REGULATIONS
COURSE STRUCTURE
AND SYLLABUS

SITE-18M REGULATIONS

For

Mechanical Engineering

With effective from the Academic Year

2020-21

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 Honourable 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.

Complimenting 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.

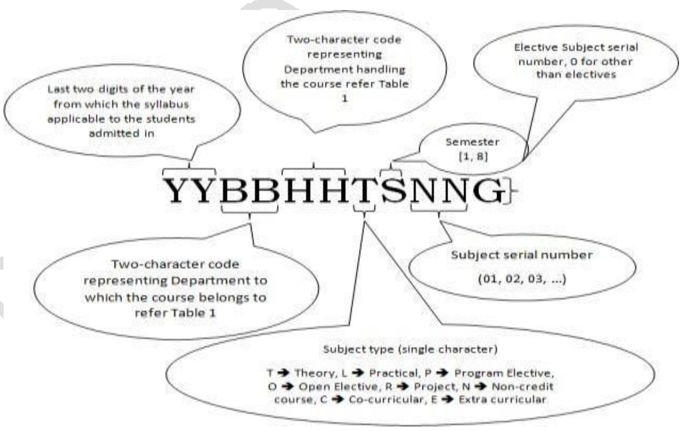

Figure 1: Course Numbering Scheme

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	26	25	24	26	25	26	26	26
3	Engineering Science courses	24	23	20	20	29	29.5	24	23	29	24.5
4	Professional Core courses	48	56	53	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	11	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 –	In case of students of the college, they shall be expelled from

	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.	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.

B. Tech. (Mechanical Engineering)
Semester I (First Year) Approved Course structure

S.No.	Course Code	CC	Course Title	L	T	P	C
1.	18CMEGT1010	HSMC	Technical English	3	0	0	3
2.	18CMMAT1020	BSC	Engineering Mathematics-I	3	1	0	4
3.	18CMCHT1030	BSC	Engineering Chemistry	3	1	0	4
4.	18CMEET1040	ESC	Basic Electrical Engineering	3	1	0	4
5.	18CMEGL1050	HSMC	English Communication skills lab	0	0	2	1
6.	18CMCHL1060	BSC	Engineering Chemistry Lab	0	0	3	1.5
7.	18CMEEL1070	ESC	Basic Electrical Engineering Lab	0	0	3	1.5
8.	18CMMSN1080	MC	Constitution of India, Professional Ethics & Human Rights	3	0	0	0
			Total	**11**	**03**	**07**	**19**

B.Tech. (Mechanical Engineering)
Semester II (First Year) Approved Course structure

S.NO.	Course Code	CC	Course Title	L	T	P	C
1.	18CMMAT2010	BSC	Engineering Mathematics-II	3	1	0	4
2.	18MEPHT2020	BSC	Engineering Physics	3	1	0	4
3.	18CMCST2030	ESC	Programming for Problem Solving	3	0	0	3
4.	18CMMEL2040	ESC	Engineering Graphics	1	0	4	3
5.	18MEPHL2050	BSC	Engineering Physics Lab	0	0	3	1.5
6.	18CMCSL2060	ESC	Programming for Problem Solving lab	0	0	4	2
7.	18CMMEL2070	ESC	Work Shop/Manufacturing Practice	0	0	3	1.5
8.	18CMCHN2080	MC	Environmental Science	3	0	0	0
			Total	**11**	**02**	**15**	**19**

ECHNICAL ENGLISH SEMESTER - I			
Subject Code	18CMEGT1010	Internal Marks	30
Number of Lecture Hours/ Week	03	External Marks	70
Total Number of Lecture Hours	50	Exams Hours	03
Credits -03			

Course Objectives:
To enable the students to learn and apply fundamental principles in Technical English & Communication by focusing on:

1. Technical English Vocabulary
2. Writing Skills
3. Common Errors in Writing
4. Nature and Style of Sensible Technical Writing
5. Writing Technical Reports and Letters
6. Providing an inspiring reading experience from the biography of a renowned technocrat.

Unit I	
Principles of Scientific Vocabulary • **Principles of Scientific vocabulary**: short and simple words-compact substitutes for wordy phrases- redundant words and expressions-Avoid hackneyed and stilted phrases, verbosity and incorrect use of words • The role of roots in word building, prefixes and suffixes, confusing words and expressions. Non-detailed text-Karmayogi: 1-4 chapters, Page No 1-53	10 hours
Unit II	
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 Non-detailed text- Karmayogi: 5-8 chapters, Page No 54-100	10 hours
Unit III	
Common Errors in Writing • Subject-verb agreement and 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** Non-detailed text-Karmayogi: 9-12 chapters, Page No101-151	10 hours
Unit IV	
Nature and Style of Sensible Technical Writing • Academic Writing Process • Describing, processes and products • Defining, Classifying • Effective use of charts, graphs, and tables Non-detailed text- Karmayogi: 13-16 chapters, Page No 152-203	10 hours
Unit V	
Report writing and Letter writing • Writing Technical Reports • Précis writing • Letter Writing • Essay writing Non-detailed text- Karmayogi: 13-16 chapters, Page No 204-250	10 Hours

Course Outcomes
On Completion of the course student will acquire 1. Ability to understand Scientific vocabulary and use them confidently 2. Familiarity with the basic principles of writing clear sentences and paragraphs 3. Ability to write error free simple technical passages 4. Knowledge of writing different writing styles 5. Confidence to write letters and technical reports clearly and coherently 6. Get inspired by achievements and values upheld by a renowned technocrat.
Question Paper Pattern

Section –A
1. 10 questions carrying one mark each
2. Five questions each from Units I and III

Section –B
1. 5 questions carrying 12 marks each (one compulsory question from non-detailed text)
2. Each question will have two or three sub questions covering all the units

Text Books
1. Effective Technical Communication by Barun K Mitra, Oxford University Publication Non-detailed Text
2. Karmayogi: A Biography of E Sreedharan by M S Ashokan

Reference Books
1. **Communication Skills by Sanjay Kumar &PushpaLatha, OUP**
2. Study Writing by Liz Hamp-Lyons and Ben Heasly, Cambridge University Press.
3. Remedial English Grammar by F T Wood, Macmillian 2007
4. Practical English Usage by Michael SwanOxford University Press
5. English Collocations in Use by Michael McCarthy & Felicity O'Dell
6. Effective Technical Communication by Arsahf Rizvi,
7. Essential English Grammar by Raymond Murphy, CUP, 2017

<table>
<tr><td colspan="4">ENGINEERING MATHEMATICS-I
SEMESTER - I</td></tr>
<tr><td>Subject Code</td><td>18CMMAT1020</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3+ 1(T)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 04</td></tr>
<tr><td colspan="4">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 solve first order differential equations.
2. To solve linear differential equations with constant coefficients.
3. To find the extrema of a function.
4. To solve partial differential equations
5. To evaluate multiple integrals
6. To verify vector integral theorems</td></tr>
<tr><td colspan="3">Unit -1</td><td></td></tr>
<tr><td colspan="3">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.</td><td>Hours – 10</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">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</td><td>Hours – 8</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="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-Lagranges method of undetermined multipliers</td><td>Hours – 10</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">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 non linear (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.</td><td>Hours – 10</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">Double and triple integrals: Evaluation of double and triple integrals. Evaluation of double integrals by changing the order of integration and by changing 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.</td><td>Hours – 12</td></tr>
<tