifier
5. To Understand the Non Linear Applications of Operational Amplifier

List of Experiments(Any twelve experiments must be conducted)

1. Plot the VI characteristics of(a)Diode(b) Zener Diode
2. Design and setup the following rectifiers with and without filters and to determine ripple factor and rectifier efficiency:(a)Half wave rectifier(b)Full Wave Rectifier
3. Conductexperimenttotestdiodeclipping(single/doubleended)andclampingcircuits(positive/negative)
4. PlottheinputandoutputcharacteristicsofBJTinCommonEmitterConfiguration
5. RealizeBJTDarlingtonEmitterfollowerwithandwithoutbootstrappinganddeterminethegain, input and output impedances.
6. Design BJT common emitter amplifier using voltage divider bias with and without feedback and determine the gain band width product from its frequency response.
7. Plot the transfer and drain characteristics of a JFET and calculate its drain resistance, mutual conductance and amplification factor.
8. Plot the transfer and drain characteristics of nchannel MOSFET and calculate its parameters, namely; drain resistance, mutual conductance and amplification factor.
9. Plot the frequency response of Common Source JFET/MOSFET amplifier and obtain the bandwidth
10. Design a practical Op Amp integrator & Differentiator to operate accurately atf=5kHz(and above)and with the magnitude of the gain=1fora5kHz sine wave input. Use standard values of or resistors and capacitors.
11. Conduct an experiment on Series Voltage Regulator using Zener diode and Op Amp determine line and load regulation characteristics.
12. Determine the Frequency response of Phase shift oscillator using Op Amp
13. Designandsetupasquarewave/Triangularwavewithamplitudeof+orVforafrequencyof1KHz.

COURSEOUTCOMES:

On completion of the course student will be able to:

1. AbilitytoUnderstandthecharacteristicsofDiode&ApplicationsofDiode(workingofrectifier, Clipping & Clamping circuits
2. AbilitytoUnderstandthecharacteristicsofBJT&analyzethedifferentamplifiercircuits
3. Ability to Understand the characteristics of MOSFET& analyze the Frequency Response of Common source amplifier circuit
4. Ability to analyze the Working of Phase shift oscillators
5. Ability to analyze the working of OPAMP based circuits like Square Wave and Triangular wave Generators

ELECTRICAL CIRCUITS ANALYSIS LAB SEMESTER III			
Subject Code	**18EEEEL3070**	**1A-Marks**	**15**
Number of Practice Hours/Week	**3P**	**Exam Marks**	**35**
Total Number of Practice Hours	**36**	**Exam Hours**	**03**
Credits-1.5			

COURSEOBJECTIVES:

This course will enable student to:

1. To verify and demonstrate various theorems.
2. To determine the transient analysis of single phase circuits
3. To verify and determine Resonance of an RLC circuit.
4. To verify and determine the parameters of two port networks.
5. To determine self and mutual inductance of a magnetic circuit.
6. To measure three phase active and reactive power for poly phase circuits.

List of Experiments (Any ten experiments must be conducted)

1. Verification of Kirchoff's laws.
2. Verification of Thevenin's and Norton's Theorems
3. VerificationofSuperpositiontheoremandMaximumPowerTransferTheorem
4. Verification of Compensation Theorem
5. Verification of Reciprocity, Millmann's Theorems
6. Transient Analysis of Series RL and RC circuit using PSPICE Software.
7. Measurementof3phasePowerbytwoWattmeterMethodforunbalancedloads
8. Measurementof3phasereactive power for star and delta connected load
9. Determination of Self, Mutual Inductances and Coefficient of coupling
10. Z and Y Parameters
11. Transmission and hybrid parameters
12. Verification of nodal analysis using MATLAB software Tool.

COURSEOUTCOMES:

On completion of the course student will be able to:

1. To be able to apply various theorems.
2. To be able to analyze the transient response of single phase circuits
3. To be able to find resonance for RLC Circuits.
4. To be able to determine parameters for two port networks.
5. To be able to determine the self and mutual inductance of a magnetic circuit.
6. To be able measure active and reactive power of Poly phase Circuits.

ELECTRICAL MACHINES LAB-I SEMESTER III			
Subject Code	**18EEEEL3080**	**IA Marks**	**15**
Number of Lecture Hours/week	**3P**	**Exam Marks**	**35**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-1.5			

Course Objectives:

This course will enable student to:

1. Gain knowledge on pre determination tests conducted on DC machines.
2. Gain knowledge on load tests conducted on DC machines.
3. Gain knowledge on various methods of controlling the speed of DC shunt motor.
4. Gain knowledge on separation of losses in DC shunt motor and single phase transformers.
5. Gain knowledge on pre determination tests conducted on single phase transformer.
6. Gain knowledge on operating two transformers in parallel and to achieve three phase to two phase transformation.

List of Experiments (Any ten experiments must be conducted)

1. Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.
2. Brake test on DC shunt motor. Determination of performance curves.
3. Hopkinson's test on DC shunt machines. Predetermination of efficiency.
4. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
5. Load test on DC compound generator. Determination of characteristics
6. Separation of losses in DC shunt motor
7. Load test on DC series generator. Determination of characteristics.
8. Brake test on DC compound motor. Determination of performance curves.
9. Load test on DC shunt generator. Determination of characteristics.
10. Sumpner's test on single phase transformer.
11. Scott connection of transformers
12. Parallel operation of Single phase Transformers
13. Separation of core losses of a single phase transformer

Course Outcomes:

On completion of the course student will be able to:

1. Pre determine the regulation, performance and efficiency on DC machines.
2. No load and Load the DC machine to obtain thecharacteristics, torque, output and efficiency.
3. Control the speed of DC shunt motor by using armature control and field control methods.
4. Separate the various losses present in DC shunt motor and single phase transformers.
5. Pre determine the regulation and efficiency for a single phase transformer.
6. Operate two transformers in parallel and to achieve three phase to two phase transformation.

SIGNALS AND SYSTEMS SEMESTER IV			
Subject Code	**18EEEET4010**	**IA Marks**	**30**
Number of Lecture Hours/Week	**2L+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student to:

1. Introduce the terminology of signals and systems
2. Analyze behavior of continuous and discrete time LTI systems
3. Introduce Fourier tools through the analogy between vectors and signals.
4. Analyzethelinearsystemsintimeandfrequencydomainsoncontinuoustimesignalsandsystem sandstudyztransformasmathematicaltooltoanalyzediscretetimesignalsandsystems.
5. Introduce the concept of sampling and reconstruction of signals

Unit1	
Introduction to Signals and Systems: Classification of Signals and Systems. Basic operations on signals. Test Signal pulse, step, ramp and sinusoid signals .Properties of signals. Energy and power signal. Transformation of independent variables.	**Hours-07**
Unit—2	
Behavior of continuous and discrete time LTI systems: Impulse response and step response, convolution, input out put behavior with a period iccon vergent inputs ,cascade inter connections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.	**Hours-10**
Unit–3	
Fourier series and Fourier Transform: Fourier series representation of periodic signals, Wave form Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.	**Hours-10**
Unit–4	
Laplace and z Transforms: Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior, Inverse Laplace Transform. The zTransform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z domain analysis, Inverse Z Transform.	**Hours-10**
Unit–5	
Sampling and Reconstruction: The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction ideal interpolator, zero order hold, first order hold. Aliasing and its effects. Relation between continuous and discrete time systems.	**Hours-08**

Course outcomes:

On completion of the course student will be able to:

1. Distinguish the signals and systems and System properties
2. Analyze behavior of continuous and discrete time LTI systems
3. AnalyzethecontinuoustimesignalsandcontinuoustimesystemsusingFourierseriesandFourier transform
4. Apply Laplace trans form to analyze continues time signals and systems
5. Apply Z transform to analyze discrete time signals and systems.
6. Applysamplingtheoremtoconvertcontinuoustimesignalstodiscretetimesignalandre construct back

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

TEXTBOOKS:

1.A.V.Oppenheim ,A.S.WillskyandS.H.Nawab,"Signalsandsystems",PrenticeHall India,1997.

2.J.G.Proakis and D.G.Manolakis, "Digital Signal Processing: Principles, Algorithms,andApplications",Pearson,2006.

3.H.P.Hsu,"Signalsandsystems",Schaum'sseries,McGrawHillEducation,2010.

REFERENCEBOOKS:

1.Signals&SystemsSimonHaykinandVanVeen,Wiley,2ndEdition.

2.PrinciplesofLinearSystemsandSignals–BPLathi,OxfordUniversityPress,2015

3.SignalsandSystems–KRajaRajeswari,BVisweswaraRao,PHI,2009

4.Fundamentals of Signals and Systems Michel J.Robert, MGH International Edition, 2008.

ENGINEERING MECHANICS (Except CE) SEMESTER IV			
Subject Code-	**18CMMET4020**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L+1T**	**Exam Marks**	**70**
Total Number of Lecture Hours	**44**	**Exam Hours**	**03**
Credits-03			

COURSE OBJECTIVES:

This course will enable student to:

1. To develop an understanding of the principles of statics and the ability to analyze problems using static equilibrium equations.
2. To introduce the basic principles of mechanics applicable to rigid bodies in equilibrium.
3. To teach the basic principles of mechanics applicable to the motion of particles and rigid bodies.
4. To introduce with mathematical description of the plane motion of rigid bodies.
5. To develop the fundamentals of engineering mechanics and problem solving skills essential for mechanical engineering

Unit -1	
Introduction to Engg. Mechanics – Basic Concepts. **Systems of Forces:** Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.	**Hours-08**
Unit -2	
Equilibrium of Systems of Forces: Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, Spatial Systems for concurrent forces. Lamis Theorm, Graphical method for the equilibrium of coplanar forces, Converse of the law of Triangle of forces, converse of the law of polygon of forces condition of equilibrium, analysis of plane trusses.	**Hours-08**
Unit – 3	
Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; **Mass moment inertia** of circular plate, Cylinder, Cone, Sphere, Hook.	**Hours-10**
Unit – 4	
Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained **Introduction to Kinetics of Rigid Bodies covering**, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies;	**Hours-10**
Unit-5	

Work – Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.	**Hours-08**

COURSE OUTCOMES:

On completion of this course, students should be able to:

1. Able to Resolve the forces into components, moment of force and its applications
2. Construct free body diagrams and develop appropriate equilibrium equations.
3. Determine centroid and moment of inertia for composite areas.
4. Determine the kinematic relations of particles & rigid bodies.
5. Apply equations of motion to particle and rigid body.
6. Analyze motion of particles & rigid bodies using the principle of energy and momentum methods.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , McGraw Hill publications.
2. Engineering Mechanics-Statics and Dynamics by A Nelson, Tata McGraw Hill Education Private Ltd, New Delhi, 2009.

Reference Books:

1. Engineering Mechanics statics and dynamics – R.C.Hibbeler, 11th Edn – Pearson Publ.
2. Engineering Mechanics, statics – J.L.Meriam, 6th Edn – Wiley India Pvt Ltd.
3. Engineering Mechanics, statics and dynamics – I.H.Shames, – Pearson Publ.
4. Mechanics For Engineers, statics - F.P.Beer & E.R.Johnston – 5th Edn McGraw Hill Publ.
5. Mechanics For Engineers, dynamics - F.P.Beer&E.R.Johnston –5th Edn McGraw Hill Publ.
6. Theory & Problems of engineering mechanics, statics & dynamics – E.W.Nelson, C.L.Best& W.G. McLean, 5th Edn – Schaum's outline series - McGraw Hill Publ.
7. Singer's Engineering Mechanics: Statics And Dynamics, K. Vijay Kumar Reddy, J. Suresh Kumar, Bs Publications
8. Engineering Mechanics, Fedinand . L. Singer, Harper – Collins.

DIGITALELECTRONICS SEMESTER IV			
Subject Code	**18EEEET4030**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**60**	**Exam Hours**	**03**
Credits–03			

COURSE-OBJECTIVES:

This course will enable student to:

1. To understand the working of Logic families and Logic gates
2. To understand the working of Combinational Logic Circuits
3. To understand the working of Sequential Logic Circuits
4. To understand the working of AD&DA Conversion
5. To understand the use of PLD to implement the given logic.
6. To understand working of Semiconductor memories

Unit-1	
Title: Fundamentals of Digital Systems and logic families Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive OR operations, Boolean algebra, examples of IC gates, number systems binary, signed binary ,octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tristate logic.	**Hours-12**
Unit-2	
Title: Combinational Digital Circuits Standard representation for logic functions, K map representation, simplification f logic functions using Kmap, minimization of logical functions. Don't care conditions ,Multiplexer, De Multiplexer/ Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices,Q M method of function realization.	**Hours-12**
Unit-3	
Title: Sequential circuits and systems A1bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, JK T and D type flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, a synchronous sequential counters, applications of counters.	**Hours-12**
Unit–4	
Title: A/D and D/A Converters Digital to analog converters: weighted resistor/converter, R2R Ladder D/A converter specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.	**Hours-12**

Unit–5

Title: Semiconductor memories and Programmable logic devices

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charged coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices(CPLDS),Field Programmable Gate Array(FPGA).

Hours-12

COURSEOUTCOMES:

On completion of the course student will be:

1. Understand working of logic families and logic gates.
2. Design and implement Combinational logic circuits
3. Design and implement Sequential logic circuits.
4. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
5. Beableto use PLDs to implement the given logical problem.
6. Understand working of Semiconductor memories

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

TEXTBOOKS:

1. R.P.Jain,"ModernDigitalElectronics",McGrawHillEducation,4th edition
2. M.M.Mano,"Digital logic and Computer design", Pearson Education India,2016.
3. A.Kumar,"Fundamentals of Digital Circuits",Prentice Hall India,2016.

REFERENCEBOOKS:

1. Fundamentals of Logic Design by Charles H Roth Jr, Jaico Publisher
2. SwitchingTheoryandLogicDesignbyHillandPetersonMcGrawHillMHEdition
3. Switching Theory and Logic Design by MV Subramanyam

CONTROL SYSTEMS SEMESTER IV			
Subject Code	**18EEEET4040**	**IA Marks**	**30**
Number of Lecture Hours/Week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**48**	**Exam Hours**	**03**
Credits-03			

Course Objectives:

This course will enable student:

1. To derive mathematical models related to various physical systems.
2. To analyze the behavior of second order systems and determine error constants
3. To analyze the stability of systems using Frequency response methods
4. To design various compensators to improve the performance of systems
5. To Able to determine control ability and Observe ability and STM of given system.

Unit-1	
MATHEMATICAL MODELING OF CONTROL SYSTEMS Mathematical models of electrical and mechanical (translational and rotational) systems, Force Voltage and Force Current analogies. Transfer function models of linear time invariant systems. Feedback Control: Open Loop and Closed loop systems, Applications Benefits of Feedback. Block diagram algebra. Signal Flow Graph Mason's gain formula.	**Hours–08**
Unit-2	
TIME RESPONSE ANALYSIS Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Classification of errors and error constants. Design specifications for second order systems based on the time response .Concept of Stability. Routh Hurwit Criteria. Relative Stability analysis. Root Locus technique. Construction of Root loci.	**Hours–12**
Unit-3	
FREQUENCY RESPONSE ANALYSIS Frequency domain specifications. Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion.	**Hours–12**
Unit-4	
CONTROL SYSTEM DESIGN Introduction to P,PI,PID controllers, Lag , Lead, Lag Lead compensator design (Bode Plot), Addition of poles and addition zeros on stability.	**Hours–08**
Unit-5	
STATE VARIABLE ANALYSIS Concepts of state variables. State space model. Canonical forms of State Matrix. Solution of state equations, State transition matrix Eigen values and Stability Analysis. Concept of controllability and observability.	**Hours–08**

Course outcomes:

On completion of the course student will be:

1. Able to derive transfer function of different physical Systems
2. Able to analyze the behavior of second order system with time domain specifications
3. Able to compute Stability of LTI system using Bode Plot Nyquist plot
4. Able to compute Stability of LTI system using Nyquist plot
5. Able to analyze the different controllers
6. Able to determine controllability and Observability and STM of given system.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. B.C.Kuo,"AutomaticControlSystem",PrenticeHall,1995.
2. K.Ogata,"ModernControlEngineering",PrenticeHall,1991.
3. I.J.NagrathandM.Gopal,"ControlSystemsEngineering",NewAgeInternational,2009 .

Reference Books:

R1.ControlSystemsbyN.K.Sinha,NewAgeInternational(P)LimitedPublishers,3rdEdition,1998.

R2. Controlsystems–by A.Nagoorkani, CBS publications

R3. Problems&solutionsincontrolsystems–by A.K.Jairath

ELECTRICAL MACHINES II SEMESTER IV			
Subject Code	**18EEEET4050**	**IA Marks**	**30**
Number of Lecture Hours/week	**3L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits -3			

Course Objectives:

This course will enable student to :

1. Explain the structure of AC machines and analyse the windings with pulsating and rotating magnetic fields.
2. Understand the operation of three phase induction
3. Analyze the performance of three phase induction motor.
4. Explain the performance of single phase induction and ac series motors.
5. Explain the operation of synchronous machines and their performance.
6. Explain the role of synchronous generators operation when connected to an infinite bus or when operating in parallel.

Unit 1	
Fundamentals of AC machine windings Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil active portion and overhang; full pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air gap MMF distribution with fixed current through winding concentrated and distributed, Sinusoidally distributed winding, winding distribution factor	**Hours-07**
Unit 2	**Hours-06**
Pulsating and revolving magnetic fields Constant magnetic field, pulsating magnetic field alternating current in windings with spatial displacement, Magnetic field produced by a single winding fixed current and alternating current. Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three phase balanced currents), revolving magnetic field.	
Unit 3	**Hours-09**
Induction Machines Construction, Types (squirrel cage and slip ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self excitation. Doubly Fed Induction Machines.	

Unit 4	
Single phase induction motors Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split phase starting methods and applications.	**Hours-08**
Unit 5	
Synchronous machines Constructional features, cylindrical rotor synchronous machine generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V curves. Salient pole machine two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators synchronization and load division.	**Hours-15**

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the structure of AC machines and identify the various types of windings.
2. Analyse the operation of three phase induction
3. Analyse the performance of three phase induction motor.
4. Analyse the performance of single phase induction and ac series motors.
5. Analyse the operation of synchronous machines for both salient and non salient pole construction and their performance.
6. Analyse the synchronization of alternators and estimate the synchronizing power, active and reactive power division.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. E. Fitzgerald and C. Kingsley, "Electric Machinery" , McGraw Hill Education,2013.
2. M. G. Say, " Performance and design of AC machines", CBS Publishers, 2002.
3. P.S.Bimbhra,"Electrical Machinery", Khanna Publishers,2011.

Reference Books:

1. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education,2010.
2. S. Langsdorf, " Alternating current machines", McGraw Hill Education,1984.
3. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

DIGITAL ELECTRONICS LAB SEMESTER IV			
Subject Code	**18EEEEL4060**	**1AMarks**	**15**
Number of Practice Hours/Week	**3P**	**Exam Marks**	**35**
Total Number of Practice Hours	**36**	**Exam Hours**	**03**
Credits-1.5			

COURSEOBJECTIVES:

This course will enable students:

1. To understand De Morgan's Theorem SOP, POS Forms.
2. To understand Full/ Parallel Adders, Subtractors and Magnitude Comparators ,Multiplexer using gates,
3. TounderstandDeMultiplexersandDecoders,FlipFlops,ShiftRegistersandCounters
4. To understand A-D and D-A Converters.
5. To understand the Semi Conductor Memories

List of Experiments(Any twelve experiments must be conducted)

1. Design and implementation of Adders and Subtractors using logic gates.
2. Design and implementation of code converters using logic gates (i) BCD to excess 3code and vice versa(ii)Binary to gray and vice versa
3. Design and implementation of 4bitbinary Adder/ subtractor and BCD adder using IC7483
4. Design and implementation of 2Bit Magnitude Comparator using logic gates 8Bit Magnitude Comparator using IC 7485
5. Design and implementation of 16 bit odd / even parity checker generator using IC74180.
6. Design and implementation of Multiplexer and Demultiplexer using logic gates and study of IC 74150 and IC 74154
7. Design and implementation of encoder and decoder using logic gates and study of IC7445 and IC 74147
8. Construction and verification of 4bit ripple counter and Mod 10/Mod 12 Ripple counters
9. Design and implementation of 3bit synchronous up/down counter
10. Implementation of SISO, SIPO, PISO and PIPO shift registers using flip flops.
11. To design and build DAC using Op Amp.
12. To design and build ADC using Op Amp
13. Realize the Ring Counter and Johnson Counter using IC7476

COURSE OUT COMES:

On completion of the course student will be:

1. Demonstrate the truth table of various Expressions and Combinational Circuits using logic gates.
2. Design, test and evaluate various Combinational Circuits such as Adders , Subtractors, Comparators, Multiplexers and Demultiplexers.
3. Construct Flip flops, Counters and Shift Registers.
4. Construct A-D Converters using OpAmp.
5. Construct D-A Converters using OpAmp.
6. Construct different types of Memories

CONTROLSYSTEMS LAB SEMESTER IV			
Subject Code	**18EEEEL4070**	**IA Marks**	**15**
Number of Lecture Hours/week	**3P**	**Exam Marks**	**35**
Total Number of Lecture Hours	**32**	**Exam Hours**	**03**
Credits1.5			

Course Objectives:

This course will enable students:

1. To strengthen the knowledge of Feedback control
2. To inculcate the controller design concepts
3. To introduce the concept of Mathematical Modeling

List of Experiments(Any ten experiments must be conducted)

1. Time response of Second order system and determination of time domain specifications
2. Characteristics of AC servomotor.
3. Characteristics of DC servomotor.
4. Transfer function of DC Motor and DC Generator
5. Effect of P, PD, PI, PID Controller on a second order systems
6. Lagand lead compensation–Magnitude and phaseplot.
7. Temperature controller using PID Controller.
8. Stabulity analysis (RootLocus,Bode plot ,Nyquist plot) of linear time in variant system.
9. Find the delay time and rise time of PID Controlled DC motor using MATLAB
10. Design the compensators with given gain margine and phase margine.
11. State space model for classical transfer function.

Course(Lab)outcomes:

On completion of the course student will be:

1. Able to derive transfer function of different physical Systems
2. Able to analyze the behavior of second order system with time domain specifications
3. Able to compute Stability of LTI system using Bode Plot Nyquist plot
4. Able to compute Stability of LTI system using Nyquist plot
5. Able to analyze the the different controllers
6. Able to determine controllability and Observability of given system

ELECTRICAL MACHINES LAB II SEMESTER IV			
Subject Code	**18EEEEL4080**	**IA Marks**	**15**
Number of Lecture Hours/week	**3P**	**Exam Marks**	**35**
Total Number of Lecture Hours	**45**	**Exam Hours**	**03**
Credits1.5			

Course Objectives:

This course will enable student to :

1. Obtain efficiency by conducting direct and indirect tests on three phase induction motor.
2. Obtain regulation of alternator by E.M.F, M.M.F, Z.P.F methods and also performance curves.
3. Obtain V and Inverter V Curves of a three phase synchronous motor.
4. Determine X_d and $X_q$of a salient pole synchronous machine.
5. Control the speed of the single phase induction motor and to obtain equivalent circuit.
6. Improve the power factor of single phase induction motor and to obtain its performance.

List of Experiments (Any ten experiments must be conducted)

1. Brake test on three phase Induction Motor
2. No–load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three –phase alternator by synchronous impedance &m.m.f. Methods
4. Regulation of three–phase alternator by Potier triangle method
5. V and Inverted V curves of a three phase synchronous motor.
6. Determination of X_d and $X_q$of a salient pole synchronous machine
7. Equivalent circuit of single phase induction motor
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three phase alternator by loading with three phase induction motor.
10. Power factor improvement of single phase induction motor by using capacitors and load test on single phase induction motor.
11. Measurement of sequence impedance of a three–phase alternator.
12. Break test on split phase induction motor.

Course outcomes:

On completion of the course student will be able to:

1. Obtain efficiency by conducting direct and indirect tests on three phase induction motor.
2. Obtain regulation of alternator by E.M.F, M.M.F, Z.P.F methods and also performance curves.
3. Obtain the V and Inverter V Curves of a three phase synchronous motor.
4. Determine X_d and $X_q$of a salient pole synchronous machine.
5. Control the speed of the single phase induction motor and to obtain equivalent circuit.
6. Improve the power factor of single phase induction motor and to obtain its performance.

MICROPROCESSORS & MICROCONTROLLERS SEMESTER-V			
Subject Code	18EEEET5010	IA-Marks	30
Number of Lecture Hours/Week	3L	Exam-Marks	70
Total Number of Lecture Hours	45	Exam-Hours	03
Credits -3			

Course-Objectives:

This course will enable student to:

1. Explain the fundamentals of microprocessor & Microcontroller
2. Apply assembly language programming
3. Explain peripheral interfacing like I/O, A/D, D/A, timer etc.
4. Explain systems using different microcontrollers

Unit 1: Fundamentals of Microprocessors & Microcontrollers	**Hours**
Fundamentals of 8086 Microprocessor Architecture, Internal block diagram, Instruction Set and Addressing modes, Difference between Microprocessor and microcontroller, Comparison of 8- bit, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems.	**09**
Unit 2: The 8051 Architecture	
Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles	**08**
Unit 3: Instruction set and Programming	
Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, indexed addressing, Bit inherentaddressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assemblers and compilers. Programming and debugging tools.	**10**
Unit 4: Memory and I/O interfacing	
Memory and I/O expansion buses, control signals, memory wait states, Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices	**08**
Unit 5: External Communication Interface & Applications	
Synchronous and Asynchronous Communication. RS232, SPI, I^2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee. LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.	**10**

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the fundamentals of 8086 microprocessor
2. Understand the fundamentals of 8051 microcontroller
3. Explain the instruction set of 8051 microcontroller.
4. Compose the programming of 8051 microcontroller.
5. Examine the memory and I/O interfacing
6. Design the interfacing 8051 microcontroller

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. M.A. Mazidi, J.G. Mazidi and R.D. Mc. Kinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2007.
2. K.J. Ayala, "8051Microcontroller", Delmar Cengage Learning, 2004.
3. R. Kamal, "Embedded System", McGraw Hill Education, 2009.
4. R.S. Goankar, "Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996.

Reference Books:

1. D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/ Software interface", Morgan Kaufman Publishers, 2013.
2. D.V. Hall, "Microprocessors & Interfacing", Mc Graw Hill Higher Education, 1991.

POWER GENERATION, TRANSMISSION & DISTRIBUTION SEMESTER-V			
Subject Code	18EEEET5020	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to :

1. Understand the concepts of electrical power generation by hydro, thermal and Nuclear power plants.
2. Understand the electrical design of the overhead lines.
3. Understand the mechanical design of the overhead lines.
4. Understand the performance of the overhead line insulators.
5. Understand performance of the cables used in power transmission.
6. Understand the concept of distribution system.

Unit 1: Basics of Power Generation & Conventional Methods	**Hours**
Generation of electrical energy by conventional methods, comparison of different sources of power, Nonconventional sources of energy. Principle operation of Hydro Electric Generation: Classification of hydro plant, Selection of site, Estimation of power available, Selection of turbine, Plant layout. Principle operation of Thermal Power Generation: Block diagram of the plant. Boilers: working and classification. Principle operation of Nuclear Power Generation: Principle of energy production by nuclear fission, schematic of nuclear power plant.	**08**
Unit 2: Electrical Design of Overhead lines	**12**
Transmission line parameters: resistance, inductance and capacitance calculations - single phase and three phase lines, double circuit line, effect of earth on transmission line capacitance. Performance of transmission lines: representation of lines, classification of transmission lines, short transmission line, medium (Nominal-T, Nominal-π, End condenser method) length transmission line, long transmission line, evaluation of ABCD parameters, surge impedance and SIL of long lines.	
Unit 3: Mechanical Design of Overhead Lines	**09**
Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor – Stringing chart and sag template and its applications Types of Insulators – String efficiency and Methods for improvement - Voltage distribution–Calculation of string efficiency – Capacitance grading and Static Shielding.	
Unit 4: Underground Cables	**08**
Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable - Capacitance of single and 3-Core belted Cables. Grading of cables: capacitance grading and intersheath grading.	
Unit 5: Distribution Systems	**08**
Introduction to distribution systems - Distribution system losses – Coincidence factor – Contribution factor – loss factor – Relationship between the load factor and loss factor – Numerical Problems – Load Modeling and Characteristics – Classification and characteristics of loads (Residential - commercial - Agricultural	

and Industrial).	

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the basic concepts of electrical power generation and hydro power generation
2. Describe various components of thermal and nuclear power generation.
3. Estimate various factors related to mechanical design of the overhead lines.
4. Distinguish various overhead line insulators.
5. Solve for various parameters of the overhead transmission lines.
6. Discuss the types of cables and their capacitance calculations

Question paper pattern:

The question paper will have 10 questions.

3. Each full question carries 14 marks.
4. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagarand A. Chakrabarti, DhanpatRai& Co. Pvt. Ltd, 2016
2. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa, New age International (P) Limited, Publishers, 3 rd edition.
3. O. I. Elgerd, "Electric Energy Systems Theory" , McGraw Hill Education, 1995.

Reference Books:

1. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi, 2009
2. D. P. Kothari and I. J. Nagrath, " Modern Power System Analysis" , McGraw Hill Education, 2003.
3. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, " Electric Power Systems", Wiley, 2012.

POWER ELECTRONICS SEMESTER-V			
Subject Code	18EEEET5040	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student:

1. To study the characteristics of various power semiconductor devices and to design their firing circuits.
2. To understand the operation of single-phase controlled rectifiers and analyze harmonics in the input current.
3. To study the operation of three phase converters for three pulse, six pulse and bridge configurations.
4. To understand the operation of different types of DC-DC converters.
5. To study the operation of different types of AC-AC regulators AC-AC regulators.
6. To understand the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.

Unit 1: Power Switching Devices	**Hours**
Thyristors– Silicon Controlled Rectifiers (SCR's)–TRIAC, Power BJT – Power MOSFET – Power IGBT and their V-I characteristics – Turn on methods and Dynamic characteristics of SCR. Two transistor analogy of SCR – UJT firing circuit – Series and parallel connections of SCR's – Thyristor ratings and protection –SCR commutation	**08**
Unit 2: Single Phase AC-DC Converters	
Principle of Phase control, Single phase half wave – controlled rectifiers – R load and RL load with and without freewheeling diode – Single phase half-controlled converters – with R, RL loads - Derivation of average load voltage, current and input power factor. Single phase fully controlled converters – Midpoint and Bridge connections with R, RL loads and RLE load – Derivation of average load voltage, current and input power factor – effect of source inductance.	**10**
Unit 3: Three Phase AC-DC Converters	
Three phase converters – Three pulse and six pulse converters – Bridge configuration with R and RL loads - average load voltage – Effect of Source inductance – Dual converters (both single phase and three phase - Principle of operation only).	**08**

Unit 4: DC-DC Converters & AC-AC Regulators	
DC-DC Converters - Time-Ratio and Current Limit control - Analysis of Buck, boost and buck - boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) – Output voltage equations – output voltage ripple & inductor current ripple for CCM only – Modes of operation of forward and fly back converters in CCM. AC-AC Regulators - Single phase AC voltage controllers with R and RL loads – modes of operation of TRIAC – TRIAC with R and RL loads – Derivation of RMS load voltage, current and input power factor. Cyclo-converters (Principle of operation only).	**12**
Unit 5: Single phase & Three phase Inverters	
Single phase and 3-phase bridge inverters with R and RL loads – 3-phase square wave inverters – 120^0 conduction and 180^0 conduction modes of operation – PWM inverters – Quasi-square wave pulse width modulation – Sinusoidal pulse width modulation – Voltage Source Inverter (VSI) – Current Source Inverter (CSI).	**07**

Course outcomes:

On completion of the course student will be able to:

1. Analyze the static and dynamic characteristics of SCRs and Design firing circuits for SCR.
2. Explain the operation of single-phase controlled rectifiers and analyze harmonics in the input current.
3. Explain the operation of three phase converters for three pulse, six pulse and bridge configurations.
4. Analyze the operation of different types of DC-DC converters.
5. Explain the operation of different types of AC-AC regulators.
6. Analyze the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.

Question paper pattern:

The question paper will have 10 questions.

4. Each full question carries 14 marks.
5. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998.
2. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books:

1. Power Electronics – by Vedam Subramanyam, New Age International (P) Limited, Publishers.
2. Power Electronics – by V.R.Murthy , 1st edition -2005, OXFORD University Press.
3. Power Electronics – by P.S. Bhimbra, Khanna Publishers.
4. Power Electronics: converters, applications & design -by Nedmohan, Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.

ELECTRICAL MEASUREMENTS & INSTRUMENTATION SEMESTER-V			
Subject Code	18EEEET5050	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to:

1. Understand working principal of PMMC, MI, Dynamo meter and instrument transformers.
2. Calculate single phase and three phase load consumption using wattmeter and energy meters.
3. Determine unknown physical parameters such as R and L using bridges.
4. Determine unknown physical parameter such as capacitance using bridges.
5. Understand the working principle and Application of different digital meters.
6. Analyze the performance of various transducers.

Unit 1: Measuring Instruments	**Hours**
Classification –Deflecting, control and damping torques – Ammeters and Voltmeters PMMC and Moving iron type instruments, dynamometer type and electrostatic instruments – Expression for the deflecting torque and control torque – Errors and compensations – Extension of range using shunts and multipliers – CT and PT: Ratio and phase angle errors.	**08**
Unit 2: Measurement of Power and Energy	**10**
Single phase and Three Phase dynamometer type wattmeter, LPF and UPF, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems. Single phase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading, Three Phase Energy meter.	
Unit 3: Measurements of R, L & C Elements	**12**
Method of measuring low, medium and high resistance – sensitivity of Wheat-stone's bridge – Carey Foster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance-Q-Factor - Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge. Measurement of capacitance and loss angle. Wien's bridge – Schering Bridge.	
Unit 4: Digital Meters	**07**
Digital Voltmeters – Successive approximation DVM - Ramp type DVM and Integrating type DVM – Digital frequency meter - Digital multimeter - Digital tachometer - Digital Energy Meter - Q meter - Power Analyzer. CRO- measurement of phase difference & Frequency using lissajious patterns - Numerical Problems.	
Unit 5: Transducers	**08**
Introduction to transducers – Classification of transducers – Advantages of Electrical transducers – Characteristics and choice of transducers – Principle operation of resistor, inductor and capacitor transducers – LVDT and its applications – Strain gauge and its principle of operation – Gauge factor – Thermistors – Thermocouples– Piezoelectric transducers – Photo diodes, Hall effect sensors.	

Course outcomes:

On completion of the course student will be able to:

1. Demonstrate working principal of PMMC, MI, Dynamo meter and instrument transformers.
2. Calculate single phase and three phase load consumption using wattmeter and energy meters.
3. Determine unknown physical parameters such as R and L using bridges.
4. Determine unknown physical parameter such as capacitance using bridges.
5. Demonstrate the working principle and Application of different digital meters.
6. Analyze the performance of various transducers.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Electrical Measurements and measuring Instruments – by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.
3. Electrical and Electronic Measurements and instrumentation by R. K. Rajput, S. Chand.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K. Sawhney, Dhanpat Rai & Co. Publications.
2. Electrical Measurements – by Buckingham and Price, Prentice – Hall
3. Electrical Measurements by Forest K. Harris. John Wiley and Sons
4. Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited, Publishers.
5. Electrical and Electronic Measurements –by G. K. Banerjee, PHI Learning Private Ltd., New Delhi–2012.

POWER SYSTEMS LAB SEMESTER-V			
Subject Code	18EEEEL5070	IA Marks	15
Number of Practice Hours/Week	3P	Exam-Marks	35
Total Number of Practice Hours	36	Exam-Hours	03
Credits – 1.5			

LAB OBJECTIVES:

This course will enable student to :

1. Calculate the various parameters of the transmission line
2. Analyze the behavior of the transmission line under abnormal conditions.
3. Examine the performance of the synchronous machine.
4. Calculate the efficiency of the insulators.
5. Analyze the characteristics of Solar PV array
6. Calculate the earth resistance and breakdown strength of the transformer oil.

List-of-Experiments (Any ten experiments must be conducted)

1. Transmission line parameter calculations (inductance & capacitance)
2. ABCD parameters of Transmission line.
3. Characteristics of transmission line with open & short circuit termination
4. Power angle characteristics of a salient pole synchronous machine.
5. Study of different types of insulators
6. Voltage distribution across the string insulator
7. Determination of string efficiency using longer cross arm method.
8. Determination of string efficiency using guard ring method.
9. Characteristics solar PV array.
10. Determination of breakdown strength of transformer oil
11. Measurement of earth resistance by earth tester

LAB-OUTCOMES:

On completion of the course student will be able to:

1. Calculate the various parameters of the transmission line
2. Analyze the behavior of the transmission line under abnormal conditions.
3. Examine the performance of the synchronous machine.
4. Calculate the efficiency of the insulators.
5. Analyze the characteristics of Solar PV array
6. Calculate the earth resistance and breakdown strength of the transformer oil.

POWER ELECTRONICS LAB SEMESTER-V			
Subject Code	18EEEEL5080	1A-Marks	15
Number of Practice Hours/Week	3P	Exam-Marks	35
Total Number of Practice Hours	36	Exam-Hours	03
Credits - 1.5			

LAB OBJECTIVES:

1. To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
2. To sketch the output waveforms of single–phase-controlled rectifiers with resistive and inductive loads.
3. To sketch the performance of three–phase-controlled rectifiers with resistive and inductive loads.
4. To understand the working of Buck, Boost and Buck boost converters.
5. To understand the operation of AC voltage regulator with resistive and inductive loads.
6. To understand the working of PWM inverters.

List-of-Experiments-(Any-ten-experiments-must-be-conducted)

Study of Characteristics of Thyristor, MOSFET & IGBT.

1. Design and development of a firing circuit for Thyristor.
2. Design and development of gate drive circuits for IGBT.
3. Single Phase Half controlled converter with R and RL load
4. Single Phase fully controlled bridge converter with R and RL loads
5. Three Phase fully controlled converter with RL–load.
6. Design and verification of voltages gain of Boost converter in Continuous Conduction Mode (CCM) and Discontinuous Conduction Mode (DCM).
7. Design and verification of voltages ripple in buck converter in CCM operation.
8. Single Phase AC Voltage Regulator with R and RL Loads
9. Three Phase AC-AC voltage regulator with R-load.
10. Single phase PWM inverter with sine triangle PWM technique.
11. Single Phase square wave bridge inverter with R and RL Loads

LAB-OUTCOMES:

On completion of the lab student will be able to:

1. Sketch the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
2. Analyze the performance of single–phase-controlled rectifiers with resistive and inductive loads.
3. Analyze the performance of three–phase-controlled rectifiers with resistive and inductive loads.
4. Examine the working of Buck, Boost and Buck boost converters.
5. Demonstrate the operation of AC voltage regulator with resistive and inductive loads.
6. Discover the applications of PWM inverters.

Soft Skills & Aptitude Builder - 1			
Subject Code	18CMAHS5090	IA Marks	15
Number of Lecture Hours/Week	02	Exam Marks	35
Total Number of Lecture Hours	32	Exam Hours	03
Credits - 2			

Section A, Soft Skills	
Unit – 1: Intrapersonal Communication	**Hours**
Introduction to Soft Skills and its Significance **Personal Effectiveness**: Who am I and What am I; My Strengths and Weaknesses; SWOT Analysis; SMART Goal Setting; Being Proactive **Principles of Personal Vision**: Beginning with the End in Mind; Time Management: Understanding Priorities; Put First-Things-First **Activity**: Psychometric Tests and SWOT Analysis, SMART Goal Setting	**06**
Unit 2: Interpersonal Communication	
Principles of Creative Cooperation and Organisation Skills: Think Win-Win; Seek First to Understand then to be Understood; Synergize; Life-Long Learning **Emotional Intelligence**: Self-Awareness, Self-Regulation, Empathy, Assertiveness, Adoptability, Managing Emotions **Activity**: Resolving a Conflict with your Friend/Colleague/Family Member; Group Discussions & Debates	**06**
Unit – 3: 21st Century Skills	
What are 21st Century Skills? Learning Skills- Digital Literacy- Life Skills **Critical Thinking**: Active Listening, Observation, Introspection, Analytical Thinking, Open Mindedness **Problem Solving**: Understanding the Complexity of the Problem, Defining the Problem, Cause and Effect Analysis, Exploring Possible Solutions, Planning Actions, Analysing Results of your Actions, Getting Feedback, Redefining the Problem, The Problem Solving Cycle **Decision Making**: Managing Conflict, Conflict Resolution, Methods of Decision Making, Effective Decision Making in Teams – Methods & Styles **Activity**: Case Study	**06**
Section B, Aptitude Builder	
Unit – 4: Ratios & Percentages	
Definition of Ratio, Properties of Ratios, Comparison of Ratios, Problems on Ratios, Compound Ratio, Problems on Proportion, Mean Proportional and Continued Proportion. **Partnership:** Introduction, Relation between Capitals, Period of Investments and Shares **Number System:** Classification of Numbers, Divisibility Rules, Finding the Units Digit, Finding Remainders in Divisions Involving Higher Powers, LCM and HCF Models **Percentages:** Introduction, Converting a Percentage into Decimals, Converting a Decimal into Percentage, Percentage Equivalent of Fractions, Problems on Percentages **Profit And Loss:** Problems on Profit and Loss Percentage, Relation between Cost Price and Selling Price, Discount and Marked Price, Two Different Articles Sold at Same Cost Price, Two Different Articles Sold at Same Selling Price Gain% / Loss% on Selling Price **Problems on Ages:** Introduction, Problems based on Ages **Averages:** Definition of Average, Rules of Average, Problems on Average ,	**07**

Problems on Weighted Average, Finding Average using Assumed Mean Method **Alligation and Mixture:** Problems on Mixtures, Alligation Rule, Problems on Alligation	
Unit – 5: Mental Ability	**07**
Difference Series, Product Series, Squares Series, Cubes Series, Alternate Series Combination Series, Miscellaneous Series, Place Values of Letters **Number and Letter Analogies:** Definition of Analogy, Problems on Number Analogy, Problems on Letter Analogy, Problems on Verbal Analogy **Odd Man Out:** Problems on Number Odd Man Out, Problems on Letter Odd Man Out, Problems on Verbal Odd Man Out **Coding and Decoding:** Coding using Same Set of Letter, Coding using Different Set of Letters, Coding into a Number, Problems on R-Model **Blood relations:** Defining the Various Relations among the Members of a Family, Solving Blood Relation Puzzles, Solving the Problems on Blood Relations using Symbols and Notations **Direction Sense:** Solving Problems by Drawing the Paths, Finding the Net Distance Travelled, Finding the Direction, Problems on Clocks ,Problems on Shadows	

Section-A: Text (T) / Reference (R) Books:	
For Units 1, 2, & 3	
T1	English and Soft Skills, Dr. S. P. Dhanvel, Orient Blackswan, 2011
R1	Seven Habits of Highly Effective People, Stephen R Covey
R2	Emotional Intelligence, Daniel Goleman, Bantom Book, 2006
R3	21st Century Skills: Learning for Life in our Times, Bernie Trilling, Charles Fadel; John Wiley & Sons
For Units 4&5	
T1	R S Agarwal, S Chand, 'Quantitative Aptitude'
T2	R S Agarwal, S.Chand , 'A Modern Approach to Logical Reasoning'
R1	Quantitative Aptitude for CAT By Arun Sharma
R2	GL Barrons, Mc Graw Hills, Thorpe's Verbal Reasoning, LSAT Materials
Course Outcomes: On completion of this course, students can	
Section A: Soft Skills	
CO1	Re-engineer attitude and understand its influence on behaviour
CO 2	Develop interpersonal skills and be an effective goal oriented team player
CO 3	Develop holistic personality with a mature outlook to function effectively in different circumstances
Section B: Aptitude Builder	
CO 4	Solve the real-time problems for performing job functions easily
CO 5	Analyze the problems logically and critically

POWER SYSTEMS OPERATION & CONTROL SEMESTER-VI			
Subject Code	18EEEET6010	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to:

1. Use numerical methods to analyze a power system in steady state.
2. Examine the faults occur in the power system network.
3. Understand stability constraints in a synchronous grid.
4. Understand methods to control the voltage, frequency and power flow.
5. Understand the monitoring and control of a power system.
6. Understand the basics of power system economics.

Unit 1: Power Flow Studies	**Hours**
Formation of Y–bus matrix, steps to form Z- bus matrix. Necessity of power flow studies, Static Real and Reactive power flow equations at a node. Application of numerical methods for solution of non- linear algebraic equations – Gauss Seidel, Newton- Raphson, Decoupled and fast decoupled methods for the solution of the power flow equations and its comparisons.	**10**
Unit 2: Symmetrical Components and Fault Analysis	**10**
Symmetrical Fault analysis - short circuit MVA Calculations, Unsymmetrical faults on power system (LG-LL-LLG and LLL)	
Unit 3: Power System Stability	**09**
Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve - Synchronizing Power Coefficient. Methods of stability analysis -Equal Area Criterion. Loss of synchronism in a single machine infinite bus system, sudden increase in mechanical input power, sudden loss of line and three--phase fault - Series compensation of Transmission lines for stability improvement.	
Unit 4: Power System Operation and Control	**08**
An overview of power system operation and control, Turbines and Speed- Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Methods of voltage control - Automatic Voltage Regulation.	
Unit 5: Power System Economics and Management	**08**
Power System load variation- System load characteristics, load curves - daily, weekly and annual, load-duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Load forecasting, techniques of forecasting. Economic dispatch – Numerical problem lambda-iteration method, Generation Control and integration of economic dispatch control with LFC. Unit Commitment numerical problems solutions Priority-list methods, forward dynamic programming approach and λ-iteration method.	

Course outcomes:

On completion of the course student will be able to:

1. Apply numerical methods to analyze a power system in steady state.
2. Explain faults occur in the power system network.
3. Illustrate stability constraints in a synchronous grid.
4. Classify the various methods to control the voltage, frequency and power flow.
5. Interpret the monitoring and control of a power system.
6. Calculate the various factors related to power system economics.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O.I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education,1995.
3. A.R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.

Reference Books:

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
2. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strabac, "Electric Power Systems", Wiley,2012.

LINE COMMUTATED & ACTIVE RECTIFIERS
SEMESTER-VI
(Program Elective – 1)

Subject Code	18EEEEP603A	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable student to :

1. Explain the control rectifier circuits
2. Summarize the operation of line commutated rectifiers and multipulse converters
3. Discuss the operation of single-switch boost converters
4. Discuss the operation of 1-phase and 3-phase bidirectional boost converters
5. Explain the steady state analysis and closed-loop structure of bidirectional boost converters
6. Discuss the operation of flyback converters

Unit 1: Thyristor rectifiers with passive filtering	**Hours**
Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current wave shape	**08**
Unit 2: Multi-Pulse Converter	**08**
Review of transformer phase shifting, generation of 6-phase ac voltage from 3- phase ac, 6- pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.	
Unit 3: Single-phase AC-DC single-switch boost converter	**08**
Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.	
Unit 4: AC-DC bidirectional boost converter	**08**
Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.	
Unit 5: Isolated single-phase AC-DC flyback converter	**13**
AC-DC fly back converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.	

Course outcomes:

On completion of the course student will be able to:

1. Explain the passive filtering of thyristor rectifiers
2. Analyze the concept of multi-phase converters
3. Describe the operation of single switch boost converters
4. Explain the operation of bidirectional boost converters
5. Analyze the bidirectional boost converter at different power factors
6. Analyze the operation of fly back converters

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison- Wesley, 1991.
3. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
4. Abraham I.Press man, "Switching Power Supply Design"

Reference Books:

1. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
2. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001.

HVDC TRANSMISSION SYSTEMS
SEMESTER-VI
(Program Elective - 1)

Subject Code	18EEEEP603B	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable student to :

1. Understand differences among AC and DC transmission system.
2. Identify the importance of HVDC in power transmission network.
3. Analyze the 6-pulse and 12-pulse converter performance.
4. Understand the control strategies for HVDC network.

Unit 1: DC Transmission Technology	**Hours**
Introduction to HVDC Transmission, Historical Development of HVDC Transmission, Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of a HVDC system.	**08**
Unit 2: Analysis of Line Commutated and Voltage Source Converters	**12**
Line Commutated Converters (LCCs): Six pulse converter, Analysis of Graetz Circuit without overlap and with overlap. Analysis of Twelve Pulse Converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links. Voltage Source Converters (VSCs): Two and Three-level VSCs. Application of HVDC-VSC Systems. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter.	
Unit 3: Control of HVDC Converters and Components	**12**
Control of HVDC Converters - Principles of Link Control in a LCC HVDC system. Control Hierarchy, Firing Angle Controls, Current and Extinction Angle Control, Starting and Stopping of a Link. Power control. Principles of Link Control in a VSC HVDC system. Phase-Locked Loop. Control Hierarchy and System control. Components - Smoothing Reactors, Reactive Power Sources and Design and types of Filters. DC line: Corona Effects. Transient Over-voltages. DC line faults in LCC systems. DC line faults in VSC systems. DC breakers. Mono polar operation. Ground electrodes.	
Unit 4: Stability Enhancement using HVDC Control	**06**
Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/DC systems.	
Unit 5: MTDC Links	**07**
Multi-Terminal and Multi-In feed Systems. Series and Parallel MTDC systems using LCCs. MTDC systems using VSCs. Introduction to Modular Multi-level Converters. Modern Trends in HVDC Technology.	

Course outcomes:

On completion of the course student will be able to:

1. Realize the importance of HVDC transmission.
2. Analyze the harmonics effect in converter performance.
3. Apply different control strategies to converters.
4. Discriminate various components of HVDC System.
5. Appraise the stability improvement using HVDC Control strategies.
6. Illustrate the benefits of MTDC links and Modular Multi-level converters

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2015.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 2008.

Reference Books:

1. E. W. Kimbark, " Direct Current Transmission", Vol.1, Wiley-Interscience,1971

CONTROL SYSTEM DESIGN
SEMESTER-VI
(Program Elective - 1)

Subject Code	18EEEEP603C	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to :

1. Explain the concepts of design problem and various design specifications.
2. Discuss the design of compensator for both time and frequency domain specifications.
3. Explain the design of various controllers.
4. Understand the concept on feed-forward control.
5. Apply the knowledge of design using state space
6. Understand the methods of solving Non-linear system of equations.

Unit 1: Design Specifications	**Hours**
Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.	**08**
Unit 2: Design of Classical Control System in the time domain and Frequency domain	**08**
Introduction to compensator. Design of Feedback and Feed forward compensators, Feedback compensation, Realization of compensators. Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using Bode diagram.	
Unit 3: Design of PID Controllers	**09**
Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.	
Unit 4: Control System Design in State Space	**10**
Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Full order, Reduced order observer. Separation Principle.	
Unit 5: Design of control for Non Linear Systems	**07**
Introduction, Methods of solving Non-linear systems of equations, Pseudo-composition, weight function procedure, Technique for extending scalar methods to the multidimensional case in a nontrivial way	

Course outcomes:

On completion of the course student will be able to:

1. Elaborate the concepts of various designing fundamentals.
2. Apply the basic design in both time and frequency domain
3. Understand the concepts of PID controllers
4. Apply the knowledge of design using state space
5. Illustrate the basic concepts of nonlinearities and their performance
6. Discuss the concepts of singular points and performance of system

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. N. Nise, "Control system Engineering", John Wiley, 2000.
2. I.J. Nagrath and M. Gopal, "Control system engineering", Wiley, 2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
4. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.

Reference Books:

1. B. C. Kuo, "Automatic Control system", Prentice Hall, 1995.
2. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
3. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994.

MICROPROCESSORS & MICROCONTROLLERS LABORATORY SEMESTER-VI			
Subject Code	18EEEEL6060	1A Marks	15
Number of Practice Hours/Week	3P	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1			

Course Objectives:

This course will enable student to :

1. Study the Architecture of 8, 16, 32 bit Microprocessors.
2. Learn the Programming skills of Microprocessor & Microcontroller.
3. Learn the design aspects of I/O and Memory Interfacing circuits.
4. Study the Architecture of 8051 microcontroller
5. Learn the design aspects of 8051 for different applications.

List of Experiments (Any 10 experiments must be conducted)

PART-A Microprocessor 8086

1. Arithmetic operation – Multi byte addition and subtraction, multiplication and Division
2. Arithmetic operation - Signed and Unsigned arithmetic operation, ASCII - arithmetic operation.
3. Logic operations- Shift and Rotate- Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
4. By using string operation and instruction prefix: Move block, Reverse string, Sorting,

PART-B Microcontroller 8051

5. Reading and writing on a parallel port using 8051.
6. Timer in different modes using 8051.
7. 8-bit Analog to Digital Converter using 8051
8. 8-bit Digital to Analog Converter using 8051

PART-C 8051 Interfacing

9. Switches and LEDs
10. 7-Segment display (multiplexed)
11. Stepper Motor Interface
12. Traffic Light Control

Course Outcomes:

On completion of the course student will be able to:

1. Develop programs on 8086 Microprocessor.
2. Develop programs for different applications using 8086 & 8051.
3. Design and implement programs on 8051 Micro controller.
4. Interface Micro Controller with other electronic devices.
5. Demonstrate the I/O interfacing
6. Demonstrate the concepts related to memory interfacing

ELECTRICAL MEASUREMENTS & INSTRUMENTATION LAB SEMESTER - VI			
Subject Code	18EEEEL6070	1A Marks	15
Number of Practice Hours/Week	3P	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

Course Objectives:

This course will enable student to :

1. Compute the errors present in Energy and current measuring instruments and its calibration.
2. Compute the errors present in power measuring instruments and its calibration.
3. Find the accuracy PMMC instruments using D.C potentiometer.
4. Examine DC and AC bridges for the measurement of Resistance, inductance and capacitance.
5. Compare various transducers for the measurement of physical quantities like weight and displacement.
6. Distinguish various transducers for the measurement of temperature.

List of Experiments (Any ten experiments must be conducted)

1. Calibration and Testing of single phase energy Meter
2. C.T. testing using mutual Inductor Measurement of %ratio error and phase angle of given C.T.by Null method
3. Calibration of dynamometer wattmeter using phantom loading
4. Calibration LPF wattmeter by using Phantom loading
5. Crompton D.C. Potentiometer Calibration of PMMC voltmeter and Ammeter
6. Capacitance Measurement using Schering Bridge.
7. Inductance Measurement using Anderson bridge
8. Kelvin's double Bridge Measurement of resistance Determination of Tolerance.
9. Measurement of displacement using LVDT
10. Measurement of weight using strain gauge based displacement transducer.
11. Measurement of temperature by RTD.
12. Measurement of temperature by thermocouple

Course Outcomes:

On completion of the course student will be able to:

1. Compute the errors present in Energy and current measuring instruments and its calibration.
2. Compute the errors present in power measuring instruments and its calibration.
3. Examine the accuracy of PMMC instruments using D.C potentiometer.
4. Demonstrate the measurement of resistance, inductance and capacitance using DC and AC bridges
5. Discriminate various transducers for the measurement of physical quantities like weight and displacement.
6. Compare various transducers for the measurement of temperature.

Soft Skills & Aptitude Builder - 2			
Subject Code	18CMAHS6080	IA Marks	15
Number of Lecture Hours/Week	2	Exam Marks	35
Total Number of Lecture Hours	32	Exam Hours	03
Credits - 2			
Section A, Soft Skills			

Unit – 1: Communicative Competence	**Hours**
Verbal Reasoning: Reading Comprehension-Text Completion- Sentence Equivalence Spotting Errors, Sequencing of Sentences, Parallelism in Structure E-Mail Etiquette, Reporting News Activity: Completing Exercises	**06**
Unit 2: Career and Employability Skills	**06**
What is a Career: Career vs Job, Career Values & Grid, Skills vs Strengths, Spotting Skills/Reflection of Present Skills, Meeting the Expectation of your Employer, Matching your Skills with the Required Skills, Preparing Resume, Preparing for Interviews & Structuring Answers Activity: Resume Building, Interviews	
Section B, Aptitude Builder	
Unit – 3: Time and Work	**06**
Pipes and Cisterns: Problems on Unitary method, Relation between Men, Days, Hours and Work, Problems on Man-Day-Hours Method, Problems on Alternate Days, Problems on Pipes and Cisterns. **Time , Distance and Speed, Problems on Trains, Boats and Streams:** Relation between Speed, Distance and Time, Converting km/h into m/s and vice versa , Problems on Average Speed, Problems on Relative Speed, Problems on Circular Tracks, Problems on Races **Problems on Trains:** Two Trains Moving in Opposite Direction, Two Trains Moving in same Direction, A Train Crossing a Stationary Object of a Given Length like a Platform or Bridge, A Train Crossing a Stationary Object like a Pole or a Man **Boats and Streams:** Time Based, which can be considered as a Point Object Speed Based, Distance Based, Average Speed Based	
Unit – 4: Logical and Analytical Reasoning	**07**
Seating Arrangement: Linear Arrangement, Circular Arrangement, Tabler, Triangular Arrangement, Complex Arrangement**.** **Clocks:** Finding the Angle When the Time is Given, Finding the Time When the Angle is Known, Relation between Angles, Minutes and Hours, Position of Hands of the Clock, Time Gained or Lost by the Clock, Mirror /Water Image-based Time. **Calendars:** Definition of a Leap Year, Finding the Number of Odd Days, Framing the Year Code for Centuries, Finding the Day of any Random Calendar Date **Syllogisms:** Finding the Conclusions using Venn Diagram Method, Finding the Conclusions using Syllogism Method **Simple Interest:** Definitions, Problems on Interest and Amount, Problems when Rate of Interest and Time Period are Numerically Equal **Compound Interest:** Definition and Formula for Amount in Compound Interest, Difference between Simple Interest and Compound Interest for 2 Years on the Same Principle and Time Period.	

Unit – 5: Permutations, Probability, Areas and Volumes		
Definition of permutation , Problems on Permutations , Definition of Combinations , problems on Combinations **Probability:** Definition of Probability, Problems on Coins, Problems on Dice, Problems on Deck of Cards , Problems on Years **Mensuration - 2D:** Formulas for Areas, Formulas for Volumes of Different Solids, Problems on Areas **Mensuration - 3D:** Problems on Volumes, Problems on Surface Areas		**07**
Text (T) / Reference (R) Books:		
For Units 1 & 2		
T1	Enhance Your Employability Skills, David Winter and Laura Brammar, University of London	
T2	R.S. Agarwal, Verbal & Non-Verbal Reasoning, S. Chand & Co., Latest ed. 2003	
R2	How to Prepare for Verbal Ability and Reading Comprehension, Arun Sharma, Meenakshi Upadhay, Mc Graw Hill	
For Units 3, 4, & 5		
T1	R S Agarwal, S Chand, 'Quantitative Aptitude'	
T2	R S Agarwal, S.Chand , 'A modern approach to Logical reasoning'	
R1	Quantitative Aptitude for CAT By Arun sharma	
R2	GL Barrons, Mc Graw Hills, Thorpe's verbal reasoning, LSAT Materials	
Course Outcomes: On completion of this course, students can		
Section A: Soft Skills		
CO 1	Learn and practice effective communication skills	
CO 2	Develop broad career plans, evaluate the employment market, and become industry ready	
Section B: Aptitude Builder		
CO 3	Develop accuracy on time and distance and units related solutions	
CO 4	Solve the real-time problems for performing job functions easily	
CO 5	Solve problems related to permutations and combinations, probability, areas and volumes	

BIOLOGY FOR ENGINEERS Semester VI			
Subject Code	**18CMBIN6090**	**IA Marks**	**30**
Number of Lecture Hours/Week	**2L**	**Exam Marks**	**70**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**
Credits –NA			

Course Objectives: Students should be able to:

1. Convey that Biology is as important as scientific discipline as Mathematics, Physics and Chemistry
2. Convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted.
3. Convey that "Genetics is to biology what Newton's laws are to Physical Sciences"
4. Convey that all forms of life has the same building blocks and yet the manifestations areas diverse as one can imagine
5. Convey that without catalysis life would not have existed on earth
6. molecular basis of coding and decoding genetic information is universal
7. Analyse biological processes at the reduction its level
8. The fundamental principles of energy transactions are the same in physical and biological world.

Unit -1 Introduction	**Teaching Hours**
Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology. How biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.	**Hours – 8**
Unit -2 Classification	
Hierarchy of life forms at phenomenological level- classification based on (a) cellularity - Unicellular or multicellular (b) ultra structure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophy, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. Musculus	**Hours – 8**
Unit – 3 Genetics & Biomolecules	
Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics. **Molecules of life:** Monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	**Hours–12**

Unit – 4 Enzymes & Proteins	
Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions - Enzyme classification. Mechanism of enzyme action. - examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis. **Proteins**- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements. **Information Transfer:** The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to doublehelix to nucleosides. Concept of genetic code. Universality and degeneracy ofgenetic code. Define gene in terms of complementation and recombination	**Hours–12**
Unit – 5 Microbiology & Metabolism	
Thermodynamics as applied to biological systems - Exothermic andendothermic versus undergone and exergoinc reactions. Concept of Keq and its relation to standard free energy - Spontaneity - ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge **Concept of single celled organisms**. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics	**Hours–10**

Course outcomes: Students will be able to

1. Describe how biological observations of 18th Century that lead to major discoveries.
2. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
3. Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
4. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
5. Classifyenzymesanddistinguishbetweendifferentmechanismsofenzymeaction.
6. Conveythat“GeneticsistobiologywhatNewton’slawsaretoPhysicalSciences”

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson EducationLtd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publisher

References

1. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.
2. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher

POWER SYSTEM PROTECTION SEMESTER-VII			
Subject Code	18EEEET7010	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits-03			

Course Objectives:

This course will enable student to:

1. Summarize the functions of components of a protection system.
2. Estimate fault current due to different types of faults in a network.
3. Explain the protection schemes for different power system components.
4. Explain the basic principles of digital protection.
5. Compare system protection schemes.
6. Discuss the Wide-Area Measurement Systems for improving protection systems.

Unit 1: Introduction and Components of a Protection System	**Hours**
Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers	**08**
Unit 2: Faults and Over-Current Protection	**08**
Review of Fault Analysis, Sequence Networks. Introduction to overcurrent Protection and overcurrent relay co-ordination.	
Unit 3: Equipment Protection Schemes and Digital Protection	**10**
Directional, Distance, Differential protection of Transformer and Generator protection, Differential protection of transmission lines, Bus bar Protection, Bus Bar arrangement schemes. Computer-aided protection, Static Relays	
Unit 4: Modeling and Simulation of Protection Schemes	**08**
CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing	
Unit 5: System Protection	**11**
Effect of Power Swings on Distance Relaying, System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.	

Course outcomes:

On completion of the course student will be able to:

1. Analyze the different components of a protection system.
2. Evaluate the fault current due to different types of fault in a network.
3. Analyze the protection schemes for different power system components.
4. Explain the basic principles of digital protection.
5. Evaluate the system protection schemes.
6. Analyze the Wide-Area Measurement Systems for improving protection systems

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
2. Y. G. Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India,2010.
3. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.

Reference Books:

1. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
2. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

MODELING & CONTROL OF DC DRIVES
SEMESTER-VII
(Program Elective – 2)

Subject Code	18EEEEP702A	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

The objectives of this course is to

1. Understand the unified theory of rotating machines
2. Explain the modeling of D.C. machines
3. Explain fundamentals of electric drives and various electric braking methods
4. Explain phase controlled converter dc motors and four quadrant operation of dc motors using dual converters.
5. Discuss the converter control of dc motors in various quadrants.

Unit 1: Basic concepts of Modeling	**Hours**
Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.	**08**
Unit 2: DC Machine Modeling	**10**
Mathematical model of separately excited D.C motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt motor-Linearization Techniques for small perturbations.	
Unit 3: Fundamentals of Electric Drives	**09**
Electric drive – Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization – Four quadrant operation of drive (hoist control) – Braking methods**:** Dynamic – Plugging – Regenerative methods.	
Unit 4: Controlled Converter Fed DC Motor Drives	**10**
Single phase half and fully controlled converter fed separately and self-excited DC motor drive – three phase fully controlled converter fed separately excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed – torque characteristics – Principle of operation of dual converters and dual converter fed DC motor drives – Numerical problems.	
Unit 5: DC–DC Converters Fed DC Motor Drives	**08**
Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current operation – Output voltage and current waveforms – Speed-Torque expressions – Speed-Torque characteristics – Four quadrant operation – Closed loop operation (qualitative treatment only).	

Course outcomes:

1. Discuss the unified theory of rotating machines
2. Develop mathematical modeling of DC machines
3. Illustrate the basics of electric drives and different electric braking methods
4. Analyze the four-quadrant control of dc motors using 1-ϕ and 3- ϕ phase controlled converters
5. Illustrate the speed-torque characteristics of DC motors using 1-ϕ and 3- ϕ phase controlled converters
6. Analyze the control of dc motors by DC-DC converters in various quadrants

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Generalized theory of Electrical Machinery –P.S.Bimbra- Khanna Publishers.
2. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education 2002.
3. N. Mohan, Power Electronics- Converters, Applications and Design, 3rd Ed., John Wiley & Sons, 2003.

Reference Books:

1. Vedam Subramanyam, "Electric Drives – Concepts and Applications", McGraw Hill, Second Edition, 2010.
2. Gobal K. Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, Second Edition ,2009
3. R. Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
4. M. Rashid, Power Electronics- Circuits, Devices and Applications, 3rd Ed., Prentice Hall, 2004.
5. Analysis of Electrical Machinery and Drive systems – P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff – Second Edition-IEEE Press.
6. Modern Power Electronics and AC Drives-B.K. Bose - PHI

SMART GRID
SEMESTER-VII
(Program Elective – 2)

Subject Code	18EEEEP702B	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits-03			

Course Objectives:

This course will enable student to :

1. Understand concept of smart grid and its advantages over conventional grid.
2. Know smart metering techniques.
3. Learn wide area measurement techniques.
4. Understanding the problems associated with integration of distributed generation & its solution through smart grid.

Unit 1: Introduction to Smart Grid	**Hours**
Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self-Healing Grid, Present development & International policies in Smart Grid.	**08**
Unit 2: Smart Grid Applications-I	**08**
Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV),Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation	
Unit 3: Smart Grid Applications-II	**08**
Geographic Information System(GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).	
Unit 4: Micro Grid Technology	**10**
Concept of micro-grid, need & applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro- turbines, Captive power plants, Integration of renewable energy sources.	
Unit 5: Regulations and Market Models for Smart Grid	**11**
Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Micro grid Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Costs benefit analysis of smart grid projects.	

Course outcomes:

On completion of the course student will be able to:

1. Discriminate smart grid & conventional grid.
2. Apply smart metering concepts to industrial and commercial installations.
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
4. Estimate smart grid solutions using modern communication technologies.
5. Discuss micro grid and solar cells
6. Analyze various techniques used in grid integration

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley2012.

Reference Books:

1. Stuart Borlas'e, "Smart Grid: Infrastructure, Technology and solutions "CRC Press.
2. A. G. Phadke , "Synchronized Phasor Measurement and their Applications", Springer.

OPTIMIZATION TECHNIQUES
SEMESTER - VII
(Program Elective – 2)

Subject Code	18EEEEP702C	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits -03			

Course Objectives:

This course will enable student to:

1. Explain the objective and constraint functions in terms of design variables, and then state the optimization problem.
2. Solve single variable and multi variable optimization problems with and without constraints.
3. Explain linear programming technique to an optimization problem, slack and surplus variables, by using Simplex method.
4. Explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.
5. Discuss evolutionary programming techniques.

Unit 1: Introduction and Classical Optimization Techniques	**Hours**
Statement of an Optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of Optimization problems.	**08**
Unit 2: Classical Optimization Techniques Single variable Optimization, multi variable Optimization without constraints, necessary and sufficient conditions for minimum/maximum, multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers, multivariable Optimization with inequality constraints, Kuhn, Tucker conditions.	**08**
Unit 3: Linear Programming Standard form of a linear programming problem , geometry of linear programming problems, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation to the simplex method, simplex algorithm, Duality in Linear Programming, Dual Simplex method.	**08**
Unit 4: Nonlinear Programming Unconstrained cases, One, dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method, Univariate method, Powell's method and steepest descent method. Constrained cases, Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.	**08**
Unit 5: Introduction to Evolutionary Methods Evolutionary programming methods, Introduction to Genetic Algorithms (GA)– Control parameters, Number of generation, population size, selection, reproduction, crossover and mutation, Operator selection criteria , Simple mapping of objective function to fitness function, constraints, Genetic algorithm steps, Stopping criteria –Simple examples.	**13**

Course outcomes:

On completion of the course student will be able to:

1. State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
2. Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
3. Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
4. Apply gradient and non-gradient methods to nonlinear optimization problems.
5. Apply interior or exterior penalty functions for the constraints to derive the optimal solutions.

Able to apply Genetic algorithms for simple electrical problems.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. "Engineering optimization: Theory and practice"-by S. S. Rao, New Age International (P) Limited, 3rd edition, 1998.
2. Soft Computing with Matlab Programming by N. P. Padhy & S.P. Simson, Oxford University Press – 2015

Reference Books:

1. "Optimization methods in operations Research and Systems Analysis" by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Genetic Algorithms in search, optimization, and Machine Learning by Davi E. Goldberg, ISBN: 978-81-7758-829-3, Pearson by Dorling Kindersley (India) Pvt Ltd.
3. "Operations Research: An Introduction" by H. A. Taha, PHI Pvt. Ltd., 6th edition.
4. Linear Programming by G. Hadley.

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ELECTRICAL & HYBRID VEHICLES
SEMESTER-VII
(Program Elective – 3)

Subject Code	18EEEEP703A	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits - 03			

Course Objectives:

This course will enable student to :

1. Explain working of hybrid and electric vehicles, its performance and characteristics.
2. Discuss hybrid vehicle configuration and its components.
3. Explain electric vehicle drive systems.
4. Discuss the properties of energy storage systems.
5. Compare different Energy management strategies

Unit 1: Introduction	**Hours**
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles.	**08**
Unit 2: Hybrid Electric Drive Trains	**10**
Architecture of Hybrid Electric Vehicles (HEV), analysis of drive trains, energy use in conventional vehicles, energy saving potential of hybrid drive trains, various HEV configurations and their operation model. Power flow in HEV: Power flow control in series, parallel, series-parallel hybrid system. Torque and Speed coupling.	
Unit 3: Electric Drive Trains	**08**
Architecture of electric drive train, electric vehicle configuration, electric drive trains, EV power source configurations. Single and Multi-Motor drives, In wheel drives, requirements of different electric motors used in EVs, Power-Torque-Speed characteristics, electric propulsion systems.	
Unit 4: Energy Storage	**10**
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.	
Unit 5: Energy Management Strategies	**09**
Introduction to energy management strategies used in hybrid and electric vehicles, classification, comparison of different energy management strategies, implementation issues of energy management strategies. Functions of control system in HEVs & EVs, Elementary control theory, Electronic control unit, control area network, control variables, classifications of Hybrid electronic control unit, fuzzy logic based control system	

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the working of hybrid and electric vehicles, its performance and characteristics.
2. Analyze hybrid vehicle configuration and its components.
3. Discuss electric vehicle drive systems.
4. Illustrate electric propulsion systems.
5. Infer the properties of energy storage systems.
6. Distinguish different energy management strategies.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

POWER SYSTEM DYNAMICS & STABILITY
SEMESTER-VII
(Program Elective – 3)

Subject Code	18EEEEP703B	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to :

1. Understand the problem of power system stability and its impact on the system.
2. Explain linear dynamical systems and use of numerical integration methods.
3. Model different power system components for the study of stability.
4. Understand the methods to improve stability.

Unit 1: Introduction to Power System Operations & Dynamic Stability	**Hours**
Introduction - Basics of system dynamics, numerical techniques, importance of power system stability in the operation and control, design distinction between transient and dynamic stability, complexity of stability problem in larges system, stability of interconnected systems. Dynamic Stability - Analysis of dynamical System, Concept of Equilibrium, System response to Small and Large Disturbance, linear model of the unregulated synchronous machine and its modes of oscillation, effect of excitation on dynamic stability, Analysis using Numerical solutions - dynamic performance measure, small signal performance measures.	**10**
Unit 2: Modeling of Synchronous Machines and Controllers	**08**
Modeling of synchronous machine: flux linkage equations, Park's transformation, equivalent circuit, current space model, flux linkage state space model, D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis, Voltage-reactive power characteristics. Synchronization to an Infinite Bus, Capability curves.	
Unit 3: Transient Stability	**10**
State equation for multi machine system with one axis model and simulation – modelling of multi machine power system with one axis machine model including excitation system, speed governing system, simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer.	
Unit 4: Stability Analysis	**08**
Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi- machine systems, Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Interaction with speed governors, Voltage Stability, Torsional Oscillations.	
Unit 5: Enhancing System Stability	**09**
Principle behind transient stability enhancement methods: high-speed fault clearing, reduction of transmission system reactance, regulated shunt compensation, dynamic braking, reactor switching, independent pole-operation of circuit-breakers, single-pole switching, and high-speed excitation systems.	

Course outcomes:

On completion of the course student will be able to:

1. Analyze the different components of a protection system.
2. Evaluate the fault current due to different types of fault in a network.
3. Analyze the protection schemes for different power system components.
4. Explain the basic principles of digital protection.
5. Evaluate the system protection schemes.
6. Analyze the Wide-Area Measurement Systems for improving protection systems

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.
2. P.Kundur,"PowerSystemStabilityandControl",McGrawHill,1995.

Reference Books:

1. P. Sauerand, M.A.Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.

DIGITAL SIGNAL PROCESSING
SEMESTER-VII
(Program Elective – 3)

Subject Code	18EEEEP703C	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to :

1. Understand of the fundamentals of discrete-time signals and systems.
2. Explain the techniques of analysis of discrete-time signals and the use of Z-transforms.
3. Explain the spectral properties of discrete-time systems through the use of Discrete Fourier transform (FFT) of sequences.
4. Discuss the design of digital filters.
5. Discover the applications of Digital Signal Processing

Unit 1: Discrete-time signals and systems	**Hours**
Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.	**08**
Unit 2: Z-transforms	**08**
Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z- transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.	
Unit 3: Discrete Fourier Transforms	**09**
Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.	
Unit 4: Design of Digital filters	**12**
Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band- stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.	
Unit 5: Applications of Digital Signal Processing	**08**
Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.	

Course outcomes:

On completion of the course student will be able to:

1. Represent signals and systems mathematically discrete-time without aliasing
2. Analyze discrete-time systems using z-transform.
3. Apply the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. Design digital FIR filters for various applications.
5. Design digital IIR filters for various applications.
6. Apply digital signal processing for the analysis of real-life signals

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. S.K. Mitra, "Digital Signal Processing: A computer based approach", Mc GrawHill, 2011.
2. A.V. Oppenheim and R.W. Schafer, "Discrete Time Signal Processing",Prentice Hall, 1989.
3. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles,Algorithms and Applications", Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.

Reference Books:

1. J. R.Johnson, "Introduction to Digital Signal Processing", PrenticeHall, 1992.
2. D.J.DeFatta ,J.G.Lucas and W.S.Hodgkiss," Digital Signal Processing" , JohnWiley & Sons, 1988.
3. Andreas Antoniou, "Digital Signal Processing", TATA McGraw Hill , 2006
4. Robert J. Schilling, Sandra L. Harris, "Fundamentals of Digital Signal Processing using Matlab", Thomson, 2007.

Web References:

1. Digital Signal Processing, IIT Delhi Prof. S.C. Dutta Roy:
2. https://nptel.ac.in/courses/117102060
3. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9234648

MODELING & CONTROL OF AC DRIVES
SEMESTER-VII
(Program Elective - 4)

Subject Code	18EEEEP704A	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

The Objectives of this course to

1. Understand the concept of phase transformation
2. Understand the modeling of 3-ϕ induction machines.
3. Explain the modeling of synchronous machines.
4. Explain the stator and rotor control of induction motor drives
5. Understand the self and separate control of synchronous motor drives.

Unit 1: Reference Frame Theory	**Hours**
Reference frame theory: Linear transformation, Phase transformation - 3-ϕ to 2-ϕ transformation (abc to dq0) and 2-ϕ to 3-ϕ transformation (dq0 to abc) - Power equivalence	**08**
Unit 2: Modeling of 3-ϕ Induction Machines	**12**
3-ϕ Induction Machines: Generalized model in arbitrary reference frame - Electromagnetic torque - Stator reference frame model - Rotor reference frame model - Synchronously rotating reference frame model	
Unit 3: Modeling of Synchronous Machines	**08**
Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame electromagnetic torque- current in terms of flux linkages - three synchronous machine model	
Unit 4: Control of Induction Motor Drives	**08**
Stator side control - Stator voltage control using 3-phase AC voltage regulators – Waveforms – Speed torque characteristics – Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop V/f control of induction motor drives (qualitative treatment only). Rotor side control - Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages – Applications.	
Unit 5: Control of Synchronous Motor Drives	**09**
Separate control & self-control of synchronous motors – Operation of self - controlled synchronous motors by VSI – Closed Loop control operation of synchronous motor drives (qualitative treatment only) – Variable frequency control – Pulse width modulation.	

Course Outcomes:

Students will be able to:

1. Analyze the phase transformation
2. Illustrate the modeling of 3- ϕ induction machines
3. Illustrate the modeling of synchronous machines
4. Explain the v/f control of induction machines
5. Compare the stator and rotor control methods of induction machines

Compare the self and separate control methods of synchronous machines

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Generalized theory of Electrical Machinery –P.S. Bimbra- Khanna Publishers.
2. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education 2002.
3. N. Mohan, Power Electronics- Converters, Applications and Design, 3rd Ed., John Wiley & Sons, 2003.

Reference Books:

1. Vedam Subramanyam, "Electric Drives – Concepts and Applications", McGraw Hill, Second Edition, 2010.
2. Gobal K. Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, Second Edition ,2009
3. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
4. M. Rashid, Power Electronics- Circuits, Devices and Applications, 3rd Ed., Prentice Hall, 2004.
5. Analysis of Electrical Machinery and Drive systems – P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff – Second Edition-IEEE Press.
6. Modern Power Electronics and AC Drives-B.K. Bose - PHI

ELECTRICAL ENERGY CONSERVATION & AUDITING
SEMESTER-VII
(Program Elective – 4)

Subject Code	18EEEEP704B	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits-03			

Course Objectives:

This course enable student to:

1. Explain energy efficiency, scope, conservation and technologies.
2. Discuss energy efficient lighting systems.
3. Calculate power factor of systems and propose suitable compensation techniques.
4. Explain the working of energy instruments.
5. Discuss energy conservation in HVAC systems.
6. Calculate life cycle costing analysis and return on investment on energy efficient technologies.

Unit 1: Basic Principles of Energy Audit and International Acts on Energy	**Hours**
Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts – Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Indian energy scenario and consumption, energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, National action plan on climate change Energy and environment, air pollution, climate change United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties	**08**
Unit 2: Energy conservation opportunities in lighting	**12**
Modification of existing systems – Replacement of existing systems – Priorities**:** Definition of terms and units – Luminous efficiency –Luminance or brightness – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers –Energy conservation measures, lighting energy audit, case studies.	
Unit 3: Power Factor and energy instruments	**10**
Power factor – Methods of improvement – Location of capacitors – Power factor with nonlinear loads – Effect of harmonics on Power factor – Numerical problems Energy Instruments – Watt–hour meter – Data loggers –Thermocouples– Pyrometers – Lux meters – Tong testers – Power analyzer..	
Unit 4: HVAC systems and ECBC	**07**
Heating, ventilation, air conditioning (HVAC), fenestrations, Energy Conservation Building Codes (ECBC), building envelope, insulation, lighting, water pumping, inverter and energy storage/captive generation, elevators and escalators, star labeling for existing buildings, Energy Service Companies based case studies,.	

Unit 5: Energy Efficient Motors and Financial Aspects of Conservation Technologies	
Energy Efficient motors Design, construction, Gorilla fan case study(Additional practical topic) Understanding energy cost, Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis — Economics of energy efficient motors and systems. Need of investment, appraisal and criteria, Calculation of simple payback period–Return on investment – Net present value – Internal rate of return – numerical examples Applications of life cycle costing analysis – Return on investment –Numerical examples.	**08**

Course outcomes:

On completion of the course student will be able to:

1. Explain energy efficiency, conservation and various technologies
2. Design energy efficient lighting system
3. Calculate power factor of systems and propose suitable compensation techniques
4. Explain the working of Energy Instruments.
5. Explain energy conservation techniques in HVAC Systems
6. Calculate life cycle costing analysis and return on investment on energy efficiency technologies.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Hand Book of Energy Audit by Sonal Desai- Tata Mc Grawhill
2. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc. Ltd–2nd edition, 1995

Reference Books:

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications.2012
2. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
3. Energy management by Paul o' Callaghan, Mc Graw Hill Book company–1st edition, 1998.
4. Energy management hand book by W.C. Turner, John Wiley and sons.
5. Energy management and conservation –k v Sharma and p venkataseshaiah-I K International Publishing House pvt. Ltd, 2011.
6. http://www.energymanagertraining.com/download/Gazette_of_IndiaPartIISecI- 37_25-08-2010.pdf

INTELLIGENT CONTROL & ITS APPLICATIONS
SEMESTER-VII
(Professional Elective - 4)

Subject Code	18EEEEP704C	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable student to :

1. Understand the basic intelligent controller concept
2. Understand concepts of feed forward neural networks and learning and understanding of feedback neural networks.
3. Understand and analyze the concept of genetic algorithm.
4. Understand the knowledge of fuzzy logic control.
5. Apply the knowledge of fuzzy logic control, genetic algorithm and neural network to the real problems.

Unit 1: Introduction to Intelligent Control	**Hours**
Introduction and motivation. Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.	**08**
Unit 2: Artificial Neural Networks	**12**
Concept of Artificial Neural Networks, its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Introduction, derivation, algorithm, flowchart, limitation-Error Back propagation, Hopefield, Radial bases function	
Unit 3: Genetic Algorithm	**08**
Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems	
Unit 4: Fuzzy Logic System	**08**
Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Fuzzy logic control for nonlinear time-delay system. Implementation of fuzzy logic controller.	
Unit 5: Applications	**09**
Aerospace and data mining applications of Genetic Algorithm - Neural Network and Fuzzy Logic Control applications in Smart grid, Electric drives and Distributed generation.	

Course outcomes:

On completion of the course student will be able to :

1. Infer representations applied to artificial intelligence techniques
2. Illustrate the use of artificial neuron in perceptron models and back propagation algorithm to multilayer feed forward networks
3. Develop rule based and decision making with the use of classical and fuzzy logic systems
4. Analyze the concept of genetic algorithm.
5. Analyze the fuzzy logic controller using MATLAB.
6. Discover various applications of neural and fuzzy logic systems in electrical Engineering

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 2003.
2. T.J. Ross, Fuzzy logic with Fuzzy Applications, McGraw Hill Inc, 1997.
3. David E Goldberg, Genetic Algorithms. Wesley Publishing Company,1989
4. John Yen and Reza Langari, Fuzzy logic Intelligence, Control, and Information, PearsonEducation, Indian Edition, 2003.
5. Neural Network, Fuzzy Logic and Genetic Algorithm : Synthesis and Applications S. Rajasekaran and G. A. VijayalakshmiPai (Prentice Hall India, 2010)

Reference Books:

1. M.T. Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint, 2008.
2. Fredric M. Ham and Ivica Kostanic, Principles of Neuro computing for science and Engineering, McGraw Hill, 2001.
3. N. K. Bose and P. Liang, Neural Network Fundamentals with Graphs, Algorithms, and Applications, Mc, Graw Hill, Inc. 1996.
4. Yung C. Shin and ChengyingXu, Intelligent System, Modeling, Optimization and Control, CRC Press, 2009.
5. N. K. Sinha and Madan M Gupta, Soft computing & Intelligent Systems, Theory &Applications, Indian Edition, Elsevier, 2007.
6. Witold Pedrycz, Fuzzy Control and Fuzzy Systems, Overseas Press, Indian Edition, 2008.

FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS
SEMESTER-VII
(Program Elective – 5)

Subject Code	18EEEEP705A	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03

Credits - 03

Course Objectives:

This course will enable student to :

1. Explain the basics of power flow control in transmission lines using FACTS controllers
2. Discuss operation and control of voltage source converter.
3. Discuss shunt compensation methods to improve stability and learn method of shunt compensations using static VAR compensators.
4. Compare various methods of compensation using series compensators
5. Infer operation of Unified Power Flow Controller (UPFC).

Unit 1: Introduction to FACTS	**Hours**
Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high power devices – Voltage and current rating – Losses and speed of switching – Parameter trade–off devices.	**08**
Unit –2: Voltage source and Current source converters	**08**
Concept of voltage source converter (VSC) – Single phase bridge converter – Square – wave voltage harmonics for a single–phase bridge converter – Three– phase full wave bridge converter– Three–phase current source converter – Comparison of current source converter with voltage source converter.	
Unit 3: Shunt Compensators	**08**
Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping – Thyristor Controlled Reactor - Thyristor Switched Capacitor (TSC)–Thyristor Switched Capacitor – Thyristor Switched Reactor (TSC–TCR).	
Unit 4: Static Synchronous Compensators	**08**
Static VAR compensator (SVC) and Static Compensator (STATCOM): The regulation and slope transfer function and dynamic performance – Transient stability enhancement and power oscillation damping– Operating point control and summary of compensation control.	
Unit 5: Series Compensators and Combined Controllers	**13**
Static series compensators - Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements. GTO thyristor controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC). Combined Controllers - Schematic and basic operating principles of Unified Power Flow Controller (UPFC) – Application on transmission lines.	

Course outcomes:

On completion of the course student will be able to:

1. Analyze the factors that affecting the power transfer in transmission lines
2. Illustrate the harmonic analysis of 3- phase and 1-phase voltage source converters
3. Formulate the enhancement of power transfer capability and transient stability of transmission network with shunt compensation
4. Compare the characteristics of static VAR compensation and STATCOM
5. Analyze the methods of compensation by using series compensators
6. Discuss the operation of combined controllers (UPFC & IPFC)

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. "Understanding FACTS" N.G. Hingorani and L. Guygi, IEEE Press. Indian Edition is available:—Standard Publications, 2001.

Reference Books:

1. "Flexible ac transmission system (FACTS)" Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
2. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R. Mohan Mathur and Rajiv K. Varma, Wiley.

POWER QUALITY
SEMESTER-VII
(Program Elective – 5)

Subject Code	18EEEEP705B	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to:

1. Infer different types of power quality phenomena.
2. Explain various sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
3. Discuss power quality terms and study power quality standards.
4. Explain the principle of voltage regulation and power factor improvement methods.
5. Distinguish distributed generation and power quality.
6. Explain the power quality monitoring concepts and the usage of measuring instruments.

Unit 1: Introduction	**Hours**
Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations.	**09**
Unit 2: Voltage Imperfections in Power Systems	**09**
Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.	
Unit 3: Voltage Regulation and Power Factor Improvement	**09**
Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor Improvement.	
Unit 4: Harmonic Distortion and Solutions	**09**
Voltage distortion vs Current distortion – Harmonics vs Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering	
Unit 5: Power quality Monitoring, Measurement	**09**
Power quality monitoring considerations & standards, Historical prospective of measuring instrument, power quality measuring equipment, flicker meter, assessments of power quality measuring data	

Course outcomes:

On completion of the course student will be able to:

1. Differentiate between different types of power quality problems.
2. Explain the sources of voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
3. Analyze power quality terms and power quality standards.
4. Explain the principle of voltage regulation and power factor improvement methods.
5. Demonstrate the relationship between distributed generation and power quality.
6. Explain the power quality monitoring concepts and the usage of measuring instruments.

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Electrical Power Systems Quality, Dugan R C, Mc Granaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw–Hill, 2012, 3rd edition.
2. Electric power quality problems –M.H.J. Bollen IEEE series-Wiley India publications, 2011.

Reference Books:

1. Power Quality Primer, Kennedy B W, First Edition, McGraw–Hill, 2000.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M HJ, First Edition, IEEE Press; 2000.
3. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
4. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
5. Power Quality C. Shankaran, CRC Press, 2001
6. Harmonics and Power Systems – Franciso C.DE LA Rosa–CRC Press (Taylor & Francis)
7. Power Quality in Power systems and Electrical Machines–Ewald F. fuchs, Mohammad A.S. Masoum–Elsevier.

DIGITAL CONTROL SYSTEMS
SEMESTER-VII
(Program Elective – 5)

Subject Code	18EEEEP705C	IA Marks	30
Number of Lecture Hours/week	3L	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable student to :

1. Obtain discrete representation of LTI systems.
2. Solve various discrete-time systems.
3. Design and analyze digital controllers.
4. Design state feedback and output feedback controllers.
5. Discuss the concepts of feedback control
6. Understand the basic concepts of fast output sampling

Unit 1: Discrete Representation of Continuous Systems	**Hours**
Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modeling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.	**08**
Unit 2: Discrete System Analysis	**08**
Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.	
Unit 3: Stability & State Space Approach for Discrete Time Systems	**12**
Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design. State space models of discrete systems, State space analysis. Controllability, reachability, Reconstructability and observability analysis. Effect of pole zero cancellation on the controllability & observability.	
Unit 4: Design of Digital Control System	**09**
Design of Discrete PID Controller, Design of discrete state feedback controller. Design of Discrete Observer, full order and reduced order for LTI System.	
Unit 5: Discrete output feedback control	**08**
Design of discrete output feedback control. Fast output sampling (FOS) and Periodic output feedback controller design for discrete time systems.	

Course outcomes:

On completion of the course student will be able to:

1. Illustrate discrete representation of LTI systems.
2. Analyze stability of open loop and closed loop discrete-time systems.
3. Design and analyze digital controllers.
4. Design state feedback and output feedback controllers.
5. Analyze the concepts of feedback control
6. Understand the basic concepts of fast output sampling

Question paper pattern:

The question paper will have 10 questions.

1. Each full question carries 14 marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs, 1995.
2. B.C. Kuo, “Digital Control System”, Holt, Rinehartand Winston, 1980.

Reference Books:

1. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley, 1998.
2. M. Gopal, “Digital Control Engineering”, Wiley Eastern, 1988.

POWER SYSTEMS ANALYSIS LAB
SEMESTER-VII

Subject Code	18EEEEL7070	1A-Marks	15
Number of Practice Hours/Week	3P	Exam-Marks	35
Total Number of Practice Hours	36	Exam-Hours	03
Credits- 1.5			

Course Objectives:

This lab will enable the students to

1. Examine various numerical methods applied to a power system in steady state.
2. Explain stability constraints in a synchronous grid.
3. Demonstrate the methods to control the voltage, frequency and power flow.
4. Explain the monitoring and control of a power system.
5. Discuss the basics of power system economics.

List-of-Experiments-(Any ten experiments must be conducted)

1. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
2. Load Flow Analysis- I : Solution of load flow and related problems using Gauss-Seidel Method
3. Load Flow Analysis II: Solution of load flow and related problems using Newton Raphson.
4. Load Flow Analysis - II: Solution of load flow and related problems using decoupled and fast decoupled.
5. Fault Analysis of symmetrical and unsymmetrical faults
6. Simulation of Swing equations of a synchronous machine connected a single infinite bus
7. Analysis of application of Equal Area Criterion in stability studies
8. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
9. Transient Stability Analysis of Multi machine Power Systems
10. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
11. System load variation and load characteristics - load curves and load-duration curve.
12. Economic dispatch using lambda-iteration method
13. Unit commitment: Priority-list schemes and dynamic programming

Curse Outcomes:

1. Examine various numerical methods applied to a power system in steady state.
2. Examine the power system under abnormal conditions
3. Examine stability constraints in a synchronous grid.
4. Demonstrate the methods to control the voltage, frequency and power flow.
5. Illustrate the monitoring and control of a power system.
6. Infer the economic operation of the power system

Design of Photovoltaic Systems
SEMESTER VII
(Skill Oriented Course)

Course Code	18EEEES7080	IA Marks	
Number of Lecture Hours/week	2P	Exam Marks	
Total Number of Lecture Hours	15	Exam Hours	02
Credits - 2			

Course Objectives:

This course will enable student to :

1. Understand the fundamentals of Photovoltaic systems.
2. Know various technologies used in the Photovoltaic systems.
3. Know various methods used to improve power track in the Photovoltaic systems.
4. Know the connectivity of battery devices using in PV system.
5. Understand the implementation of PV system to Grid.

All the following topics are to be discussed

1. Basics of Photovoltaic (PV) cell
2. Series and Parallel Interconnections of PV cell
3. Energy from sun and Incident energy estimation
4. Sizing of PV
5. Maximum Power Point Tracking (MPPT) and Its Algorithms
6. PV Battery interfaces
7. Peltier cooling system
8. PV and water pumping
9. PV grid interfacing
10. Life cycle costing

Course Outcomes:

On completion of the course student will be able to:

1. Understand the fundamentals of Photovoltaic systems.
2. Know various technologies used in the Photovoltaic systems.
3. Know various methods used to improve power track in the Photovoltaic systems.
4. Learn the connectivity of battery devices to the PV system.
5. Learn the process of cooling and maintenance of the system.
6. Understand the implementation of PV system to Grid.

Books and references:

1. Chenming, H. and White, R.M., Solar Cells from B to Advanced Systems, McGraw Hill Book Co, 1983
2. Ruschenbach, HS, Solar Cell Array Design Hand Varmostrand, Reinhold, NY, 1980
3. Proceedings of IEEE Photovoltaics Specialists Conferences, Solar Energy Journal.

Open Elective
Courses Offered by All the Departments

Open Elective
Courses Offered by Civil to other Departments

Open Electives offered by Civil Department:

S.No	Subject Code	Subject
1	18XXCEOXXXX	Civil Engineering-Societal & Global Impact
2	18XXCEOXXXX	Introduction to Civil Engineering
3	18XXCEOXXXX	Disaster Management
4	18XXCEOXXXX	Environmental Pollution and control
5	18XXCEOXXXX	Building Materials
6	18XXCEOXXXX	Green Buildings and sustainability

CIVIL ENGINEERING -SOCIETAL & GLOBAL IMPACT			
Subject Code	18XXCEOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

- Awareness of the importance of Civil Engineering and the impact it has on the Society and at global levels
- Awareness of the impact of Civil Engineering for the various specific fields of human endeavour
- Need to think innovatively to ensure Sustainability

Unit -1	Hours
Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering	09
Unit -2	
Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy)	10
Unit – 3	
Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationary and non- stationary; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.	10
Unit – 4	
Built environment – Facilities management, Climate control; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures	09
Unit-5	
Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Project	10

Course outcomes:

On completion of this course, students are able to:

1. Understand the role of Civil Engineering in Modern World
2. Understand various constructional Infrastructure and their importance in present environment
3. Interpret modern transportation systems and their advantages

4. Effect of global Warming and mitigation measures
5. Understand the importance of Sustainability and Reduction of Green House Gas Emissions

TEXT BOOKS

1. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.

REFERENCES

1. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.
2. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options
3. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx
4. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014

INTRODUCTION TO CIVIL ENGINEERING			
Subject Code	18XXCEOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

1. To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering
2. To motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness.
3. To expose the students to the various avenues available for doing creative and
4. Innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

Unit -1History of Civil engineering	**Hours**
Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers	**10**
Unit -2Fundamentals of Building Materials	
Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Admixture; Structural Steel, High Tensile Steel, Recycling of Construction & Demolition wastes, Damp Proofing and water proofing materials and uses – Plastering Pointing, white washing and distempering. Paints: Constituents of a paint – Types of paints – Painting of new/old wood- Varnish. Form Works and Scaffoldings.	**10**
Unit – 3Basics of Construction Management & Contracts Management	
Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management-Terms in Contract-contract Types	**10**
Unit – 4 Surveying & Geomatics	
Surveying & Geomatics: Overview of Surveying, Traditional surveying techniques-, Total Stations; GPS & GIS Applications	**09**
Unit-5 Geotechnical Engineering	
Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunneling	**09**

Course outcomes:

On completion of this course, students are able to:

1. Understand the role of Civil Engineering in Modern World
2. Know the details and working of various building materials
3. Understand the concept of various construction management Techniques
4. Know basic surveying methods and their applications
5. Understand the importance of soil mechanics and rock mechanics in various structural designs

TEXT BOOKS

1. Patil, B.S.(1974), Legal Aspects of Building and Engineering Contract
2. Soil dynamics and machine foundations by K.R. Arora
3. Surveying vol 1&2 byB.C.Punmia, Laxmi publications, 2005
4. Building Materials by P.C.Verghese, PHI learning pvt. Ltd., 2015
5. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset

REFERENCES

1. Chandiramani, Neelima (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
2. Avtarsingh (2002), Law of Contract, Eastern Book Co.
3. Dutt (1994), Indian Contract Act, Eastern Law House
4. The National Building Code, BIS, (2017)

DISASTER MANAGEMENT			
Subject Code	18XXCEOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

1. Develop an understanding of why and how the modern disaster manager is involved with pre-disaster and post-disaster activities.
2. Develop an awareness of the chronological phases of natural disaster response and refugee relief operations. Understand how the phases of each are parallel and how they differ.
3. Understand the 'relief system' and the 'disaster victim.
4. Describe the three planning strategies use full in mitigation.
5. Identify the regulatory controls used in hazard management.
6. Describe public awareness and economic incentive possibilities.

Unit -1 Natural Hazards And Disaster Management	**Hours**
Introduction of DM–Inter Disciplinary –nature of the subject–Disaster Management cycle–Five priorities for action. Case study methods of the following: floods, draughts – Earthquakes – global warming, cyclones &Tsunamis – Post Tsunami hazards along the Indian coast– landslides.	**10**
Unit -2 Man Made Disaster And Their Management Along With Case Study Methods Of The Following	
Fire hazards– transport hazard dynamics– solid waste management–post disaster–bio terrotirism- threat in mega cities, rail and aircraft's accidents, and Emerging in factious diseases & Aids and their management.	**09**
Unit – 3RiskAndVulnerability	
Building codes and land use planning –social vulnerability–environmental vulnerability–Macroeconomic management and sustainable development, climate change risk rendition–financial management of disaster– related losses	**09**
Unit – 4 Role Of Technology In Disaster Managements:	
Disaster management for infrastructures, taxonomy of infrastructure–treatment plants and process facilities-electrical substations- roads and bridges- mitigation programme for earthquakes–flow chart, geospatial information in agriculture drought assessment-multimedia technology in disaster risk management and training- transformable indigenous knowledge in disaster reduction.	**10**
Unit-5 Education And Community Preparedness:	
Education in disaster risk reduction-Essentials of school disaster education-Community capacity and disaster resilience-Community based disaster recovery-Community based disaster management and social capital- Designing resilience-building community capacity for action.	**10**

Course outcomes:

On completion of this course, students are able to

1. Affirm the usefulness of integrating management principles in disaster mitigation work.
2. Distinguish between the different approaches needed to manage pre- during and post-disaster periods.
3. Explain the process of risk management.
4. Relate to risk transfer.
5. Prepare community for risk reduction.

TEXT BOOKS

1. Disaster Management–Global Challenges and Local Solutions ’by Rajib shah & RKrishnamurthy (2009), Universities press.
2. Disaster Science & Management ’by Tushar Bhattacharya, Tata Mc Graw Hill Education Pvt. Ltd., NewDelhi.
3. Disaster Management–Future Challenges and Opportunities ’by Jagbir Singh(2007),I K International Publishing House Pvt. Ltd.
4. http://ndma.gov.in/ (Home page of National Disaster Management Authority).

ENVIONMENTAL POLLUTION AND CONTROL			
Subject Code	18XXCEOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

1. Impart knowledge on fundamental aspects of air pollution & control, noise pollution, and solid waste management.
2. Provide basic knowledge on sustainable development.
3. Introduces some basics of sanitation methods essential for protection of community health.
4. Differentiate the solid and hazardous waste based on characterization.

Unit -1 Introduction	**Hours**
Air Pollution: Air pollution Control Methods–Particulate control devices– Methods of Controlling Gaseous Emissions–Air quality standards. **Noise Pollution**: Noise standards, Measurement and control methods– Reducing residential and industrial noise– ISO14000.	**10**
Unit -2 Industrial wastewater Management	
Strategies for pollution control- Volume and Strength reduction–Neutralization – Equalization– Proportioning –Common Effluent Treatment Plants-Recirculation of industrial wastes–Effluent standards.	**09**
Unit – 3SolidWasteManagement	
Solid waste characteristics –basics of on-site handling and collection –separation and processing-Incineration- Composting-Solid waste disposal methods– fundamentals of Land filling.	**09**
Unit – 4 Environmental Sanitation	
Environmental Sanitation Methods for Hostels and Hotels, Hospitals, Swimming pools and public bathing places, social gatherings (mela sand fares),Schools and Institutions, Rural Sanitation-low cost waste disposal methods.	**10**
Unit-5 Hazardous Waste	
Characterization – Nuclear waste– Biomedical wastes– Electronic wastes- Chemical wastes–Treatment and management of hazardous waste-Disposal and Control methods.	**10**

Course outcomes:

On completion of this course, students are able to

1. Identify the air pollutant control devices
2. Have knowledge on the NAAQ standard sand air emission standards.
3. Differentiate the treatment techniques used for sewage and industrial waste water treatment methods.
4. Understand the fundamentals of solid waste management; practices adopted in his town/village and its importance in keeping the health of the city.
5. Appreciate the methods o f environmental sanitation and the management of community facilities without spread of epidemics.

TEXT BOOKS

1. Environmental E n g i n e e r i n g , byRuth F. Weiner andRobin Matthews– 4thEditionElesevier,2003.
2. Environmental Science and Engineering byJ.G.HenryandG.W. Heinke–Pearson Education.
3. Environmental Engineering by Mackenzie L Davis &David A Cornwell.McGrawHillPublishing1. Air Pollution and Control by M.N.Rao&H.N.Rao

REFERENCES

1. Air Pollution and Control by M.N.Rao&H.N.Rao
2. Solid Waste Management by K.SasiKumar,S.A.GopiKrishna. PHI New Delhi.
3. Environmental Engineering by Gerard Kiley,TataMcGrawHill.
4. Environmental Sanitation by KVSG Murali Krishna, Reem Publications, New Delhi.

BUILDING MATERIALS			
Subject Code	18XXCEOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

1. Initiating the student with the knowledge of basic building materials and their properties
2. Imparting the knowledge of course pattern in masonry construction and flat roofs and techniques of forming foundation, columns, beams, walls, sloped and flat roofs.
3. The student is to be exposed to the various patterns of floors, walls, different types of paints and varnishes.
4. Imparting the students with the techniques of formwork and scaffolding
5. The students should be exposed to classification of aggregates, moisture content of the aggregate.

Unit -1 Introduction	**Hours**
Stones, Bricks And Tiles Properties of building stones – relation to their structural requirements, classification of stones – stone quarrying – precautions in blasting, dressing of stone, composition of good brick earth, various methods of manufacturing of bricks. Characteristics of good tile - manufacturing methods, types of tiles. Uses of materials like Aluminium, Gypsum, Glass and Bituminous materials	**10**
Unit -2Masonry	
Types of masonry, English and Flemish bonds, Rubble and Ashlars Masonry. Cavity and partition walls. Wood: Structure – Properties- Seasoning of timber- Classification of various types of woods used in buildings- Defects in timber. Alternative materials for wood – Galvanized Iron, Fiber Reinforced Plastics, Steel, Aluminium	**10**
Unit – 3Lime And Cement Lime	
Various ingredients of lime – Constituents of lime stone – classification of lime – various methods of manufacture of lime. Cement: Portland cement- Chemical Composition – Hydration, setting and fineness of cement. Various types of cement and their properties. Various field and laboratory tests for Cement. Various ingredients of cement concrete and their importance – various tests for concrete.	**10**
Unit – 4 Building Components	
Lintels, arches, vaults, stair cases – types. Different types of floors – Concrete, Mosaic, and Terrazzo floors, Pitched, flat roofs. Lean to roof, Coupled Roofs. Trussed roofs – King and Queen post Trusses. R.C.C Roofs, Madras Terrace and Pre-fabricated roofs	**09**
Unit-5 Finishing's	
Damp Proofing and water proofing materials and uses – Plastering Pointing, white washing and distempering. Paints: Constituents of a paint – Types of paints – Painting of new/old wood- Varnish. Form Works and Scaffoldings.	**09**

Course outcomes:

On completion of this course, students are able to

1. Identify different building materials and their importance in building construction.

2. Differentiate brick masonry, stone masonry construction and use of lime and cement in various constructions.
3. Importance of building components and finishings.
4. Classification of aggregates, sieve analysis and moisture content usually required in building construction.
5. Understand the role of different floors, paints, Damp Proofing, structural elements

TEXT BOOKS

1. Building Materials, S. S. Bhavikatti, Vices publications House private ltd.
2. Building Construction, S. S. Bhavikatti, Vices publications House private ltd.
3. Building Materials, B. C. Punmia, Laxmi Publications private ltd.
4. Building Construction, B.C. Punmia, Laxmi Publications (p) ltd

REFERENCES

1. Building Materials, S. K. Duggal, New Age International Publications.
2. Building Materials, P. C. Verghese, PHI learning (P) ltd.
3. Building Materials, M. L. Gambhir, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
4. Building construction, P. C. Verghese, PHI Learning (P) Ltd.

GREEN BUILDINGS AND SUSTAINABILITY			
Subject Code	18XXCEOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits –03			

Course Objectives:

Enable the students to

1. Know the green building and green energy building materials.
2. Familiarize with different rating agencies and features of green buildings.
3. Understand the term sustainability and sustainable development.
4. Learn sources of greenhouse gases and its impact on climate.
5. Understand and Plan land use confirming to zonal regulations

Unit -1	**Hours**
INTRODUCTION What is Green Building, Why to go for Green Building, Benefits of Green Buildings, Green Building Materials and Equipment in India, What are key Requisites for Constructing a Green Building, Important Sustainable features for Green Building	**10**
Unit -2	
GREEN BUILDING CONCEPTS AND PRACTICES Indian Green Building Council, Green Building Moment in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities And Benefits: Opportunities of Green Building, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy Saving Approach in Buildings, LEED India Rating System and Energy Efficiency,	**10**
Unit – 3	
SUSTAINABILITY Introduction, Human development index, Sustainable development and social ethics, definitions of sustainability, populations and consumptions	**09**
Unit – 4	
THE CARBON CYCLE AND ENERGY BALANCES Introduction, Climate science history, carbon sources and emissions, The carbon cycle, carbon flow pathways, and repositories, Global energy balance, Global energy balance and temperature model, Greenhouse gases and Effects, Climate change projections and impacts	**09**
Unit-5	
SUSTAINABILITY AND BUILT ENVIRONMENT Introduction, Land use and land cover change, Land use planning and its role in sustainable development-Zoning and land use planning, smart growth, Environmentally sensitive design- low impact development, green infrastructure and conservation design, Green buildings and land use planning, Energy use and buildings	**10**

Course outcomes:

On completion of this course, students are able to:

1. Describe green buildings and green building materials.
2. Acquaint with different rating agencies and energy features of green buildings.
3. Understand the term sustainability and sustainable development.

4. Recognize sources of green house gases emissions and its impact on climate.
5. Plan land use confirming to zonal regulations.

TEXT BOOKS

1. Standard for the Design of High-Performance Green Buildings by ASHRAE
2. Engineering Applications in Sustainable Design and Development By Bradley A.Striebig, Adebayo A.Ogundipe and Maria Papadakis. First edition, 2016, CENGAGE Learning.

REFERENCES

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air Conditioning Engineers, 2009. 2.
2. Green Building Hand Book by Tomwoolley and Samkimings, 2009.
3. IGBC - Smart Cities & Green Building Concept in India

Open Elective
Courses Offered by CSE, CST & IT to other Departments

Open Elective Courses offered by CSE

S.No.	Subject Code	Name of the subject	L	T	P	Cr
1.	18XXCSOXXXX	Internet of Things	3	0	0	3
2.	18XXCSOXXXX	Block Chain	3	0	0	3
3.	18XXCSOXXXX	Quantum Computing	3	0	0	3
4.	18XXCSOXXXX	Virtual Reality	3	0	0	3
5.	18XXCSOXXXX	Data Structures through C	3	0	0	3
6.	18XXCSOXXXX	Designing Database Management Systems	3	0	0	3
7.	18XXCSOXXXX	Operating Systems Concepts	3	0	0	3
8.	18XXCSOXXXX	R Programming	3	0	0	3
9.	18XXCSOXXXX	Python Programming	3	0	0	3
10.	18XXCSOXXXX	Java Programming	3	0	0	3
11.	18XXCSOXXXX	App Technologies	3	0	0	3
12.	18XXCSOXXXX	Web Technologies	3	0	0	3
13.	18XXCSOXXXX	Artificial Intelligence	3	0	0	3

Open Electives Courses Offered by CST to other Departments

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	18XXCTOXXXX	Internet of Things	3	0	0	3
2	18XXCTOXXXX	Block Chain	3	0	0	3
3	18XXCTOXXXX	Quantum Computing	3	0	0	3
4	18XXCTOXXXX	Virtual Reality	3	0	0	3
5	18XXCTOXXXX	Data Structures Through C	3	0	0	3
6	18XXCTOXXXX	Designing Database Management Systems	3	0	0	3
7	18XXCTOXXXX	Operating Systems Concepts	3	0	0	3
8	18XXCTOXXXX	R Programming	3	0	0	3
9	18XXCTOXXXX	Python Programming	3	0	0	3
10	18XXCTOXXXX	Java Programming	3	0	0	3
11	18XXCTOXXXX	App Technologies	3	0	0	3
12	18XXCTOXXXX	Web Technologies	3	0	0	3
13	18XXCTOXXXX	Artificial Intelligence	3	0	0	3

INTERNET OF THINGS			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:
The learning objectives of this course are:

1. Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
2. Formalize a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).
3. Implement basic AI algorithms (e.g., standard search algorithms or dynamic programming).
4. Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports.

Unit -1: The Internet of Things	**Hours**
An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples OF IoTs, Design Principles for Connected Devices	**09**
Unit -2 :Business Models	
Business Processes in the Internet of Things ,IoT/M2M systems LAYERS AND designs standardizations ,Modified OSI Stack for the IoT/M2M Systems ,ETSI M2M domains and High-level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability	**10**
Unit – 3:Design Principles for the Web Connectivity	
Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.	**10**
Unit – 4:Internet Connectivity Principles	
Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet. Data Acquiring, Organizing and Analytics in IoT/M2M, Applications/Services/Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.	**10**
Unit – 5:Data Collection	
Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.	**09**

Text(T) / Reference(R) Books:

T1	Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
T2	Internet of Things, A.Bahgya and V.Madisetti, Univesity Press, 2015
R1	Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley
R2	Getting Started with the Internet of Things CunoPfister , Oreilly
W1	https://www.coursera.org/specializations/internet-of-things
W2	https://alison.com/course/internet-of-things-and-the-cloud
Course Outcomes: On completion of this course, students can	
CO1	Demonstrate knowledge and understanding of the security and ethical issues of the Internet of Things
CO2	Conceptually identify vulnerabilities in Internet of Things
CO3	Conceptually identify recent attacks, involving the Internet of Things
CO4	Develop critical thinking skills
CO5	Compare and contrast the threat environment based on industry and/or device type.

BLOCK CHAIN TECHNOLOGY			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

The learning objectives of this course are:

1. To assess blockchain applications in a structured manner.
2. To impart knowledge in block chain techniques and able to present the concepts clearly and structured.
3. To get familiarity with future currencies and to create own crypto token.

Unit -1: Introduction	**Hours**
Overview of Block chain, public ledgers, bitcoin, smart contracts, block in a block chain, transactions, distributed consensus, public vs private block chain, understanding crypto currency to block chain, permissioned model of block chain, overview of security aspects of block chain, cryptographic hash function, properties of a hash function, hash pointer and Merkle tree, digital signature, public key cryptography, a basic crypto currency.	**10**
Unit -2 :Understanding block chain with crypto currency	
Creation of coins, payments and double spending, bitcoin scripts, bitcoin P2P network, transaction in bitcoin network, block mining, block propagation and block relay, distributed consensus in open environments, consensus in a bitcoin network, Proof of Work (PoW)- Basic Introduction, hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of burn and proof of elapsed time, the life of a bitcoin miner, Mining- Difficulty, mining pool.	**10**
Unit – 3:Permissioned Block Chain	
Permissioned model and usecases, design issues for permissioned block chains, execute contracts, state machine replication, overview of consensus models for permissioned block chain, Distributed consensus in closed environment, paxos, RAFT consensus, Byzantine general problem, Byzantine fault tolerance system, Lamport-Shostak-Pease BFT algorithm, BFT over Asynchronous systems.	**10**
Unit – 4:Enterprise application of Block chain	
Cross border payments, Know Your Customer, Food security, Mortgage over block chain, Block chain enabled trade, trade finance network, supply chain financing, identity on block chain.	**09**
Unit – 5:Block chain application development	
Hyperledger fabric- architecture, identities and policies, membership and access control, channels, transaction validation, writing smart contract using Hyperledger fabric, writing smart contract using Ethereum, overview of Ripple and Corda.	**09**

Text(T) / Reference(R) Books:

T1	Block Chain: Blueprint for a new economy, Melanie Swan, O'Reilly, 2015.
T2	Block Chain: The Block Chain for Beginners- Guide to Block Chain Technology and Leveraging Block Chain Programming, Josh Thompsons
R1	Block Chain Basics, Daniel Drescher, Apress; 1st edition, 2017
R2	Block Chain and Crypto Currencies, Anshul Kaushik, Khanna Publishing House, Delhi.
R3	Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained, Imran Bhashir, Packt Publishing.

W1	https://www.edx.org/learn/blockchain
W2	https://www.coursera.org/courses?query=blockchain

Course Outcomes: On completion of this course, students can	
CO1	Understand block chain technology.
CO2	Develop block chain-based solutions
CO3	Write smart contract using Hyperledger Fabric and Ethereum frameworks.
CO4	Build and deploy block chain application for on premise and cloud-based architecture.
CO5	Integrate ideas from various domains and implement them.

QUANTUM COMPUTING			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

- This course teaches the fundamentals of quantum information processing, including quantum computation, quantum cryptography, and quantum information theory.

Unit -1:Introduction to Quantum computing	**Hours**
Motivation for studying Quantum computing,, Mojor players in industry, Origin of Quantum Computing, overview of major concepts in Quantum Computing.	**09**
Unit -2 :Math Foundation for Quantum Computing	
Matrix algebra- Basic vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, dirac notation, Eigen values and Eigen vector	**09**
Unit – 3: Building Blocks for Quantum Program	
Architectures of a Quantum Computing Platform, Details of q-bit system of information representation- Block sphere, Multi-qubits states, Quantum superposition of qubits, Quantum entanglement, Useful states from quantum algorithmic perceptive, Operations on qubits, Quantum Logic gates and circuits, Programming model for a Quantum Computing Program- Steps performed on classical computer, steps performed on Quantum computer, Moving data between bits and qubits.	**10**
Unit – 4: Quantum Algorithms	
Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks	**10**
Unit – 5: Algorithms	
Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm, IBM Quantum Experience, Microsoft Q, Rigetti PyQuil	**10**

Text(T) / Reference(R) Books:

T1	Quantum Computation and Quantum Information, Michael A. Nielsen, Cambridge University Press.
R1	Quantum Computation Explained, David Mc Mahon, Wiley
W1	https://quantumcurriculum.mit.edu/
W2	https://www.coursera.org/courses?query=quantum%20computing

Course Outcomes: On completion of this course, students can

CO1	To explain the working of Quantum computing program.
CO2	To explain architecture and program model.
CO3	Develop Quantum logic gate circuits
CO4	Develop quantum algorithm
CO5	Program Quantum algorithm on major toolkits.

VIRTUAL REALITY			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

The learning objectives of this course are:

1. Understand how the design of VR technology relates to human perception and cognition.
2. Discuss applications of VR to the conduct of scientific research, training, and industrial design.
3. Gain first-hand experience with using virtual environment technology, including 3D rendering software, tracking hardware, and input/output functions for capturing user data.
4. Learn the fundamental aspects of designing and implementing rigorous empirical experiments using VR.
5. Learn about multimodal virtual displays for conveying and presenting information and techniques for evaluating good and bad virtual interfaces.

Unit -1:Virtual reality and Virtual Environment	**Hours**
Introduction, Computer graphics, Real time computer graphics, flight simulation, virtual environment requirement, benefits of virtual reality, historical development of VR, scientific landmark. 3D Commuter Graphics: Introduction, virtual world space, positioning the virtual observer, perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, simple 3D modelling, Illumination models, reflection models, shading algorithms, radiosity, hidden surface removal, realism-stereographic image.	**10**
Unit -2 :Geometric Modelling	
Introduction, from 2D to 3D, 3D space curves, 3D boundary representation. Geometric transformation: Introduction, frames to reference, modelling transformations, instances, picking, flying, scaling the VE, Collision and detection. Generic VR system: Virtual environment, computer environment, VR technology- models of interaction, VR systems.	**10**
Unit – 3:Animating the Virtual Environment	
Introduction, the dynamics of numbers, linear and non-linear and non-linear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system. Physical Simulation: Objects falling in a gravitational field, rotating wheels, elastic collisions, projectiles, simple pendulum, springs, flight dynamics of an aircraft	**09**
Unit – 4:Human Factors	
the eye, the ear, the somatic senses. VR Hardware: Sensor hardware, head-coupled displays, acoustic hardware, integrated VR systems. VR Software: Modelling virtual world, physical simulation, VR toolkits, Introduction to VRML.	**09**
Unit – 5:VR Applications	
Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm, IBM Quantum Experience, Microsoft Q, Rigetti PyQuil	**12**

Text(T) / Reference(R) Books:	
T1	Virtual Reality Systems, John Vince, Pearson Education Asia, 2007.
T2	Augmented and Virtual Reality, Anand R, Khanna Publishing House. Delhi
R1	Visualizations of Virtual Reality, Adams, Tata Mc Graw Hill, 2000
R2	Virtual Reality Technology, Grigore C. Burdea, Philippe Coieffet, Wiley Inter Science, 2nd edition, 2006.
W1	https://www.coursera.org/courses?query=virtual%20reality
W2	https://www.classcentral.com/tag/virtual-reality
Course Outcomes: On completion of this course, students can	
CO1	Understand geometric modelling
CO2	Understand Virtual environment
CO3	Study about Virtual Hardware and Software
CO4	Study about Software needed for developing virtual reality environment.
CO5	Develop Virtual Reality applications.

DATA STRUCTURES THROUGH C			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Operations on linear data structures and their applications.
2. The various operations on linked lists.
3. The basic concepts of Trees, Traversal methods and operations.
4. Concepts of implementing graphs and its relevant algorithms.
5. Sorting and searching algorithms.

Unit -1: INTRODUCTION TO DATA STRUCTURE	**Hours**
Data Management concepts, Data types – primitive and non-primitive, Performance Analysis and Measurement (Time and space analysis of algorithms-Average, best- and worst-case analysis), Types of Data Structures- Linear & Non-Linear Data Structures. Sorting and Searching: Sorting – Bubble Sort, Selection Sort, Quick Sort, Merge Sort Searching – Sequential Search and Binary Search	**10**
Unit -2 :LINEAR DATA STRUCTURE	
Array: Representation of arrays, Applications of arrays, sparse matrix and its representation Stack: Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation, Recursion. Queue: Representation Of Queue, Operations On Queue, Circular Queue, Double Ended Queue, Applications of Queue.	**10**
Unit – 3: LINKED LIST	
Linked List: Singly Linked List, Doubly Linked list, Circular linked list ,Linked implementation of Stack, Linked implementation of Queue, Applications of linked list.	**09**
Unit – 4:NONLINEAR DATA STRUCTURE	
Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Binary search trees, Conversion of General Trees To Binary Trees, Applications of Trees.	**09**
Unit – 5:GRAPH, HASHING AND FILE STRUCTURES	
Graph-Matrix Representation Of Graphs, Elementary Graph operations, (Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree) Hashing: The symbol table, Hashing Functions, Collision Resolution Techniques, File Structure: Concepts of fields, records and files, Sequential, Indexed and Relative/Random File Organization, Indexing structure forindex files, hashing for direct files, Multi-Key file organization and accessmethods.	**10**

Text(T) / Reference(R) Books:	
T1	Data Structures using C -By Reema Thareja - OXFORD Higher Publication
T2	Data Structures using C & C++ -By Ten Baum Publisher – Prenctice-Hall International
R1	Fundamentals of Computer Algorithms by Horowitz, Sahni,Galgotia Pub. 2001 ed
R2	Fundamentals of Data Structures in C++-By Sartaj Sahani.
R3	Data Structures: A Pseudo-code approach with C -By Gilberg & Forouzan Publisher Thomson Learning
W1	https://www.coursera.org/specializations/data-structures-algorithms
W2	https://online-learning.harvard.edu/course/data-structures-and-algorithms

Course Outcomes: On completion of this course, students can	
CO1	Choose appropriate data structure as applied to specified problem definition.
CO2	Handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures
CO3	Apply concepts learned in various domains like DBMS
CO4	Apply concepts learned in various domains like compiler construction
CO5	Use linear and non-linear data structures like stacks, queues , linked list

DESIGNING DATABASE MANAGEMENT SYSTEMS			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

The learning objectives of this course are:

1.To introduce about database management systems

2.To give a good formal foundation on the relational model of data and usage of Relational Algebra

3.To introduce the concepts of basic SQL as a universal Database language

4.To demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization

5. To provide an overview of database transactions and concurrency control.

Unit -1: Database system architecture	**Hours**
Introduction to Databases: Characteristics of the Database Approach, Advantages of using the DBMS Approach, A Brief History of Database Applications. Overview of Database Languages and Architectures: Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Users , Architecture for DBMS.	**10**
Unit -2 : E-R Models	
The E-R Models,TheRelationalModel,IntroductiontoDatabaseDesign,DatabaseDesign and Er Diagrams, Entities Attributes, and Entity Sets, Relationship and Relationship Sets, Conceptual Design with the Er Models, The Relational Model Integrity Constraints Over Relations, Key Constraints, Foreign Key Constraints, General Constraints.	**10**
Unit - 3: Relational Algebra	
Relational Algebra, Selection and Projection, Set Operation, Renaming, Joins, Division, More Examples of Queries, Relational Calculus: Tuple Relational Calculus, Domain Relational Calculus. The Form of Basic SQL Query, Union, Intersect, and Except, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and Active Database.	**10**
Unit - 4: Normalization	
Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form (BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF).	**09**
Unit - 5: Transaction Management	
Transaction, properties of transactions, transaction log, and transaction management with SQL using commit rollback and save point. Concurrency control for lost updates, Uncommitted data, inconsistent retrievals and the Scheduler. Concurrency control with locking methods, lock granularity, lock types, two phase locking for ensuring serializability, deadlocks, Concurrency control with time stamp ordering: Wait/Die and Wound/Wait Schemes, Database Recovery management.	**09**

Text(T) / Reference(R) Books:	
T1	In Introduction to Database Systems, CJDate, Pearson.
T2	Database Management Systems,3rdEdition,Raghurama Krishnan, Johannes Gehrke, TATAMcGrawHill.
T3	Database Systems-TheCompleteBook,H GMolina,J DUllman,J WidomPearson.
T4	Database Management Systems,6/e Ramez Elmasri, Shamkant B. Navathe, PEA
R1	DatabaseSystemsdesign,Implementation,andManagement,7thEdition,PeterRob&CarlosCoronel
R2	Database System Concepts, 5th edition, Silberschatz, Korth, TMH
R3	The Database Book Principles & Practice Using Oracle/MySQL, Narain Gehani, University Press.
W1	https://onlinecourses.nptel.ac.in/noc18_cs15/preview
W2	https://www.coursera.org/courses?query=database

Course Outcomes: On completion of this course, students can	
CO1	Understand the basic elements of a relational database management system.
CO2	Draw entity relationship and convert entity relationship diagrams into RDBMS.
CO3	Create, maintain, and manipulate a relational database using SQL.
CO4	Designs and applies normalization techniques for logical schema model.
CO5	Solves concurrent issues and problems through locking mechanism.

OPERATING SYSTEMS CONCEPTS			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

The learning objectives of this course are:

1. Introduce the basic concepts of operating systems, its functions and services.
2. To provide the basic concepts of process management and synchronization.
3. Familiarize with deadlock issues.
4. Understand the various memory management skills.
5. Give exposure over I/O systems and mass storage structures.

Unit -1: Operating Systems Overview	**Hours**
Computer system organization, Operating system structure, Process, memory, storage management, Protection and security, Distributed systems, Computing Environments, Open-source operating systems, OS services, User operating-system interface.	**09**
Unit -2 :System Calls & IPC	
System calls, Types, System programs, OS structure, OS generation, System Boot Process concept, scheduling (Operations on processes, Cooperating processes, Inter-process communication), Multi-threading models	**09**
Unit - 3: Process Management	
Basic concepts, Scheduling criteria, Scheduling algorithms, Thread scheduling, Multiple processor scheduling Operating system, Algorithm Evaluation, The critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Critical regions, Monitors.	**10**
Unit - 4:Memory Management & Dead lock	
System model, Deadlock characterization, Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock detection, Recovery from deadlock. Storage Management: Swapping, Contiguous memory allocation, Paging, Segmentation Virtual Memory Background, Demand paging, copy on write, Page replacement and various Page replacement algorithms, Allocation of frames, Thrashing.	**10**
Unit - 5:I/O Systems	
File concept, Access methods, Directory structure, Filesystem mounting, Protection, Directory implementation, Allocation methods, Free-space management, Disk scheduling, Disk management, Swap-space management, Protection.	**10**

Text(T) / Reference(R) Books:

T1	Operating System Concepts Essentials, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, John Wiley & Sons Inc., 2010.
T2	Operating System Concepts, 9th Edition, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, John Wiley and Sons Inc., 2012
T3	Operating Systems, Second Edition, S Halder, Alex A Aravind, Pearson Education, 2016
T4	Operating Systems – Internals and Design Principles, 7th Edition, William Stallings, Prentice Hall, 2011
R1	Modern Operating Systems, Second Edition, Andrew S. Tanenbaum, Addison Wesley, 2001.
R2	Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata McGraw Hill Education, 1996.
R3	Operating Systems: A Concept-based Approach, Second Edition, D M Dhamdhere, Tata McGraw-Hill Education, 2007

R4	Operating Systems: Internals and Design Principles, Seventh Edition, William Stallings, Prentice Hall, 2011
W1	https://www.coursera.org/courses?query=operating%20system
W2	https://onlinecourses.nptel.ac.in/noc16_cs10/preview

Course Outcomes: On completion of this course, students can	
CO1	Demonstrate knowledge on Computer System organization and Operating system services.
CO2	Design solutions for process synchronization problems by using System calls and Inter process communication.
CO3	Identify the functionality involved in process management concepts like scheduling and synchronization.
CO4	Design models for handling deadlock and perform memory management.
CO5	Analyze services of I/O subsystems and mechanisms of security & protection.

R PROGRAMMING			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:
The learning objectives of this course are:

1. Use R for statistical programming, computation, graphics, and modeling.
2. Write functions and use R in an efficient way.
3. Fit some basic types of statistical models.
4. Use R in their own research.
5. Be able to expand their knowledge of R on their own.

Unit -1: Introduction	**Hours**
How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes**.**	**09**
Unit -2 :	
R Programming Structures, Control Statements, Loops,-Looping Over Nonvector Sets,-If-Else,Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation-Extended Extended Example: A Binary Search Tree.	**10**
Unit – 3: Math and Simulation in R	
Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability- Cumulative Sums and Products-Minima and Maxima- Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product- Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /out put, Accessing the Keyboard and Monitor, Reading and writer Files	**10**
Unit – 4: Graphics	
Creating Graphs, The Workhorse of R Base Graphics, the plot() Function – Customizing Graphs, Saving Graphs to Files, Probability Distributions, Normal Distribution- Binomial Distribution- Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests,-ANOVA.	**10**
Unit – 5: Linear Models	
Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models-Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests	**09**

Text(T) / Reference(R) Books:	
T1	The Art of R Programming, Norman Matloff, Cengage Learning
T2	R for Everyone, Lander, Pearson
R1	R Cookbook, PaulTeetor, Oreilly
R2	R in Action, Rob Kabacoff, Manning
W1	https://www.edx.org/learn/r-programming
W2	https://www.coursera.org/learn/r-programming
Course Outcomes: On completion of this course, students can	
CO1	List motivation for learning a programming language
CO2	Access online resources for R and import new function packages into the R workspace
CO3	Import, review, manipulate and summarize data-sets in R
CO4	Explore data-sets to create testable hypotheses and identify appropriate statistical tests
CO5	Perform appropriate statistical tests using R Create and edit visualizations

PYTHON PROGRAMMING			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Introduction to Scripting Language.
2. Exposure to various problems solving approaches of computer science.

Unit -1: Introduction	**Hours**
History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation	**09**
Unit -2 : Types, Operators and Expressions	
Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass. Data Structures Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions.	**10**
Unit – 3: Functions	
Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions(Function Returning Values), Scope of the Variables in a Function - Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages	**10**
Unit – 4: Object Oriented Programming in Python	
Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions	**10**
Unit – 5: Brief Tour of the Standard Library	
Operating System Interface - String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing:Why testing is required?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.	**09**

Text(T) / Reference(R) Books:	
T1	Python Programming: A Modern Approach, Vamsi Kurama, Pearson
T2	Learning Python, Mark Lutz, Orielly
R1	Think Python, Allen Downey, Green Tea Press
R2	Core Python Programming, W.Chun, Pearson
R3	Introduction to Python, Kenneth A. Lambert, Cengage
W1	https://www.coursera.org/courses?query=python
W2	https://www.edx.org/learn/python
Course Outcomes: On completion of this course, students can	
CO1	Making Software easily right out of the box
CO2	Experience with an interpreted Language
CO3	To build software for real needs.
CO4	Prior Introduction to testing software
CO5	Experience with implementation in current technologies

JAVA PROGRAMMING			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

The learning objectives of this course are:

1. Understanding the OOP's concepts, classes and objects, threads, files, applets, swings and act.

2. This course introduces computer programming using the JAVA programming language with object-oriented programming principles.

3. Emphasis is placed on event-driven programming methods, including creating and manipulating objects, classes, and using Java for network level programming and middleware development.

Unit -1: Introduction to OOP	**Hours**
procedural programming language and object-oriented language, principles of OOP, applications of OOP, history of java, java features, JVM, program structure. Variables, primitive data types, identifiers, literals, operators, expressions, precedence rules and associativity, primitive type conversion and casting, flow of control.	**10**
Unit -2 :Classes and objects	
Classes and objects, class declaration, creating objects, methods, constructors and constructor overloading, garbage collector, importance of static keyword and examples, this keyword, arrays, command line arguments, nested classes.	**09**
Unit – 3:Inheritance	
Inheritance, types of inheritance, super keyword, final keyword, overriding and abstract class. Interfaces, creating the packages, using packages, importance of CLASSPATH and java.lang package. Exception handling, importance of try, catch, throw, throws and finally block, userdefined exceptions, Assertions	**10**
Unit – 4:Multithreading	
Introduction, thread life cycle, creation of threads, thread priorities, thread synchronization, communication between threads. Reading data from files and writing data to files, random access file.	**09**
Unit – 5:Applet	
Applet class, Applet structure, Applet life cycle, sample Applet programs. Event handling: event delegation model, sources of event, Event Listeners, adapter classes, inner classes. AWT: introduction, components and containers, Button, Label, Checkbox, Radio Buttons, List Boxes, Choice Boxes, Container class, Layouts, Menu and Scrollbar.	**10**

Text(T) / Reference(R) Books:

T1	The complete Reference Java, 8th edition, Herbert Schildt, TMH
T2	Programming in JAVA, Sachin Malhotra, SaurabhChoudary, Oxford
R1	Introduction to java programming, 7th edition by Y Daniel Liang, Pearson
W1	https://www.coursera.org/courses?query=java
W2	https://www.udemy.com/java-tutorial/

Course Outcomes: On completion of this course, students can	
CO1	Understand Java programming concepts and utilize Java Graphical User Interface in Program writing.
CO2	Write, compile, execute and troubleshoot Java programming for networking concepts.
CO3	Build Java Application for distributed environment.
CO4	Design and Develop multi-tier applications.
CO5	Identify and Analyze Enterprise applications.

APP TECHNOLOGIES			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

- To provide in depth knowledge and hands on experience in application development, the latest trends and features.

Unit -1: Android Programming Environment	**Hours**
Android programming environment, linking activities using intents, calling built-in applications using intents.	**09**
Unit -2:User Interface	
Creating the user interface programmatically, Listening for UI notifications, build basic views, build picker views, build list views, Using image views, Using menus with views, Saving and loading user preferences	**10**
Unit – 3:Data	
Persisting data to files, Creating and using databases, Study Session, sharing data in android, Using a content provider, Creating a content provider	**10**
Unit – 4: Networking	
SMS messaging, sending emails, Networking, displaying maps, Getting location data	**10**
Unit – 5: Services	
Creating your own services, communicating between a service and an Activity, Binding Activities to Services, A complete lab work for Android service development, Deploy APK files.	**09**

Text(T) / Reference(R) Books:

T1	Beginning Android Application Development, Wei-Meng Lee, 1st Ed, Wiley Publishing.
T2	Android: A Programmers Guide, J. F. DiMarzio, McGraw Hill Education (India) Private Limited.1st Edition.
R1	Android for Programmers: An App-Driven Approach, Paul Deitel, 1st Edition, Pearson India
R2	Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India Pvt Ltd
W1	https://www.coursera.org/browse/computer-science/mobile-and-web-development
W2	https://in.udacity.com/course/new-android-fundamentals--ud851

Course Outcomes: On completion of this course, students can

CO1	Demonstrate their understanding of the fundamentals of Android operating systems
CO2	Demonstrate their skills of using Android software development tools
CO3	Demonstrate their ability to develop software with reasonable complexity on mobile platform
CO4	Demonstrate their ability to deploy software to mobile devices
CO5	Demonstrate their ability to debug programs running on mobile devices

WEB TECHNOLOGIES			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

- This course is designed to introduce students with no programming experience to the programming languages and techniques associated with the World Wide Web. The course will introduce web-based media-rich programming tools for creating interactive web pages.

Unit-1: HTML	**Hours**
HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Html styles, Elements, Attributes, Heading, Layouts, Html media, Iframes Images, Hypertext Links, Lists, Tables, Forms, GET and POST method, HTML 5, Dynamic HTML. **CSS:** Cascading style sheets, Levels of Style Sheets, Style Specification Formats, Selector Forms, The Box Model, Conflict Resolution, CSS3.	**10**
Unit -2: JSON	
Introduction to JSON: JSON, Syntax, Data Types, Schema, Security Concerns, JSON Vs XML, the JavaScript XML Http Request and Web APIs, JSON and Client-Side Frameworks, JSON and NoSQL, JSON on the server side.	**09**
Unit –3: YAML	
Introduction to YAML: YAML, Syntax, Structure, indentation in YAML documents, YAML vs JSON and XML, data types, Using advanced features like anchors in a YAML.	**9**
Unit -4: PHP	
PHP Programming: Introduction to PHP, Creating PHP script, Running PHP script. **Working with variables and constants:** Using variables, Using constants, Data types, Operators. **Controlling program flow:** Conditional statements, Control statements, Arrays, functions.	**10**
Unit – 5: Laravel	
Introduction to Laravel, Features, routing, controllers, views, Blade template, migration, Laravel Database.	**10**

Text(T) / Reference(R) Books:	
T1	Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013
T2	Web Technologies, 1st Edition 7th impression, Uttam K Roy, Oxford, 2012.
T3	Introduction to JavaScript by Lindsay Bassett, 2015.
T4	Introduction to YAML: Demystifying YAML Data Serialization Format by Tarun Telang
T5	Full-Stack Vue.Js 2 and Laravel 5: Bring the frontend and backend together with Vue, Vuex, and Laravel
R1	Programming world wide web, Sebesta, Pearson
R2	An Introduction to web Design and Programming, Wang, Thomson
W1	https://www.edx.org/learn/web-development
W2	https://www.javatpoint.com/what-is-json
W3	https://www.javatpoint.com/yaml-scalars
W4	https://www.javatpoint.com/laravel-blade-template

Course Outcomes: On completion of this course, students can	
CO1	To develop a dynamic webpage by the use of HTML
CO2	To develop a dynamic webpage by the use of CSS
CO3	To develop a dynamic webpage by the use of JSON
CO4	To develop a dynamic webpage by the use of YML
CO5	Build web applications using PHP
CO6	To develop a dynamic webpage by the use of Laravel

ARTIFICIAL INTELLIGENCE			
Subject Code	18XXCSOXXXX	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

The learning objectives of this course are:

1. To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language
2. To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AI programs
3. To have a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, and planning.

Unit -1: Introduction to artificial intelligence	**Hours**
Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI.	**09**
Unit -2 : Problem solving: state-space search and control strategies	
Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative deepening a*, constraint satisfaction.	**10**
Unit – 3:Problem reduction, Game playing	
Problem Reduction: Introduction, Problem reduction using AO* algorithm, Towers of Hanoi problem, Matrix Multiplication problem game playing, alpha-beta pruning, two-player perfect information games.	**10**
Unit – 4: Logic Concepts & Knowledge Representation Techniques	
Logic Concepts: Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic. Introduction to KR techniques, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.	**10**
Unit – 5: Expert systems and its applications	
Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems, blackboard systems, truth maintenance systems, application of expert systems, list of shells and tools.	**09**

Text(T) / Reference(R) Books:

T1	Artificial Intelligence- Saroj Kaushik, CENGAGE Learning
T2	Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, PEA
T3	Artificial Intelligence- Rich, Kevin Knight, Shiv Shankar B Nair, 3rded, TMH
T4	Introduction to Artificial Intelligence, Patterson, PHI
R1	Artificial intelligence, structures and Strategies for Complex problem solving, -George F Lugar, 5thed, PEA
R2	Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer
R3	Artificial Intelligence, A new Synthesis, Nils J Nilsson, Elsevier
R4	AI: A Modern Approach, Stuart Russell and Peter Norvig, Additional Readings: Marr, Bishop, occasionally others

W1	https://www.edx.org/learn/artificial-intelligence
W2	https://www.coursera.org/courses?query=artificial%20intelligence
Course Outcomes: On completion of this course, students can	
CO1	To introduce basic concepts of AI with its working principles.
CO2	To understand different kinds of heuristic search algorithms to get feasible solution for AI problems.
CO3	To understand problem reduction concepts using various problem reduction techniques. (Ex: Problem reduction using AO* algorithm, Towers of Hanoi problem, Matrix Multiplication problem)
CO4	To understand various Knowledge Representation (KR) techniques
CO5	To understand different kinds of Expert Systems.

Open Elective
Courses Offered by ECE
To other Departments

Open Electives Courses Offered by the ECE to other Departments

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	18XXECOX0XA	VLSI Design	3	0	0	3
2	18XXECOX0XB	HDL Programming for IC Design	3	0	0	3
3	18XXECOX0XC	Principles of Communication Systems	3	0	0	3
4	18XXECOX0XD	Transducers and Sensors	3	0	0	3
5	18XXECOX0XE	Fundamentals of Microprocessors and Microcontrollers	3	0	0	3
6	18XXECOX0XF	Fundaments of Internet of Things	3	0	0	3
7	18XXECOX0XG	Fundamentals of Digital Image Processing	3	0	0	3
8	18XXECOX0XH	Signals and Systems	3	0	0	3

VLSI DESIGN
(Open Elective)

Subject Code	18XXECOX0XA	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to

1. To learn about various fabrication steps of IC and electrical properties of MOSFET.
2. To learn about specific rules to draw the stick diagrams and Layouts.
3. To analyze circuit concepts and to apply Scaling factors for Device parameters.
4. To learn concept of chip I/O and techniques of testability.
5. To learn about different FPGA designs and implementation

Unit -1	**Hours**
Introduction and Basic Electrical Properties of MOS Circuits: Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS. Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms of pull-up, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology.	10
Unit -2	
MOS and Bi-CMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout, General observations on the Design rules, 2µm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2µm Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter, Symbolic Diagrams Translation to Mask Form.	10
Unit -3	
Basic Circuit Concepts: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, some area Capacitance Calculations, The Delay Unit, Inverter Delays, driving large capacitive loads, Propagation Delays, Wiring Capacitances, Choice of layers. **Scaling of MOS Circuits:** Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, Limits due to sub threshold currents, Limits on logic levels and supply voltage due to noise and current density. Switch logic, Gate logic.	10
Unit – 4	
Chip Input and Output circuits: ESD Protection, Input Circuits, Output Circuits and L(di/dt) Noise, On-Chip Clock Generation and Distribution. **Design for Testability:** Fault types and Models, Controllability and Observability, Ad Hoc Testable Design Techniques, Scan Based Techniques and Built-In Self-Test techniques.	10
Unit – 5	
FPGA Design: FPGA design flow, Basic FPGA architecture, FPGA Technologies, FPGA families- Altera Flex 8000FPGA, Altera Flex 10FPGA, Xilinx XC4000 series FPGA, Xilinx Spartan XL FPGA, Xilinx Spartan II FPGAs, Xilinx Vertex FPGA.	8
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Elaborate the fabrication steps of IC and electrical properties of MOSFET.
2. Justify the concepts of design rules during the layout of a circuit.
3. Apply the circuit concepts and scaling factors for device parameters.
4. Analyze the concepts of chip I/O and techniques of testability.
5. Examine commercial architectures of FPGA.

Text Books:

1. Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Essentials of VLSI Circuits and Systems, Prentice-Hall of India Private Limited,2005 Edition.
2. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, Tata McGrawHill Education, 2003.

Reference Books:

1. Michael D. Ciletti, Advanced Digital Design with the Verilog HDL, Xilinx Design Series, Pearson Education
2. Analysis and Design of Digital Integrated Circuits in Deep Submicron Technology, 3rd edition, David Hodges.
3. A. Shanthi and A. Kavita, VLSI Design, New Age International Private Limited, 2006 First Edition.

HDL PROGRAMMING FOR IC DESIGN
(Open Elective)

Subject Code	18XXECOX0XB	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to

1. Learn different Verilog programming constructs.
2. Familiarize the different levels of abstraction in Verilog HDL.
3. Construct digital circuits and corresponding RTL modeling using different styles along with test bench based verification.
4. Understand Verilog Tasks, Functions and Directives.
5. Understand timing and delay simulation.

Unit -1	**Hours**
Introduction to Verilog HDL: Verilog as HDL, Typical HDL flow, Top-Down and Bottom-up design methodology. Levels of Design Description, Simulation and Synthesis, Function Verification, Module definition. Difference between module and module instances.	10
Unit -2	
Language Constructs and Conventions: Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators.	10
Unit -3	
Gate Level Modeling: Modeling using basic Verilog gate primitives, Array of Instances of Primitives, Design of Flip-Flops with Gate Primitives, Delay, Strengths and Construction Resolution **Modeling at Dataflow Level**: Continuous Assignment Structure, delay specification, expressions, vectors, operators, operands, operator types	10
Unit – 4	
Behavioral Level Modeling: Structured procedures, Initial and Always statements, blocking and non-blocking statements, delay control, generate statement, conditional statement, multiway branching, loops, sequential and parallel blocks.	10
Unit – 5	
Switch Level Modeling: Basic transistor switches, CMOS Switches, bi-directional gates, time delays with switch primitives **Tasks and Functions:** Difference between tasks and functions, declaration, invocation, automatic tasks and functions.	8
Total	**48**

Course outcomes:
On completion of the course student will be able to

1. Demonstrate knowledge on HDL design flow and identify the suitable abstraction level of a particular design
2. Memorizing the constructs and conventions used for Verilog programming
3. Design and develop the combinational and sequential circuits using dataflow modeling
4. Implement sequential logic circuits using behavioral modeling
5. Writing the programs more effectively using tasks and functions

Text Books:

1. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis”, Pearson Education, Second Edition
2. T.R.Padmanabhan, B Bala Tripura Sundari, “Design Through Verilog HDL”, Wiley 2009

Reference Books:

1. Michael D Ciletti, “Advanced Digital Design with the Verilog HDL”, Xilinx Design Series, PearsonEducation.
2. Stephen Brown, Zvonkoc Vranesic, “Fundamentals of Digital Logic with Verilog Design”, TMH, 2nd Edition.
3. Donald E. Thomas, Philip R. Moorby, “The Verilog Hardware Description Language”, Springer Science + Business Media, LLC, Fifth edition

PRINCIPLES OF COMMUNICATION SYSTEMS
(Open Elective)

Subject Code	18XXECOX0XC	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to

1. Analyze the performance of angle modulated signals.
2. Characterize analog signals in time domain as random processes and noise
3. Characterize the influence of channel on analog modulated signals
4. Determine the performance of analog communication systems in terms of SNR
5. Understand the concepts of noise and signal.

Unit -1	**Hours**
Amplitude modulation: Introduction, Amplitude Modulation: Time & Frequency – Domain description, switching modulator, Envelop detector. **Double side band-suppressed carrier modulation:** Time and Frequency – Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing. **Single side and vestigial side band methods of modulation**: SSB Modulation, VSB Modulation, Frequency Translation, Frequency-Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television	10
Unit -2	
Angle modulation: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, **Phase–Locked Loop:** Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM Systems. The Super-heterodyne Receiver	10
Unit -3	
Random variables & process: Introduction, Probability, Conditional Probability, Random variables, Several Random Variables. Statistical Averages: Function of a random variable, Moments, Random Processes, Mean, Correlation and Covariance function: Properties of autocorrelation function, Cross–correlation functions. **Noise:** ShotNoise,Thermalnoise,WhiteNoise,NoiseEquivalentBandwidth,NoiseFigure	10
Unit – 4	
Noise in analog modulation: Introduction, Receiver Model, Noise in DSB-SC receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM.	10
Unit – 5	
Digital representation of an analog signals: Introduction, Why Digitize Analog Sources? The Sampling process, Pulse Amplitude Modulation, Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves, The Quantization Process, Quantization Noise, **Pulse Code Modulation:** Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing	8
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Analyze the performance of analog modulation schemes in time and frequency domains.
2. Analyze the performance of angle modulated signals.
3. Characterize analog signals in time domain as random processes and noise
4. Characterize the influence of channel on analog modulated signals
5. Determine the performance of analog communication systems in terms of SNR

Text Books:

1. H Taub& D. Schilling, Gautam Sahe, Principles of Communication Systems –TMH, 2007, 3rd Edition.
2. B.P. Lathi, Communication Systems–BSPublication,20062.
3. Simon Haykin, Principles of Communication Systems –John Wiley, 2 nd Edition

Reference Books:

1. George Kennedy and Bernard Davis, Electronics & Communication System –TMH 2004.
2. R.P. Singh, SPSapre, Communication Systems–SecondEditionTMH,2007

TRANSDUCERS AND SENSORS
(Open Elective)

Subject Code	18XXECOX0XD	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to

1. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
2. Predict correctly the expected performance of various sensors
3. Locate different type of sensors used in real life applications and paraphrase their importance
4. Understand and analyze the characteristics of temperature sensors
5. Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers

Unit -1	**Hours**
Introduction: functional elements of an instrument, generalized performance characteristics of instruments – static characteristics, dynamic characteristics. Zero order, first order, second order instruments – step response, ramp response and impulse response. Response of general form of instruments to periodic input and to transient input Experimental determination of measurement system parameters, loading effects under dynamic conditions	10
Unit -2	
Transducers for motion and dimensional measurements: Relative displacement, translation and rotational resistive potentiometers, resistance strain gauges, LVDT, synchros, capacitance pickups, Piezo-electric transducers, electro-optical devices, nozzle – flapper transducers, digital displacement transducers, ultrasonic transducers. Magnetic and photoelectric pulse counting methods, relative acceleration measurements, seismic acceleration pickups, calibration of vibration pickups. Gyroscopic sensors	10
Unit -3	
TRANSDUCERS FOR FORCE MEASUREMENT: Bonded strain guage transducers, Photo-electric transducers, variable reluctance pickup, torque measurement dynamometers. **TRANSDUCERS FOR FLOW MEASUREMENT**: Hot wire and hot-film anemometers, Electro-magnetic flow meters, laser Doppler velocity meter TRANSDUCERS FOR PRESSURE MEASUREMENT: Manometers, elastic transducers, liquid systems, gas systems, very high pressure transducers. Thermal conductivity gauges, ionization gauges, microphone	10
Unit – 4	
TRANSDUCERS FOR TEMPERATURE MEASUREMENT: Thermal expansion methods, Thermometers (liquid in glass), pressure thermometers, Thermocouples, Materials configuration and techniques. Resistance thermometers, Thermistors, junction semiconductors, Sensors, Radiation methods, Optical pyrometers, Dynamic response of temperature sensors heat flux Sensors, Transducers for liquid level measurement, humidity, silicon and quartz sensors, fiber optic sensors.	10
Unit – 5	
Smart sensors: Introduction, primary sensors, converters, compensation. Recent trends in sensor technology – film sensors, semiconductor IC technology, MEMS, Nano-sensors	8
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Use concepts in common methods for converting a physical parameter into an electrical quantity
2. Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light
3. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
4. Predict correctly the expected performance of various sensors knowledge outside the classroom through design of a real-life instrumentation system
5. Locate different type of sensors used in real life applications and paraphrase their importance

Text Books:

1. Sensors and Transducers Hardcover – Import, 5 December 2000by Ian Sinclai , newness publication.
2. Sensors and Transducers , Author, Department of Cybernetics, University of Reading, UK , M. J. Usher, 1985, Springer

Reference Books:

1. Doebelin, E.O., "Measurement systems – Application and Design", McGraw Hill.
2. D. Patranabis, "Sensors and Transducers", PHI, 2nd Edition.

FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS
(Open Elective)

Subject Code	18XXECOX0XE	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to

1. To Learn the architecture of microprocessor and microcontroller.
2. To know the programming of 8086
3. To understand the interfacing of the processors
4. To know Memory System and I/O Organization and its applications.
5. To develop Microcontroller programming for various applications

Unit -1	**Hours**
8085 PROCESSOR Hardware Architecture, pinouts — Functional Building Blocks of Processor — Memory organization — I/O ports and data transfer concepts, Interrupts. 8086 Architecture: Main features, pin diagram/description, 8086 microprocessor family, internal architecture, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.	10
Unit -2	
8086 Programming: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.	10
Unit -3	
8086 Interfacing: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.	10
Unit – 4	
8051 MICRO CONTROLLER Hardware Architecture, pinouts — Functional Building Blocks of Processor — Memory organization — I/O ports and data transfer concepts– Timing Diagram — Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.	10
Unit – 5	
MICRO CONTROLLER PROGRAMMING & APPLICATIONS Simple programming exercises- key board and display interface –Control of servo motor stepper motor control- Application to automation systems.	8
Total	**48**

Course outcomes:
On completion of the course student will be able to

1. Understand the architecture of microprocessor and their operation.
2. Demonstrate programming skills in assembly language for processors and controllers.
3. Analyze various interfacing techniques and apply them for the design of processor/Controller based systems.
4. Understand 8051 architecture.
5. Analyze Microcontroller programming & applications

Text Books:

1. R.S. Gaonkar, Microprocessor Architecture Programming and Application, with 8085, Wiley Eastern Ltd., New Delhi, 2013.

2. A.K Ray, K.M. Bhurchandhi," Advanced Microprocessor and Peripherals", Tata McGraw Hill Publications, 2000.

3. The 8051 Microcontrollers and Embedded systems Using Assembly and C, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D.McKinlay; Pearson 2-Edition, 2011

Reference Books:

1. Douglas V Hall, SSSP Rao, Microprocessors and Interfacing – Programming and Hardware, Tata Mc Graw Hill Education Private Limited,3rdEdition,1994

FUNDAMENTALS OF INTERNET OF THINGS
(Open Elective)

Subject Code	18XXECOX0XF	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to

1. To introduce IoT Fundamentals
2. To know about the IoT Characteristics.
3. To give the understanding of IoT Architecture overview
4. To understand the concepts of IoT Reference Architecture.
5. To know different case studies of IoT.

Unit -1	**Hours**
Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models &APis.	10
Unit -2	
M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT.	10
Unit -3	
M2M vs loT An Architectural Overview-Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT.	10
Unit – 4	
IoT Reference Architecture-Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world-Introduction, Technical design Constraints.	10
Unit – 5	
Developing IoT solutions: Introduction to Python, Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi, Introduction to Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT. Case Studies: Home Automation, Smart Health care.	8
Total	**48**

Course outcomes:
On completion of the course student will be able to

1. Understand general concepts of Internet of Things (IoT)
2. Understand general concepts of M2M
3. Know the design principals of IoT
4. Recognize the various architectural view IoT
5. Apply the different applications of IoT

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-onApproach)", 1st Edition,VPT,2014
2. JanHoller, Vlasios Tsiatsis, Catherine Mulligan,StefanAvesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of intelligence",1stEdition,AcademicPress,2014.

Reference Books:

1. Francisda Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",1st Edition, A press Publications,2013
2. CunoPfister, Getting Started with the Internet of Things, O"ReillyMedia, 2011,ISBN:978-1-4493-9357-1

FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING
(Open Elective)

Subject Code	18XXECOX0XG	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to

1. Know digital signal processing concepts
2. Find the DFT of the given Discrete Time Sequences
3. Impose FFT concept for solving the DFT of a sequence
4. Design Digital filters for the given specifications
5. Know the concepts on Digital Signal Processors

Unit -1	**Hours**
Introduction: Introduction to Digital Signal Processing: Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems, Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems.	10
Unit -2	
Discrete Fourier Transforms: Introduction, Discrete Fourier transforms of standard signals, Properties of DFT, Linear filtering methods based on DFT.	10
Unit -3	
Fast Fourier transforms (FFT): Introduction, Radix-2 decimation in time FFT Algorithm (DIT-FFT), Radix-2 decimation in frequency FFT Algorithm (DIF-FFT), Inverse FFT.	10
Unit – 4	
Design of IIR Digital Filters: Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. **Design of FIR Digital Filters:** Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Window Techniques, Comparison of IIR & FIR filters	10
Unit – 5	
DSP Processors: Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs, Multiple Access Memory, Multi-ported memory, VLIW architecture, Pipelining, Special addressing modes, On-Chip Peripherals.	8
Total	**48**

Course outcomes:
On completion of the course student will be able to

1. Interpret digital signal processing concepts and solve difference equations for analyzing Discrete Time Systems
2. Apply DFT for Discrete Time Sequences
3. Construct FFT algorithm for solving the DFT of a sequence
4. Construct Digital filters for the given specifications
5. Apply the signal processing concepts on Digital Signal Processors.

Text Books:

1. John G. Proakis, Dimitris G.Manolakis, “Digital Signal Processing, Principles, Algorithms, and Applications”,Pearson Education / PHI, 2007.
2. A Anand Kumar, “Digital Signal Processing”, 2nd Edition, PHI Publications
3. B.Venkataramani, M.Bhaskar, “ Digital Signal Processors, Architecture, Programming and Applications”, TATA McGraw Hill, 2002

1. Andreas Antoniou, **“**Digital Signal Processing”, TATA McGraw Hill , 2006
2. Robert J. Schilling, Sandra L. Harris, “Fundamentals of Digital Signal Processing using Matlab”,Thomson, 2007.

SIGNALS AND SYSTEMS
(Open Elective)

Subject Code	18XXECOX0XH	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to

1. Learn various signals, systems both in continuous time and discrete time.
2. Know the Fourier analysis of continuous-time periodic signals and finite energy signals.
3. Perform signal conversion by applying sampling theorem.
4. Make use of applying various signal and system properties to LTI systems
5. Extend the transform analysis to discrete time sequences

Unit -1	**Hours**
Introduction to Signals and Systems: Definition of Signals and Systems, Singularity functions and related functions. Complex exponential and sinusoidal signals. Classification of Signals, Operations on signals. Classification of Systems.	8
Unit -2	
Fourier Series: Fourier series representation of continuous time periodic signals, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series. **Fourier Transform:** Fourier transform of arbitrary signal, Fourier transform of standard signals, properties of Fourier transforms.	10
Unit -3	
Sampling Theorem: Representation of a CT signal by its samples: The Sampling theorem, impulse sampling, Natural and Flat-top Sampling, Reconstruction of signal from its samples, effect of under sampling–Aliasing. Review of Laplace Transforms, Properties, Inverse Laplace Transform, Relation between L.T and F.T of a signal.	10
Unit – 4	
Analysis of Linear Systems: Linear Time Invariant systems, impulse response, Response of a linear system, Transfer function of a LTI system, Concept of convolution and graphical representation of convolution. Cross-correlation and auto-correlation of signals, Relation between convolution and correlation.	10
Unit – 5	
Z–Transforms: Concept of Z- Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms. Region of convergence, constraints on ROC for various classes of signals, Properties of Z-transforms, Inverse Z-transform. **Applications of signals and Systems:** Modulation for communication, Filtering of signals and Feedback control systems.	10
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Understand various signals and systems and demonstrate their properties.
2. Develop Fourier analysis of continuous-time periodic signals and continuous-time finite energy signals.
3. Apply sampling theorem for signal conversion from continuous- time signals to discrete-time.
4. Illustrate various operations on LTI systems.
5. Apply z-transform to analyze discrete-time signals.

Text Books:

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals and Systems", 2nd Edition, PHI, 2009.
2. A Anand Kumar, " Signals and Systems", PHI Publications.

Reference Books

1. B.P. Lathi, "Signal Processing & Linear Systems", 1st Edition, Oxford University Press, 2006
2. Simon Haykin and Van Veen, "Signals & Systems", 2nd Edition, John Wiley India, 2011.

Open Elective
Courses Offered by ECT to other Departments

Open Elective Courses offered by ECT Department

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	18XXETOXXXX	Signals and Systems	3	0	0	3
2	18XXETOXXXX	Principles of Signal Processing	3	0	0	3
3	18XXETOXXXX	Consumer Electronics	3	0	0	3
4	18XXETOXXXX	Transducers and Sensors	3	0	0	3
5	18XXETOXXXX	IOT and Applications	3	0	0	3
6	18XXETOXXXX	IC Applications	3	0	0	3
7	18XXETOXXXX	Principles of Communications	3	0	0	3
8	18XXETOXXXX	Data Communications	3	0	0	3
9	18XXETOXXXX	Digital Logic design	3	0	0	3
10	18XXETOXXXX	Remote Sensing and GIS	3	0	0	3

SIGNALS AND SYSTEMS (Open Elective)			
Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Engineering Mathematics	Credits – 03	

Course Objectives:

This course will enable students to

1. Understand signals and systems classification
2. Explain convolution and representations of Systems
3. Understand frequency domain representation of systems
4. Explain the applications of Fourier representation

Unit -1	**Hours**
Introduction: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as Interconnections of operations, properties of systems	10
Unit -2	
Time-domain representations for LTI systems: Convolution, impulse response representation, Convolution Sum and Convolution Integral. Properties of impulse response representation, Differential and difference equation Representations, Block diagram representations.	10
Unit -3	
Frequency-domain representation for signals: Introduction, Discrete-time and continuous time Fourier series (derivation of series excluded) and their properties. **Discrete-time and continuous-time** Fourier transforms (derivations of transforms are excluded) and their properties.	10
Unit – 4	
Applications of Fourier representations: Introduction, Frequency response of LTI systems, Fourier transform representation of periodic signals, Fourier transform representation of discrete time signals.	9
Unit – 5	
LAPLACE & Z-TRANSFORMS: Introduction, Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Inverse Laplace transform, Relation between L.T's, and F.T. of a signal. Z-Transforms: Introduction, Z-transform, properties of ROC, properties of Z – transforms, inversion Z-transforms. Z-Transform analysis of LTI Systems, unilateral Z-Transform and its application to solve difference equations	9

Course outcomes: Students will be able to

1. Understand signal and its basic operations
2. Understand linear time invariant systems.
3. Apply the concepts of Fourier series representations to analyze continuous and discrete time periodic signals.
4. Understand and apply the continuous time Fourier transform, discrete time Fourier transform,
5. Apply the concepts of Laplace transform, and z-Transform to the analysis and description of LTI continuous and discrete-time systems

Text Books:

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals and Systems", Pearson, 2 nd Edn.G. Streetman and S. K. Banerjee, "Solid State Electronic Devices", 2nd edition, Pearson, 2014.
2. B. P. Lathi, "Linear Systems and Signals", Second Edition, Oxford University Press
3. Simon Haykin and Van Veen, "Signals & Systems", Wiley, 2nd Edition.

Reference Books:

1. Michel J. Robert, “Fundamentals of Signals and Systems”, MGH International Edition, 2008.
2. Ramakrishna Rao,“Signals and Systems”, 2008, TMH

PRINCIPLES OF SIGNAL PROCESSING
(Open Elective)

Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Signals and Systems	Credits – 03	

Course Objectives:

This course will enable students to

1. Understand discrete signals and systems, DIT algorithms
2. Explain the structures of IIR filters by bilinear transformation
3. Explain the structures of FIR filters by window techniques
4. Explain the concept of multirate signal processing and adaptive filters

Unit -1	**Hours**
Discrete Signals and Systems- A Review – Introduction to DFT – Properties of DFT – Circular Convolution – Filtering methods based on DFT – FFT Algorithms –Decimation in time Algorithms, Decimation in frequency Algorithms – Use of FFT in Linear Filtering.	10
Unit -2	
Structures of IIR filters – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation.	10
Unit -3	
Structures of FIR filters – Linear phase FIR filter – Filter design. **Design using windowing techniques** (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques	9
Unit – 4	
Multi rate signal processing: Basic building blocks of multi rate DSP, Decimation, Interpolation, Sampling rate conversion by a rational factor, Multistage Sampling Rate Converters.	10
Unit – 5	
Adaptive Filters: Introduction, LMS and RLS Adaptation Algorithms, Applications of adaptive filtering to equalization, noise cancellation.	9

Course Outcomes:

The student will be able to

1. Use the FFT algorithm for solving the DFT of a given signal
2. Design a Digital filter (FIR&IIR) from the given specifications
3. Realize the FIR and IIR structures from the designed digital filter.
4. Use the Multirate Processing concepts in various applications.
5. Apply the Adaptive signal processing concepts to various signal processing applications

Text Books:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G.Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, PH

Reference Books:

1. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling, Sandra L. Harris,Thomson, 2007.
2. Understanding Digital Signal Processing 2nd Edition by Richard G.Lyons

CONSUMER ELECTRONICS
(Open Elective)

Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Analog Communications	Credits – 03	

Course Objectives:

This course will enable students to

1. Understand the significance of audio systems
2. Explain the digital audio fundamentals and operation
3. Explain the operation of digital transmission and reception
4. Understand the need for different type of appliances

Unit -1	**Hours**
Audio Systems: Microphones and Loudspeakers: Carbon, moving coil, cordless microphone, Direct radiating and horn loudspeaker, Multi-speaker system, Hi-Fi stereo and dolby system. Concept to fidelity, Noise and different types of distortion in audio system	10
Unit -2	
Digital Audio Fundamentals: Audio as Data and Signal, Digital Audio Processes Outlined, Time Compression and Expansion.	9
Unit -3	
SCR and Thyristor: Principles of operation and characteristics of SCR, Triggering of Television: Basics of Television: Elements of TV communication system, Scanning and its need, Need of synchronizing and blanking pulses, VSB, Composite Video Signal. **Colour Television:** Primary, secondary colours, Concept of Mixing, Colour Triangle,	10
Unit – 4	
Digital Transmission and Reception: Digital satellite television, Direct-To-Home(DTH) satellite television, Introduction to :Video on demand, CCTV, High Definition(HD)-TV. Introduction to Liquid Crystal and LED Screen Televisions Basic block diagram of LCD and LED Television and their comparison	10
Unit – 5	
Introduction to different type of domestic/commercial appliances: Operation of Micro-wave oven, Food Processors, Digital Electronic Lock, Vacuum cleaner, Xerox Machine, scanner .	09

Course Outcomes:

Student will be able to

1. Understand the various type of microphones and loud speakers.
2. To identify the various digital and analog signal.
3. Describe the basis of television and composite video signal.
4. Describe the various kind of colour TV standards and system.
5. Compare the various types of digital TV system.
6. Understand the various type of consumer goods.

Text Books :

1. Modern Television Practice by R. R. Gulai; New Age International Publishers.
2. Audio Video Systems by R. G. Gupta; McGraw Hill Education System.
3. Audio Video Systems Principles Practices and Troubleshooting by Bali & Bali; Khanna Publishing Company

Reference Books:

1. Consumer Electronics by S. P. Bali; Pearson Education, New Delhi

TRANSDUCERS AND SENSORS (Open Elective)			
Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	EMI	Credits – 03	

Course Objectives:

This course will enable students to

- Understand measurements and instrumentation and its need.
- Explain the Characteristics of Transducers.
- Explain the Characteristics of resistive, inductive and capacitive transducers

Unit -1	**Hours**
Measurements and Instrumentation of Transducers: Measurements – Basic method of measurement – Generalized scheme for measurement systems – Units and standards – Errors – Classification of errors, error analysis – Statistical methods – Sensor – Transducer – Classification of transducers – Basic requirement of transducers.	10
Unit -2	
Characteristics of Transducers: Static characteristics – Dynamic characteristics – Mathematical model of transducer – Zero, first order and second order transducers – Response to impulse, step, ramp and sinusoidal inputs	10
Unit -3	
Resistive Transducers: Potentiometer –Loading effect – Strain gauge – Theory, types, temperature compensation – Applications **Torque measurement** – Proving Ring – Load Cell – Resistance thermometer – Thermistors materials – Constructions, Characteristics – Hot wire anemometer	9
Unit – 4	
Inductive and Capacitive Transducer: Self inductive transducer – Mutual inductive transducers – Linear Variable Differential Transformer – LVDT Accelerometer – RVDT – Synchros – Microsyn – Capacitive transducer – Variable Area Type – Variable Air Gap type – Variable Permittivity type – Capacitor microphone.	10
Unit – 5	
Miscellaneous Transducers: Piezoelectric transducer – Hall Effect transducers – Smart sensors – Fiber optic sensors – Film sensors – MEMS – Nano sensors, Digital transducers	09

Course Outcomes:

At the end of the course, a student will be able to:

1. Use concepts in common methods for converting a physical parameter into an electrical quantity
2. Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light
3. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
4. Predict correctly the expected performance of various sensors
5. Locate different type of sensors used in real life applications and paraphrase their importance
6. Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers

7. develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system

Text Books:

1. Sawhney. A.K, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, Dhanpat Rai & Company Private Limited, 2007.
2. Patranabis. D, "Sensors and Transducers", Prentice Hall of India, 2003.

Reference Books:

1. Renganathan. S, “Transducer Engineering”, Allied Publishers, Chennai, 2003.
2. Doebelin. E.A, “Measurement Systems – Applications and Design”, Tata McGraw Hill, New York, 2000
3. John. P, Bentley, “Principles of Measurement Systems”, III Edition, Pearson Education, 2000.
4. Murthy. D. V. S, “Transducers and Instrumentation”, Prentice Hall of India, 2001. 4. Sensor Technology Hand Book – Jon Wilson, Newne 2004.
5. Instrument Transducers – An Introduction to their Performance and design – by Herman K. P. Neubrat, Oxford University Press

IOT AND APPLICATIONS
(Open Elective)

Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite		Credits – 03	

Course Objectives:

This course will enable students to

1. Understand the IoT and its role in cloud computing.
2. Understand the elements and application development using IoT.
3. Explain the solution framework for IoT applications
4. Analyze the IoT Case Studies.

Unit -1	**Hours**
Introduction to IoT: Introduction to IoT, Architectural Overview, Design principles and needed capabilities, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IoT, Security aspects in IoT.	10
Unit -2	
Elements of IoT: Hardware Components- Computing- Arduino, Raspberry Pi, ARM Cortex-A class processor, Embedded Devices – ARM Cortex-M class processor, Arm Cortex-M0 Processor Architecture, Block Diagram, Cortex-M0 Processor Instruction Set, ARM and Thumb Instruction Set.	10
Unit -3	
IoT Application Development: Communication, IoT Applications, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, CoAP, UDP, TCP, Bluetooth. **Bluetooth Smart Connectivity** Bluetooth overview, Bluetooth Key Versions, Bluetooth Low Energy (BLE) Protocol, Bluetooth, Low Energy Architecture, PSoC4 BLE architecture and Component Overview.	9
Unit – 4	
Solution framework for IoT applications: Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.	10
Unit – 5	
IoT Case Studies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation. Cloud Analytics for IoT Application : Introduction to cloud computing, Difference between Cloud Computing and Fog Computing: The Next Evolution of Cloud Computing, Role of Cloud Computing in IoT, Connecting IoT to cloud, Cloud Storage for IoT Challenge in integration of IoT with Cloud.	9

Course Outcomes:

The student will be able to:

1. Understand internet of Things and its hardware and software components.
2. Interface I/O devices, sensors & communication modules.
3. Remotely monitor data and control devices.
4. Design real time IoT based applications.
5. Design the real case studies.

Text Books:

1. Raj Kamal, “Internet of Things: Architecture and Design Principles”, 1st Edition, McGraw Hill Education,2017.
2. The Definitive Guide to the ARM Cortex-M0 by JosephYiu,2011
3. Vijay Madisetti, Arshdeep Bahga, Internet of Things, “A Hands on Approach”, UniversityPress,2015

Reference Books:

1. CypressSemiconductor/PSoC4BLE(BluetoothLowEnergy)ProductTrainingModules.
2. PethuruRajandAnupamaC.Raman,“TheInternetofThings:EnablingTechnologies,Platforms,andUse Cases”,CRCPress,2017.

IC APPLICATIONS
(Open Elective)

Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Analog Circuits, DSD	Credits – 03	

Course Objectives:
This course will enable students to
1. Understand the ideal op-amp and practical op-amp.
2. Understand 555 timer and IC565 VCO and its application.
3. Explain the DAC and ADC techniques and its specifications.
4. Explain the Use of TTL-74XX Series & CMOS 40XX Series ICs

Unit -1	**Hours**
Ideal and Practical Op-Amp, Op-amp characteristics-DC and AC Characteristics, General Linear Applications of Op-Amp: Adder, Subtractor, Differentiators and Integrators, Active Filters and Oscillators, Nonlinear Applications of OPAMP: Comparators, Schmitt Trigger, Multivibrators	10
Unit -2	
Introduction to 555 Timer, Functional Diagram, Monostable and Astable Operations and Applications, Schmitt Trigger, PLL- Introduction, Block Schematic, Principles and Description of individual Blocks of 565, VCO.	10
Unit -3	
Introduction, Basic DAC Techniques - Weighted Resistor Type. R-2R Ladder Type, inverted R-2R Type. **Different types of ADCs** - Parallel Comparator Type. Counter Type. Successive Approximation Register Type and Dual Slope Type DAC and ADC Specifications.	9
Unit – 4	
Use of TTL-74XX Series & CMOS 40XX Series ICs, TTL ICs - Code Converters, Decoders, Demultiplexer, Encoders, Priority Encoders, multiplexers & their applications. Priority Generators, Arithmetic Circuit ICs-Parallel Binary Adder/Subtractor Using 2's Complement System, Magnitude Comparator Circuits.	10
Unit – 5	
Commonly Available 74XX & CMOS 40XX Series ICs - RS, JK. JK Master-Slave. D and T Type Flip-Flops & their Conversions, Synchronous and asynchronous counters. Decade counters. Shift Registers & applications	09
Course Outcomes: The student will be able to 1. Analyze the Differential Amplifier with Discrete components 2. Describe the Op-Amp and internal Circuitry: 555 Timer, PLL 3. Discuss the Applications of Operational amplifier: 555 Timer, PLL 4. Design the digital application using digital ICs 5. Use the Op-Amp in A to D & D to A Converters	

Text Books:

1. Linear Integrated Circuits -D. Roy Chowdhury, New Age International (p)Ltd, 3" Ed., 2008.
2. Digital Fundamentals - Floyd and Jain, Pearson Education,8th Edition, 2005.

Reference Books:

1. Modern Digital Electronics - RP Jain - 4/e - TMH, 2010.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI, 1987

PRINCIPLES OF COMMUNICATION SYSTEMS (Open Elective)			
Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Signals and Systems	Credits – 03	

Course Objectives:

This course will enable students to

1. Understand modulation techniques in time and frequency domain
2. Explain angle modulation and signal sampling.
3. Analyze noise in analog modulation systems
4. Understand Transmission of Binary Data in Communication Systems

Unit -1	**Hours**
Amplitude modulation: Introduction, Amplitude Modulation: Time & Frequency – Domain description, switching modulator, Envelop detector. Double side band-suppressed carrier modulation: Time and Frequency – Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing. Single side–band and vestigial sideband methods of modulation: SSB Modulation, VSB Modulation, Frequency Translation, Frequency- Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television	10
Unit -2	
Angle modulation: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing,	9
Unit -3	
Signal Sampling and Analog Pulse Communication: Ideal Sampling, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation. **Digital Communication Techniques:** Quantization, Digital Transmission of Data, Parallel and Serial Transmission, Data Conversion, Pulse Code Modulation, Delta Modulation.	9
Unit – 4	
Noise in analog modulation: Introduction, Receiver Model, Noise in DSB-SC receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM.	10
Unit – 5	
Transmission of Binary Data in Communication Systems: Digital Codes, Principles of Digital Transmission, Transmission Efficiency, Modem Concepts and Methods – FSK, BPSK, Error Detection and Correction	10

Course Outcomes:

The student will be able to

1. Analyze the performance of analog modulation schemes in time and frequency domains.
2. Analyze the performance of angle modulated signals.
3. Characterize analog signals in time domain as random processes and noise
4. Characterize the influence of channel on analog modulated signals
5. Determine the performance of analog communication systems in terms of SNR
6. Analyze pulse amplitude modulation, pulse position modulation, pulse code modulation and TDM systems

Text Books:

1. Principles of Communication Systems – H Taub& D. Schilling, GautamSahe, TMH, 2007, 3rdEdition.
2. Communication Systems – B.P. Lathi, BS Publication,2006.

Reference Books:

1. Principles of Communication Systems - Simon Haykin, John Wiley,2ndEdition.
2. Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004.

3. Communication Systems– R.P. Singh, SP Sapre, Second Edition TMH,2007.

DATA COMMUNICATIONS (Open Elective)			
Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Communication	Credits – 03	

Course Objectives:

This course will enable students to

1. Understand the concept of data communications and network connection.
2. Explain the operation of data link layer and network layer.
3. Understand the operation of transport layer and IP.
4. Explain the application layer and Principles of Networking Applications.

Unit -1	**Hours**
Introduction to Data Communications: Components, Data Representation, Data Flow, Networks Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards - Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture,	10
Unit -2	
Data Link Layer: Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols. 802.11 MAC Protocol, IEEE 802.11 Frame.	10
Unit -3	
The Network Layer: Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane. **The Internet Protocol(IP):** Forwarding and Addressing in the Internet Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6	9
Unit – 4	
Transport Layer: Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N(GBN), Selective Repeat(SR), Connection Oriented **Transport:** TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control	10
Unit – 5	
Application Layer: Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.	9

Course Outcomes:

1. Know the Categories and functions of various Data Communication Networks
2. Design and analyze various error detection techniques.
3. Demonstrate the mechanism of routing the data in network layer
4. Know the significance of various Flow control and Congestion control Mechanisms

Text Books:

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6thEdition , Pearson,2017.
2. Data Communications and Networking Behrouz A.Forouzan4th Edition McGraw Hill Education,2017.

Reference Books:

1. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education, 2003.
3. Understanding Communications and Networks, 3 rd Edition, W.A.Shay, Cengage Learning, 2003.

DIGITAL LOGIC DESIGN (Open Elective)			
Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite		Credits – 03	

Course Objectives:

This course will enable students to

1. Understand the number system and codes.
2. Explain the minimization techniques with four variables and single function.
3. Understand the logic circuits design using MSI and LSI
4. Explain the operation of sequential and combinational circuit design.

Unit -1	**Hours**
REVIEW OF NUMBER SYSTEMS & CODES: Representation of numbers of different radix, conversation from one radix to another radix, r-1's compliments and r's compliments of signed members, Gray code ,4 bit codes; BCD, Excess-3, 2421, 84-2-1 code etc. Error detection & correction codes: parity checking, even parity, odd parity, Hamming code. BOOLEAN **THEOREMS AND LOGIC OPERATIONS:** Boolean theorems, principle of complementation & duality, De-Morgan theorems, Logic operations; Basic logic operations -NOT, OR, AND, Universal Logic operations, EX-OR, EX- NOR operations. Standard SOP and POS Forms, NAND-NAND and NOR-NOR realizations, Realization of three level logic circuits. Study the pin diagram and obtain truth table for the following relevant ICs 7400,7402,7404,7408,7432,7486.	9
Unit -2	
MINIMIZATION TECHNIQUES: Minimization and realization of switching functions using Boolean theorems, K-Map (up to 6 variables)and tabular method(Quine-mccluskey method) with only four variables and single function. COMBINATIONAL LOGIC CIRCUITS DESIGN: Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders; 4-bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-a-head adder circuit, Design code converts using Karnaugh method and draw the complete circuit diagrams.	10
Unit -3	
COMBINATIONAL LOGIC CIRCUITS DESIGN USING MSI &LSI : Design of encoder ,decoder, multiplexer and de-multiplexers, Implementation of higher order circuits using lower order circuits . Realization of Boolean functions using decoders and multiplexers, Design of Priority encoder, 4-bit digital comparator and seven segment decoder. . Study the relevant ICs pin diagrams and their functions 7442,7447,7485,74154. **INTRODUCTION OF PLD's :** PLDs: PROM, PAL, PLA -Basics structures, realization of Boolean functions, Programming table.	10
Unit – 4	
SEQUENTIAL CIRCUITS I: Classification of sequential circuits (synchronous and asynchronous) , operation of NAND & NOR Latches and flip-flops; truth tables and excitation tables of RS flip-flop, JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals. Conversion from one flip-flop to another flip- flop, Design of 5ripple counters, design of synchronous counters, Johnson counter, ring counter. Design of registers - Buffer register, control buffer register, shift register, bi-directional shift register, universal shift, register, Study the following relevant ICs and their relevant functions 7474,7475,7476,7490,7493,74121.	10

Unit – 5	
SEQUENTIAL CIRCUITS II : Finite state machine; state diagrams, state tables, reduction of state tables. Analysis of clocked sequential circuits Mealy to Moore conversion and vice-versa, Realization of sequence generator, Design of Clocked Sequential Circuit to detect the given sequence (with overlapping or without overlapping)	9

Course Outcomes:

The student will be able to

1. Classify different number systems and apply to generate various codes.
2. Use the concept of Boolean algebra in minimization of switching functions
3. Design different types of combinational logic circuits.
4. Apply knowledge of flip-flops in designing of Registers and counters
5. The operation and design methodology for synchronous sequential circuits and algorithmic state machines
6. Produce innovative designs by modifying the traditional design techniques

Text Books:

1. Switching and finite automata theory Zvi.KOHAVI, Niraj.K. Jha 3rdEdition, Cambridge UniversityPress,2009
2. Digital Design by M.Morris Mano, Michael D Ciletti,4th edition PHIpublication,2008
3. Switching theory and logic design by Hill and Peterson, Mc-Graw Hill TMH edition, 2012.

Reference Books:

1. Fundamentals of Logic Design by Charles H.RothJr,JaicoPublishers,2006
2. Digital electronics by R S Sedha.S.Chand&companylimited,2010
3. Switching Theory and Logic Design by A.Anand Kumar,PHILearningpvtltd,2016.
4. Digital logic applications and design by John M Yarbough,Cengagelearning,2006.
5. TTL74-Seriesdatabook.

REMOTE SENSING AND GIS
(Open Elective)

Subject Code	18XXETOXXXX	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite		Credits – 03	

Course Objectives:
This course will enable students to
1. Understand the concept of photogrammetry and its significance.
2. Explain the basic concept of remote sensing and limitations.
3. Understand the vector data model and topology rules.
4. Explain the raster data model , elements and importance of source map and data editing

Unit -1	**Hours**
Introduction to Photogrammetry: Principles& types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducial points, parallax measurement using fiducial line.	09
Unit -2	
Remote Sensing: Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.	10
Unit -3	
Remote Sensing: Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process. **Electromagnetic Spectrum**, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.	10
Unit – 4	
Vector Data Model: Representation of simple features- Topology and its importance; coverage and its data structure, Shape file; Data models for composite features Object Based Vector Data Model; Classes and their Relationship; The geobase data model; Geometric representation of Spatial Feature and data structure, Topology rules	10
Unit – 5	
Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data Conversion, Integration of Raster and Vector data. Data Input: Metadata, Conversion of Existing data, creating new data; Remote Sensing data, Field data, Text data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing	09

Course Outcomes:
The student will be able to
1. Retrieve the information content of remotely sensed data
2. Analyze the energy interactions in the atmosphere and earth surface features
3. Interpret the images for preparation of thematic maps
4. Apply problem specific remote sensing data for engineering applications
5. Analyze spatial and attribute data for solving spatial problems
6. Create GIS and cartographic outputs for presentation

Text Books:

1. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
2. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015.
3. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

Reference Books:

1. Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
2. Principals of Geo physical Information Systems – Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
3. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications

Open Elective

Courses Offered by EEE to other Departments

Open Electives offered by EEE department

S. No	Subject Code	Subject title
1	18XXEEOM0XA	Control system design
2	18XXEEOM0XB	Optimization techniques
3	18XXEEOM0XC	Electrical Energy Conservation And Auditing
4	18XXEEOM0XD	Electrical and Hybrid Vehicles
5	18XXEEOM0XE	Intelligent control & its applications
6	18XXEEOM0XF	Electrical materials
7	18XXEEOM0XG	Industrial Electrical Systems
8	18XXEEOM0XH	Advanced Control Systems

CONTROL SYSTEM DESIGN (Open Elective)			
Subject Code	18XXEEOM0XA	IA Marks	30
Number of Lecture Hours/week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable student to

1. Explain the concepts of design problem and various design specifications.
2. Discuss the design of compensator for both time and frequencydomain specifications.
3. Explain the design of various controllers.
4. Understand the concept on feed-forward control.
5. Apply the knowledge of design using statespace
6. Understand the methods of solving Non-linear system of equations.

Unit 1: Design Specifications	**Hours**
Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.	**10**
Unit 2: Design of Classical Control System in the time domain and Frequency domain	
Introduction to compensator. Design of Feedback and Feed forward compensators, Feedback compensation. Realization of compensators. Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using Bode diagram.	**10**
Unit 3: Design of PID controllers	
Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.	**09**
Unit 4: Control System Design in state space	
Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Full order, Reduced order observer. Separation Principle.	**10**
Unit 5: Design of control for Non LinearSystems	
Introduction, Methods of solving Non-linear systems of equations. Pseudo-composition, weight function procedure, Technique for extending scalar methods to the multidimensional case in a nontrivial way	**09**

Course outcomes:

On completion of the course student will be able to:

1. Elaborate the concepts of various designing fundamentals.
2. Apply the basic design in both time and frequency domain
3. Understand the concepts of PID controllers
4. Apply the knowledge of design using state space
5. Illustrate the basic concepts of nonlinearities and their performance
6. Discuss the concepts of singular points and performance of system

Text Books:

1. N.Nise,“ControlsystemEngineering”,JohnWiley,2000.
2. I.J.NagrathandM.Gopal,“Controlsystemengineering”,Wiley,2000.
3. M.Gopal,“DigitalControlEngineering”,WileyEastern,1988.
4. K.Ogata,“ModernControlEngineering”,PrenticeHall,2010.

Reference Books:

1. B. C. Kuo, “ Automatic Control system”, PrenticeHall,1995.
2. J. J. D’Azzo and C. H. Houpis, “ Linear control system analysis anddesign (conventional and modern)” , McGrawHill,1995.
3. R. T. Stefani and G. H. Hostettler, “Design of feedback Control Systems”, Saunders CollegePub,1994.

OPTIMIZATION TECHNIQUES **Open Elective**			
Subject Code	18XXEEOM0XB	IA Marks	30
Number of Lecture Hours/week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits -3			

Course Objectives:

This course will enable student to:

1. Explain the objective and constraint functions in terms of design variables, and then state the optimization problem.
2. Solve single variable and multi variable optimization problems with and without constraints.
3. Explain linear programming technique to an optimization problem, slack and surplus variables, by using Simplex method.
4. Explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.
5. Discuss evolutionary programming techniques.

Unit 1: Introduction	**Hours**
Statement of an Optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of Optimization problems.	**09**
Unit 2: Classical Optimization Techniques	**10**
Single variable Optimization, multi variable Optimization without constraints, necessary and sufficient conditions for minimum/maximum, multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers, multivariableOptimizationwithinequalityconstraints,Kuhn,Tuckerconditions.	
Unit 3: Linear Programming	**09**
Standard form of a linear programming problem , geometry of linear programming problems, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation to the simplex method, simplex algorithm, Duality in Linear Programming, Dual Simplex method.	
Unit 4: Nonlinear Programming	
Unconstrained cases, One, dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method, Univariate method, Powell's method and steepest descent method. Constrained cases, Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.	**10**
Unit 5: Introduction to Evolutionary Methods	**10**
Evolutionary programming methods, Introduction to Genetic Algorithms (GA)– Control parameters, Number of generation, population size, selection, reproduction, crossover and mutation, Operator selection criteria , Simple mapping of objective function to fitness function, constraints, Genetic algorithm steps, Stopping criteria –Simple examples.	

Course outcomes:

On completion of the course student will be able to:

1. State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
2. Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
3. Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
4. Apply gradient and non-gradient methods to nonlinear optimization problems.
5. Apply interior or exterior penalty functions for the constraints to derive the optimal solutions.
6. Able to apply Genetic algorithms for simple electrical problems.

Text Books:

1. "Engineering optimization: Theory and practice"-by S. S.Rao, NewAge International (P) Limited, 3rd edition,1998.
2. Soft Computing with Matlab Programming by N.P.Padhy&S.P.Simson,Oxford University Press –2015

Reference Books:

1. "Optimization methods in operations Research and Systems Analysis" by K.V.Mitaland C.Mohan, New Age International (P) Limited, Publishers, 3rd edition,1996.
2. Genetic Algorithms in search, optimization, and Machine Learning by DaviE.Goldberg, ISBN:978-81-7758-829-3, Pearsonby Dorling Kindersley (India) PvtLtd.
3. "Operations Research: An Introduction" by H.A.Taha, PHI Pvt. Ltd., 6thedition.
4. Linear Programming byG.Hadley.

ELECTRICAL ENERGY CONSERVATION AND AUDITING (Open Elective)			
Subject Code	18XXEEOM0XC	IA Marks	30
Number of Lecture Hours/week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits-03			

Course Objectives:

This course enable student to:

1. Explain energy efficiency, scope, conservation and technologies.
2. Discuss energy efficient lighting systems.
3. Calculate power factor of systems and propose suitable compensation techniques.
4. Explain the working of energy instruments.
5. Discuss energy conservation in HVAC systems.
6. Calculate life cycle costing analysis and return on investment on energy efficient technologies.

Unit 1: Basic Principles of Energy Audit and International Acts on Energy	**Hours**
Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts –Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Indian energy scenario and consumption, energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, National action plan on climate change Energy and environment, air pollution, climate change United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties	**10**
Unit 2: Energy conservation opportunities in lighting	
Modification of existing systems – Replacement of existing systems – Priorities Definition of terms and units – Luminous efficiency –Luminance or brightness – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers –Energy conservation measures, lighting energy audit,case studies.	**10**
Unit 3: Power Factor and energy instruments	
Power factor – Methods of improvement – Location of capacitors – Power factor with nonlinear loads – Effect of harmonics on Power factor – Numerical problems Energy Instruments – Watt–hour meter – Data loggers –Thermocouples– Pyrometers – Lux meters – Tong testers – Power analyzer.	**09**
Unit 4: HVAC Systems and ECBC	
Heating, ventilation, air conditioning (HVAC), fenestrations Energy Conservation Building Codes (ECBC), building envelope, insulation, lighting, water pumping, inverter and energy storage/captive generation, elevators and escalators, star labeling for existing buildings, Energy Service Companies based case studies.	**09**

Unit 5: Energy Efficient Motors and Financial Aspects of Conservation Technologies Energy Efficient motors Design, construction, Gorilla fan case study(Additional practical topic) Understanding energy cost, Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis — Economics of energy efficient motors and systems. Need of investment, appraisal and criteria, Calculation of simple payback period–Return on investment – Net present value – Internal rate of return – numerical examples Applications of life cycle costing analysis – Return on investment –Numerical examples.	**10**

Course outcomes:

On completion of the course student will be able to:

1. Explain energy efficiency, conservation and various technologies
2. Design energy efficient lighting system
3. Calculate power factor of systems and propose suitable compensation techniques
4. Explain the working of Energy Instruments.
5. Explain energy conservation techniques in HVAC Systems
6. Calculate life cycle costing analysis and return on investment on energy efficiency technologies.

Text Books:

1. Hand Book of Energy Audit by Sonal Desai- Tata McGrawhill
2. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc. Ltd–2nd edition, 1995

Reference Books:

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications.2012
2. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. NewDelhi.
3. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.
4. Energy management hand book by W.C.Turner, John wileyandsons.
5. Energy management and conservation –k v Sharma and pvenkataseshaiah-I K International Publishing Housepvt.ltd,2011.
6. http://www.energymanagertraining.com/download/Gazette_of_IndiaPartIISecI-37_25-08-2010.pdf

ELECTRICAL AND HYBRID VEHICLES (Open Elective)			
Subject Code	18XXEEOM0XD	IA Marks	30
Number of Lecture Hours/week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits-03			

Course Objectives:

This course will enable student to:

1. Explain working of hybrid and electric vehicles, its performance and characteristics.
2. Discuss hybrid vehicle configuration and its components.
3. Explain electric vehicle drive systems.
4. Discuss the properties of energy storage systems.
5. Compare different Energy management strategies

Unit 1: Introduction	**Hours**
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles.	**10**
Unit 2: Hybrid Electric Drive Trains	**10**
Architecture of Hybrid Electric Vehicles (HEV), analysis of drive trains, energy use in conventional vehicles, energy saving potential of hybrid drive trains, various HEV configurations and their operation model. Power flow in HEV: Power flow control in series, parallel, series-parallel hybrid system. Torque and Speed coupling.	
Unit 3: Electric Drive Trains	**09**
Architecture of electric drive train, electric vehicle configuration, electric drive trains, EV power source configurations. Single and Multi-Motor drives, In wheel drives, requirements of different electric motors used in EVs, Power-Torque-Speed characteristics, electric propulsion systems.	
Unit 4: Energy Storage	
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.	**09**
Unit 5: Energy Management Strategies	**10**
Introduction to energy management strategies used in hybrid and electric vehicles, classification, comparison of different energy management strategies, implementation issues of energy management strategies. Functions of control system in HEVs & EVs, Elementary control theory, Electronic control unit, control area network, control variables, classifications of Hybrid electronic control unit, fuzzy logic based control system	

Course outcomes:

On completion of the course student will be able to:

1. Illustrate the working of hybrid and electric vehicles, its performance and characteristics.
2. Analyze hybrid vehicle configuration and its components.
3. Discuss electric vehicle drive systems.
4. Illustrate electric propulsion systems.
5. Infer the properties of energy storage systems.
6. Distinguish different energy management strategies.

Question paper pattern:

The question paper will have 10questions.

1. Each full question carries 14marks.
2. Each full question will have sub question covering all topics under unit.

The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, " Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons,2011.
2. S. Onori, L. Serrao and G. Rizzoni, " Hybrid Electric Vehicles: Energy Management Strategies" , Springer,2015.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric,HybridElectric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge,2016.

INTELLIGENT CONTROL & ITS APPLICATIONS (Open Elective)			
Subject Code	18XXEEOM0XE	IA Marks	30
Number of Lecture Hours/week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to:

1. Explain the basic intelligent controller concepts
2. Understand concepts of feed forward neural networks and learning and understanding of feedback neural networks.
3. Discuss the concept of genetic algorithm.
4. Understand the basic knowledge of fuzzy logic control.
5. Apply the knowledge of fuzzy logic control, genetic algorithm and neural network to the real problems.

Unit 1: Introduction to Intelligent Control	**Hours**
Introduction and motivation. Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation, Expert systems.	**09**
Unit 2: Artificial Neural Networks	**10**
Concept of Artificial Neural Networks, its basic mathematical model, McCulloch- Pitts neuron model, simple perception, Adeline and Madeline, Feed-forward Multilayer Perception. Learning and Training the neural network. Introduction, derivation, algorithm, flowchart, limitation-Error Back propagation, Hopfield, Radial bases function	
Unit 3: Genetic Algorithm	**10**
Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tab search and ant-colony search techniques for solving optimization problems	
Unit 4: Fuzzy Logic System	**10**
Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Fuzzy logic control for nonlinear time- delay system. Implementation of fuzzy logic controller.	
Unit 5: Applications	**09**
Aerospace and data mining applications of Genetic Algorithm - Neural Network and Fuzzy Logic Control applications in Smart grid, Electric drives and Distributed generation.	

Course outcomes:

On completion of the course student will be able to :

1. Infer representations applied to artificial intelligence techniques
2. Illustrate the use of artificial neuron in perceptron models and back propagation algorithm to multilayer feed forward networks
3. Develop rule based and decision making with the use of classical and fuzzylogic systems
4. Analyze the concept of geneticalgorithm.
5. Analyze the fuzzy logic controller using MATLAB.
6. Discover various applications of neural and fuzzy logic systems inelectrical Engineering

Text Books:

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition,2003.
2. T.J. Ross, Fuzzy logic with Fuzzy Applications, McGraw Hill Inc,1997.
3. David E Goldberg, Genetic Algorithms. Wesley PublishingCompany,1989
4. John Yen and Reza Langari, Fuzzy logic Intelligence, Control, and Information, Pearson Education, Indian Edition,2003.
5. Neural Network, Fuzzy Logic and Genetic Algorithm : Synthesis and Applications.

   Rajasekaran and G. A. VijayalakshmiPai (Prentice Hall India, 2010)

Reference Books:

1. M.T. Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint,2008.
2. Fredric M. Ham and IvicaKostanic, Principles of Neuro computing for science and Engineering, McGraw Hill,2001.
3. N. K. Bose and P. Liang, Neural Network Fundamentals with Graphs, Algorithms, and Applications, Mc. Graw Hill, Inc.1996.
4. Yung C. Shin and ChengyingXu, Intelligent System, Modeling, Optimization and Control, CRC Press,2009.
5. N. K. Sinha and Madan M Gupta, Soft computing & Intelligent Systems, Theory &Applications, Indian Edition, Elsevier,2007.
6. WitoldPedrycz, Fuzzy Control and Fuzzy Systems, Overseas Press, Indian Edition,2008.

ELECTRICAL MATERIALS (Open Elective)			
Subject Code	18XXEEOM0XF	IA Marks	30
Number of Lecture Hours/week	03	Exam Marks	70
Total Number of Lecture Hours	45	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to:

1. Describe the formation and properties of conducting material.
2. Explain the formation and properties of Semiconductor Materials.
3. Infer the formation and properties of Dielectric Materials.
4. Explain the formation and properties of Magnetic Materials.
5. Describe the formation and properties of Special Purpose Materials.

Unit 1: Conducting Materials	**Hours**
Review of metallic conduction on the basis of free electron theory. Fermi-Dirac distribution – variation of conductivity with temperature and composition, materials for electric resistors- general electric properties; material for brushes of electrical machines, lamp filaments, fuses and solder.	**10**
Unit 2: Semiconductor Materials	**09**
Mechanism of conduction in semiconductors, density of carriers in intrinsic semiconductors, the energy gap, types of semiconductors. Hall effect, compound semiconductors, basic ideas of amorphous and organic semiconductors.	
Unit 3: Dielectric Materials	**10**
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyro electric materials.	
Unit 4: Magnetic Materials	**10**
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis	
Unit 5: Materials for Electrical Applications & Special Purpose Materials	**10**
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation. Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI	

Course outcomes:

On completion of the course student will be able to:

1. Understand various types of conducting, their properties in various conditions.
2. Evaluate semiconductor materials and technologies
3. Understand various types of dielectric materials, their properties in various conditions.
4. Evaluate magnetic materials and their behavior.
5. Acquire Knowledge on Materials used in electrical engineering and applications.
6. Able to test Transformer oil as per standard.

Text Books:

1. R K Rajput", " A course in Electrical Engineering Materials", Laxmi Publications, 2009
2. "T K Basak", " A course in Electrical Engineering Materials", New Age Science Publications 2009

Reference Books:

1. TTTI Madras, "Electrical Engineering Materials", McGraw Hill Education, 2004.
2. "AdrianusJ.Dekker", Electrical Engineering Materials, PHI Publication, 2006.
3. S. P. Seth, P. V. Gupta "A course in Electrical Engineering Materials", DhanpatRai& Sons, 2011.

INDUSTRIAL ELECTRICAL SYSTEMS (Open Elective)			
Subject Code	18XXEEOM0XG	IA Marks	30
Number of Lecture Hours/week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable student to:

1. Explain Tariff structure and protection components.
2. Compare various types wiring systems and IE rules.
3. Describe the Illumination technology.
4. Compare various types of cables.
5. Discuss on PLC applications.
6. Explain the implementation of SCADA for various applications.

Unit 1: Electrical System Components	**Hours**
LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices	**10**
Unit 2: Residential and Commercial Electrical Systems	
Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.	**10**
Unit 3: Illumination Systems	
Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.	**10**
Unit 4: Industrial Electrical Systems	
HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components. DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.	**10**

Unit 5: Industrial Electrical System Automation	
Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.	**10**

Course outcomes:

On completion of the course student will be able to:

1. Illustrate Tariff structure and protection components.
2. Discuss various types wiring systems and IE rules.
3. Explain the Illumination technology.
4. Distinguish various types of cables.
5. Discover PLC applications.
6. Choose various applications to implement SCADA.

Text Books:

1. S. L. Uppal and G. C. Garg, " Electrical Wiring, Estimating & Costing", Khannapublishers,2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International,2007.
3. S. Singh and R. D. Singh, "Electrical estimating and costing",DhanpatRai and Co.,1997.

Reference Books:

1. Web site for IS Standards.
2. H. Joshi, "Residential Commercial and Industrial Systems", McGrawHill Education,2008.

ADVANCED CONTROL SYSTEMS (Open Elective)			
Subject Code	18XXEEOM0XH	IA Marks	30
Number of Lecture Hours/week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits -03			

Course Objectives:

The objectives of this course is to acquire knowledge on

1. formulation of different models using state space analysis
2. analysis of state feedback control through pole placement technique.
3. analysis of a nonlinear system using Lypanov's method of stability
4. formulation of Euler Lagrange equation to optimize typical functional and solutions.
5. optimal controller design using LQG framework

Unit 1: State Space Analysis	**Hours**
State Space Representation –Solution of state equation –State transition matrix, –Canonical forms –Controllable canonical form –Observable canonical form, Jordan Canonical Form.	**09**
Unit 2: Controllability, Observability and Design of Pole Placement	**10**
Tests for controllability and observability for continuous time systems –Time varying case –Minimum energy control –Time invariant case –Principle of duality –Controllability and observability form Jordan canonical form and other canonical forms –Effect of state feedback on controllability and observability –Design of state feedback control through pole placement.	
Unit 3: Describing Function and Stability Analysis	**10**
Introduction to nonlinear systems, Types of nonlinearities, describing functions, Introduction to phase–plane analysis. Stability in the sense of Lyapunov – Lyapunov's stability and Lypanov's instability theorems –Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.	
Unit 4: Calculus of variations	**09**
Minimization of functional of single function –Constrained minimization –Minimum principle –Control variable inequality constraints –Control and state variable inequality constraints –Euler lagrangine equation	
Unit 5: Optimal Control Design	**10**
Linear Quadratic Optimal Regulator (LQR) problem formulation –Optimal regulator Design by parameter adjustment (Lyapunov method) –Optimal regulator Design by Continuous Time Algebraic Riccatti equation (CARE) - Optimal controller Design using LQG framework.	

Course outcomes:

1. Able to design the state space model of control system and formulate different state models
2. Able to design of control system using the pole placement technique
3. Able to analyse of nonlinear system using the describing function technique and phase plane analysis.
4. Able to analysis the stability analysis using lypnov method.
5. Able to minimize the function using calculus of variation studied.
6. Able to design optimal controller using LQG framework.

Text Books:

1. Modern Control Engineering by K. Ogata, Prentice Hall of India, 3rd edition, 1998.
2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication

Reference Books:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition, 1996.
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies, 1997

Open Electives offered

By ME to other Department

Open Elective Courses Offered by Mechanical Engineering to other Departments

S. No.	Subject Code	Name of the subject	L	T	P	Cr
1.	18XXMEOX0XA	Operations Research	3	0	0	3
2.	18XXMEOX0XB	Fundamentals of Mechanical Engineering	3	0	0	3
3.	18XXMEOX0XC	Industrial Robotics	3	0	0	3
4.	18XXMEOX0XD	Engineering Materials	3	0	0	3
5.	18XXMEOX0XE	Introduction to Material Handling	3	0	0	3
6.	18XXMEOX0XF	Production Planning and Control	3	0	0	3
7.	18XXMEOX0XG	Non-Conventional Sources of Energy	3	0	0	3
8.	18XXMEOX0XH	Fluid Mechanics and Fluid Machinery	3	0	0	3

Operations Research SEMESTER - XX			
Subject Code	18XXMEOX0XA	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

Course Objectives:

Enable the students to

1. Understand the definition, scope, objectives, phases, models and limitations of operations research and developing the ability to formulate the linear programming problems for minimizing the project cost and maximizing its profit.
2. Solve linear programming problems using various techniques based on the constraints
3. Understand about different application areas of operations research like transportation problem, assignment model, sequencing models.
4. Suggest optimal sequence and replacement policy and economic order quantities to be maintained for better and economic growth of the industry.
5. Suggest optimal game strategies and estimation of waiting times in waiting line problems in the competitive business world.

Unit -1	**Hours**
Introduction to Operations Research: Definition, Features, types of OR models, Methodology, Tools, Limitations and applications of Linear Programming. **Linear Programming-I:** Introduction, Formulation of Linear Programming Problem (LPP), Assumptions for solving LPP, Applications of LPP, Graphical method of solving LPP.	**10**
Unit -2	
Linear Programming-II: Introduction, steps in solving problems using simplex method, Principle of simplex method- Maximization and minimization problems, solution by simplex method, limitations of LPP simplex method. **Linear Programming-III:** Introduction, Concept of primal, dual relationship, formulation of the dual of the primal problem, solution of LP problems using dual simplex method.	**10**
Unit – 3	
Transportation Problem: Basics, Solution of Transportation problem with several methods, performing optimality test, degeneracy in transportation problem. **Assignment model:** Definition, Formulation, Different methods of solutions, Hungarian assignment method, unbalanced assignment problems, travelling salesman problems. **Sequencing problems:** introduction, basics, types of sequencing problems, priority sequencing, sequencing n-jobs through two machines, n-jobs and m-machines, two jobs 3-machines case.	**10**

Unit – 4	
Replacement: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement. **Inventory Control:** Introduction, Types of Inventories, Costs associated with inventories, the concept of EOQ, Deterministic inventory problems with no shortages, with shortage.	**10**
Unit – 5	
Queuing Theory: Introduction, Queuing system, elements of Queuing system Operating characteristics of a Queuing system, Classification of queuing models: Model-I [M/M/1:∞ / FIFO], Model-III [M/M/1: N/FIFO]. **Game Theory**: Introduction, Two Person Zero sum games, Maximin - Minimax principle, Games without saddle points- mixed strategies, Graphical solution of 2Xn, mX2 games, and Dominance property, P-system, S-system, Q-system and Ss-system	**10**

Course outcomes:

1. Formulate and solve mathematical model (linear programming problem) for real situations like production and distribution of goods using basic linear programming techniques li graphical methods
2. Apply the concepts of linear programming for decision making like simplex and dual simplex algorithms in production industries.
3. Calculate the optimal values of cost, job distribution and placement using transportation, assignment and sequencing methods
4. Select the best optimal inventory and replacement time for the goods produced in an industry for its better and economic growth using inventory and replacement techniques.
5. Select the best optimal time and strategy to be followed by any organization to identify the waiting times and strategies to be implemented using waiting lines and game theory techniques for a continuous and successful growth of an industry.

TEXT BOOKS:

1. Operation Research /Premkumar Gupta, D.S.Hira / S.Chand
2. Operations Research / S.D.Sharma-KedarnathRamnath(JNTU)

REFERENCES:

1. Operations Research / R. Pannerselvam / PHI Publications.
2. Operation Research /J.K.Sharma/MacMilan.
3. Operation Research An Introduction / Taha / Pearson
4. Operations Research / A.M.Natarajan, P. Balasubramani, A. Tamilarasi / Pearson Education.

Question paper pattern:

1. Question paper contains 10 Questions, 2 from each course outcome. The student must answer 5 full questions by selecting one question from each course outcome (Internal Choice)
2. All questions carries 14 marks each
3. Each full question will have sub question covering all topics under a course outcome

Fundamentals of Mechanical Engineering SEMESTER - XX			
Subject Code	18XXMEOX0XB	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

Course Objectives:

Enable the students to

1. Understand the concepts of fluid properties like specific gravity, viscosity, density, surface tension
2. To study the classification of turbines and work done and efficiency of the different turbines and also study about draft tube theory and to determine the function efficiency.
3. To study about specific speed and performance characteristics of different types of turbines.
4. To study automobile engine working, valve timing and associated systems such as lubricating system, cooling system, fuel feed system, ignition system etc., their necessity, requirements, construction details, different types and their working
6. To study the construction, working principles and advantages of belt and rope drives, selection of belt drive- types of belt drives, V-belts, types of coupling.

Unit -1	**Hours**
Fluid Mechanics: Dimensions and units: physical properties of fluids- specific gravity, viscosity and its significance, surface tension, capillarity, and vapor pressure. Atmospheric gauge and vacuum pressure – Measurement of pressure. Manometers- Piezometer, U-tube, inverted and differential manometers.	**10**
Unit -2	
Impact of jets: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.	**10**
Unit – 3	
Hydraulic Turbines and Governing systems: Classification of turbines; Working principle, Efficiency calculation and Design principles for Pelton Wheel, Francis and for Kaplan turbines; Governing of turbines; Performance and characteristic curves..	**10**
Unit – 4	
I. C. Engines: Classification, working principles – valve and port timing diagrams – air standard cycles –fuel injection system, carburetion, ignition, cooling and lubrication – Engine performance evaluation. **Spark Ignition and Combustion Ignition engines** – Classification, working principles, Types of engines.	**10**
Unit – 5	
Belt drives: Introduction, Belt and rope drives, selection of belt drive- types of belt drives, V-belts, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, **Coupling:** Brief introduction of coupling, Rigid couplings - muff, split muff and flange couplings, flexible couplings - flange coupling	**10**

Course outcomes:

1. Understand the concepts of fluid properties like specific gravity, viscosity, density, surface tension.
2. To study the classification of turbines and work done and efficiency of the different turbines and also study about draft tube theory and to determine the function efficiency.
3. This study is also used for the estimation of efficiency and performance of the turbine with the study of characteristics curves.
4. To study automobile engine working, valve timing and associated systems such as lubricating system, cooling system, fuel feed system, ignition system etc., their necessity, requirements, construction details, different types and their working
5. To study the construction, working principles and advantages of belt and rope drives, selection of belt drive- types of belt drives, V-belts, types of coupling.

TEXT BOOKS:

1. Basic Mechanical Engineering / Pravin Kumar/ Pearson
2. Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.
3. Introduction to Engineering Materials / B.K. Agrawal/ McGraw Hill

REFERENCES:

1. Fundamental of Mechanical Engineering/ G.S. Sawhney/PHI
2. Thermal Science and Engineering / Dr. D.S. Kumar/ Kataria

Question paper pattern:

1. Question paper contains 10 Questions, 2 from each course outcome. The student must answer 5 full questions by selecting one question from each course outcome (Internal Choice)
2. All questions carries 14 marks each
3. Each full question will have sub question covering all topics under a course outcome

Industrial Robotics			
Subject Code	18XXMEOX0XC	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Course Objectives:

Enable the students to

1. Understand various applications of robotics and classification of coordinate system and control systems
2. Build the concepts of components of industrial robotics.
3. Determine kinematic analysis with D-H notation, forward and inverse kinematics
4. Model trajectory planning for a manipulator by avoiding obstacles
5. Understand different types of actuators and importance of application of robots in manufacturing

Unit -1	**Hours**
Introduction: Automation and Robotics, CAD/CAM and Robotics – An overview of Robotics –present and future applications – classification by coordinate system and control system.	10
Unit -2	
Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.	10
Unit – 3	
Motion Analysis: Homogeneous transformations as applicable to rotation and translation – problems. Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.	10
Unit – 4	
Trajectory Planning: General considerations in path description and generation. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages-description of paths with a robot programming language.	10

Unit – 5

Robot Actuators and Feed Back Components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors– potentiometers, resolvers, encoders – Velocity sensors. Robot Applications in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.	10

Course outcomes:

1. Understand various applications of robotics and classification of coordinate system and control systems
2. Build the concepts of components of industrial robotics.
3. Apply kinematic analysis with D-H notation, forward and inverse kinematics
4. Model trajectory planning for a manipulator by avoiding obstacles.
5. Understand different types of actuators and various applications of robots in manufacturing

TEXT BOOKS:

1.Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John J. Craig/ Pearson

REFERENCES:

1. Introduction to Robotics/ Saeed B Niku / Wiely Publications.

Question paper pattern:

1. Question paper contains 10 Questions, 2 from each course outcome. The student must answer 5 full questions by selecting one question from each course outcome (Internal Choice)
2. All questions carries 14 marks each
3. Each full question will have sub question covering all topics under a course outcome

ENGINEERING MATERIALS SEMESTER XX			
Subject Code	18XXMEOX0XD	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits - 03

Course objectives:

This course will enable students to:

1. Classify different bonds in solids and understand crystallization of the metals, for the formation of the solid solutions and compounds.
2. Understand different phase diagrams .
3. Recorgnize the property requirements of a given application and suggest a suitable ferrous and non ferrous metal and their alloys.
4. Illustrate the property requirements of a given application and suggest appropriate heat treatment
5. Identify the property requirements of a given application and suggest a suitable ceramics, composite materials
6. Identify the relationships between structure, composition and properties of different engineering materials.

Unit -1	**Hours**
Structure of Metals and Constitution of alloys: Bonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size. Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds. Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery.	**10**
Unit -2	
Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Isomorpous alloy systems, equilibrium cooling and heating of alloys, lever rule, coring, miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys.	**8**
Unit - 3	
Ferrous & non-ferrous metals and their alloys Structure and properties of white cast iron, malleable cast iron, grey cast iron, spheroid graphite cast iron, alloy cast irons. Classification of steels, structure and properties of plain carbon steels, low alloy steels, Hadfield manganese steels, tool and die steels. Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys	**12**
Unit – 4	
Heat treatment of Alloys: Annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface-hardening methods (carburizing, carbo-nitriding, cyaniding, induction hardening and flame hardening), age hardening treatment, and cryogenic treatment of alloys. vacuum and plasma hardening	**8**

Unit-5

Ceramic and composite materials: Crystalline ceramics, glasses, cermets, abrasive materials, nanomaterial's – definition, properties and applications of the above. Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and C – C composites.	**12**

Course outcomes:

On completion of the course, student will be able to

1. Classify different bonds in solids and understand crystallization of the metals, for the formation of the solid solutions and compounds.
2. Different phase diagrams and study of binary phase diagrams
3. Recorgnize the property requirements of a given application and suggest suitable ferrous & non ferrous alloys
4. Analyze the property requirements of a given application and suggest appropriate heat treatment
5. Identified the property requirements of a given application and suggest a suitable ceramics, composite materials
6. Understand the relationships between structure, composition and properties of different engineering materials

Text Books:

1. Introduction to Physical Metallurgy - Sidney H. Avener - McGrawHill
2. Essential of Materials science and engineering - Donald R.Askeland –Thomson

Reference Books:

1. Material Science and Metallurgy – V.D.Kodgire and S.V.Kodgire
2. Materials Science and engineering - Callister & Baalasubrahmanyam
3. Material Science for Engineering students – Fischer – Elsevier Publishers.
4. Material science and Engineering - V. Rahghavan
5. Introduction to Material Science and Engineering – Yip-Wah Chung CRC Press.
6. Material Science and Metallurgy – A V K Suryanarayana – B S Publications.
7. Material Science and Metallurgy – U. C. Jindal – Pearson Publication

Web Source References:

1. https://www.iitm.ac.in/mmresearch
2. http://nptel.ac.in/courses/113106032/3
3. https://en.wikipedia.org/wiki/Materials_science

Question paper pattern:

1. Question paper contains 10 Questions, 2 from each course outcome. The student must answer 5 full questions by selecting one question from each course outcome (Internal Choice)
2. All questions carries 14 marks each
3. Each full question will have sub question covering all topics under a course outcome

INTRODUCTION TO MATERIAL HANDLING SEMESTER - XX			
Subject Code	18XXMEOX0XE	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

COURSE OBJECTIVES:

Students should be able

1. To understand the classification of material handling equipment
2. To explain the usage of different material handling equipment in industry
3. To know how to connect loading stations to the different discharge conditions.
4. To explain the usage of cranes at industries
5. To explain the usage of hoists and monorails at industries

Unit -1	**Hours**
Introduction to materials handling, examples of materials equipment, examples of materials handling equipment, continuous conveying, intermittent conveying, examples, lifting, hoisting, handling of bulk goods and piece goods, cranes and conveyors, principles of calculation of conveying equipment, cycle time, bulk materials and bulk density, angle of repose, example for a belt conveyor and a simple hoist.	**10**
Unit -2	
Belt conveyors, constructional details, toughing angle, idlers, belt specifications, chutes, skirt boards, ploughs, belt conveyor layouts, belt trippers and typical examples, roller conveyors, overhead conveyors, apron conveyors, component parts and operational details and applications with typical layouts.	**10**
Unit – 3	
Unit materials handling and storage: Unit load concept (platform sheet industrial hand trucks, self contained unit load, palletless handling, introduction only), industrial hand trucks, powered industrial trucks, automated guided vehicles, basic storage and equipment system, Automated storage and retrieval systems (AS/RS), carosel storage system and its applications.	**10**
Unit – 4	
Cranes Jib cranes like wall mounted and travelling type, stability criteria, wheel loads, wheel trucks and bogeys, number of mechanisms in jib cranes, jib construction. Harbour cranes, luffing and level luffing cranes, shipyard gantry cranes,	**10**
Unit – 5	
Hoists and monorails Portal frames and slewing rings and bearings typical stability, calculations of portal cranes, types of hoists	**10**

Course outcomes:

1. Classify the material handling equipment
2. Explain the usage of different material handling equipment in industry
3. Discuss how to connect loading stations to the different discharge conditions
4. Associate the usage of cranes at industries

TEXT BOOKS

1. Material handling handbook, 2nd edition, ASME, 1985
2. Automation production systems and computer integrated manufacturing, Mikell P Groover, Prentice Hall of India, 2002

REFERENCE BOOK

1. R.O. Bailey, "Bulk material handling by conveyor belt I and II" M.A. Al
2. Frutchbaum, " Bulk solids handling

Question paper pattern:

1. Question paper contains 12 Questions, 2 from each course outcome. The student must answer 6 full questions by selecting one question from each course outcome (Internal Choice)
2. CO1- CO5 questions carries 12 marks each
3. Each full question will have sub question covering all topics under a course outcome

PRODUCTION PLANNING AND CONTROL SEMESTER - XX			
Subject Code	118XXMEOX0XF	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

Course Objectives:

Enable the students to

1. Understand the concepts of production design concepts for production and service systems
2. Apply forecasting techniques for various firms, namely qualitative & quantitative methods to optimize/make best use of resources in achieving their objectives.
3. Identify different strategies employed in manufacturing and service industries to plan inventory
4. Apply different scheduling policies in planning and control and make best use of resources.
5. Measure the effectiveness, identify likely areas for improvement, develop and implement improved planning and control methods for production systems.

Unit -1	**Hours**
Introduction: Definition – objectives and functions of production planning and control – elements of production control – types of production – organization of production planning and control department – internal organization of department.	**10**
Unit -2	
Forecasting – importance of forecasting – types of forecasting, their uses – general principles of forecasting – forecasting techniques – qualitative methods and quantitative methods.	**10**
Unit – 3	
Inventory management – functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ models – Inventory control systems – P– Systems and Q-Systems **Material Management Techniques:** Introduction to MRP I, MRP II, ERP, LOB (Line of Balance), JIT and KANBAN system.	**12**
Unit – 4	
Routing & Scheduling– definition – routing procedure –route sheets – bill of material – factors affecting routing procedure, schedule –definition – difference with loading, Scheduling policies – techniques, standard scheduling methods, line balancing, aggregate planning	**10**
Unit – 5	
Dispatching– activities of dispatcher – dispatching procedure – follow up– definition – reason for existence of functions – types of follow up, expediting, controlling aspects. Applications of computer in production planning and control.	**8**

Course outcomes:

On completion of this course, students will be be able to:

1. **Choose** the acceptable production planning and control system for designing and development of a product.

2. **Examine** the forecasts made in the manufacturing and service sectors by using selected quantitative and qualitative techniques.
3. **Categorize** the production systems based on the inventory principles and techniques to optimize/make best use of resources.
4. **Select and use** an appropriate principles/methods/ techniques/ modern concept with reference to given application/situation in the preparation of route sheets with scheduling and loading in manufacturing systems
5. **Illustrate** the role of a dispatching and follow-up necessary at various stages of manufacturing in an industry.

1.

Text Books:

1. Elements of Production Planning and Control / Samuel Eilon.
2. Manufacturing, Planning and Control, Partik Jonsson Stig-Arne Mattsson, Tata Mc Graw Hill.
3. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran, GK Vijaya Raghavan & MS Balasundaram/WILEY India Edition

Reference Books:

1. Production Planning and Control, Mukhopadyay, PHI.
2. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller/Prentice-Hall
3. Production Control A Quantitative Approach / John E. Biegel/Prentice-Hall

Question paper pattern:

1. Question paper contains 10 Questions, 2 from each course outcome. The student must answer 5 full questions by selecting one question from each course outcome (Internal Choice)
2. CO1- CO5 questions carries 14 marks each.
3. Each full question will have a sub question covering all topics under a course outcome.

NON-CONVENTIONAL SOURCES OF ENERGY SEMESTER-XX			
Subject code	18XXMEOX0XG	**Internal marks**	30
Number of lecture hours/Week	3(L)	**External marks**	70
Total No Of lecture hours	50	**Exam hours**	03
Credits-03			

Course Objectives:

Enable the students to:

1. Understand the principles and working of solar and solar energy collection.
2. Apply the principles of solar energy storage, applications in generation of electric power.
3. Apply the knowledge of Wind energy and Biomass, in generation of electric power production.
4. Apply the Principles and working of Geothermal energy power plant, OTEC plants, tidal, wave energy and Mini hydel power plants in generation of the electric power
5. Apply the principles of direct energy conversion systems like Thermoelectric generators, MHD generators and fuel cells, in generation of electric power production

Unit-1	**Hours**
Principles of Solar Radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power - the solar constant, extra-terrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data. **Solar Energy Collection:** Flat plate and concentrating collectors, classification of concentrating collectors, advanced collectors..	**8**
Unit-2	
Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications - solar heating/cooling techniques, solar distillation and drying, photovoltaic energy conversion.	**6**
Unit-3	
Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria **Bio-Mass:** Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of biogas, utilization for cooking, I.C. Engine operation, and economic aspects.	**10**
Unit-4	
Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India. Ocean Energy – OTEC, Principles, utilization, setting of OTEC plants, thermodynamic cycles. **Tidal and Wave energy:** Potential and conversion techniques, mini-hydel power plants, their economics.	**10**
Unit-5	
Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermoelectric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principle, faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.	**16**

Course outcomes:

1. The student understands the principles and working of solar and solar energy collection.
2. The students apply the principles of solar energy storage, applications in power generation.
3. The students Apply the knowledge of Wind energy and Biomass, in generation of power
4. The students Apply the Principles and working of Geothermal energy power plant, OTEC plants, tidal, wave energy and Mini hydel power plants in generation of the electric power.
5. Apply the principles of direct energy conversion systems like Thermoelectric generators, MHD generators and fuel cells, in generation of electric power.

Text books:

1. Renewable Energy Resources / Tiwari and Ghosal / Narosa
2. Non- conventional Energy Sources / G.D. Rai/ Khanna Publishers
3. Biological Energy Resources/ Malcolm Fleischer & Chris Lawis/ E&FN Spon

Reference books:

1. Renewable Energy Sources / Twidell& Weir
2. Solar Power Engineering / B.S. Magal Frank Kreith& J.F. Kreith
3. Principles of Solar Energy / Frank Krieth& John F Kreider
4. Non-Conventional Energy / Ashok V Desai / Wiley Eastern

Question paper pattern:

1. Question paper contains 10 questions,2 from each course outcomes, the student must answer 5 full questions by selecting one question from each course outcome (Internal choice)
2. All question carries 14 marks each
3. Each full question will have sub question covering all topics under a course outcome

FLUID MECHANICS AND FLUID MACHINERY SEMESTER -XX			
Subject Code	18XXMEOX0XH	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

1. Understand the fundamental properties of fluid and calculate fluid pressure using the manometer.
2. Apply the differential conservation equations of mass, momentum, and energy to fluid flow problems.
3. Evaluate major and minor losses in pipes and also discuss boundary layer concepts.
4. Solve problems on the turbo machines like turbines using analytical method and velocity triangles.
5. Discuss the Classification and working principles of pumps and evaluate the performance of hydraulic machines.

Unit -1	**Hours**
Fluids: Definition of fluid, Fluid properties, Atmospheric gauge and vacuum pressure – measurement of pressure. Manometers- Piezometer, U-tube, inverted and differential manometers. Pascal's law, hydrostatic law. Buoyancy, forces on submerged bodies, stability of floating bodies.	**10**
Unit -2	
Fluid Kinematics: Introduction, flow types. Equation of continuity for one dimensional flow. Stream line, path line and streak lines and stream tube. Stream function and velocity potential function. **Fluid Dynamics:** surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend.	**10**
Unit – 3	
Closed Conduit Flow: Reynold's experiment- Darcy Weisbach equation, Minor losses in pipes- pipes in series and pipes in parallel- total energy line hydraulic gradient line. **Basics of Turbo Machinery:** Hydrodynamic force of jets on stationery and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.	**10**

Unit – 4	
Turbines: Hydraulic Turbines: classification of turbines, Working and efficiencies of Pelton wheel, Francis and Kaplan turbines. Importance of Draft Tube. **Hydraulic Quantities:** Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.	**10**
Unit – 5	
Pumps: Centrifugal Pumps: Classification, working, work done – manometric head losses and efficiencies- specific speed- pumps in series and parallel performance characteristic curves, cavitation & NPSH. Reciprocating Pumps: Working, Discharge, slip, indicator diagrams.	**10**

Course outcomes:

1.Demonstrate various properties of fluids, pressure measurement devices and their applications.

2.Identify the kinematics and dynamics properties of fluids flowing in different conditions and its effects on the bodies.

3.Estimate the effect of various losses in fluids due to flowing and obstructions and understand using the concepts of pipe losses and Boundary layer theory.

4. Analyze the performance of hydraulic turbines, units and specific quantities based on the design by applying the knowledge of turbomachinery using analytical methods and velocity triangles.

5. Analyze the performance of various hydraulic pumps based on workings and design.

TEXT BOOKS

1. Hydraulics, fluid mechanics and Hydraulic machinery Modi and Seth
2. Fluid Mechanics and Hydraulic Machines/ RK Bansal/Laxmi Publications (P) Ltd.

REFERENCE BOOKS

1. Fluid Mechanics and Hydraulic Machines by Rajput
2. Fluid Mechanics & Turbo machinery by Dixon, 7th Edn, Elesvier
3. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International
4. Fluid Mechanics- Fundementals and Applications by Y.A. Cengel, J.M.Cimbala, 6th Edn, McGrawHill
5. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons.

Question paper pattern:

1. Question paper contains 10 Questions, 2 from each course outcome. The student must answer 5 full
   questions by selecting one question from each course outcome (Internal Choice)
2. All questions carries 14 marks each
3. Each full question will have sub question covering all topics under a course outcome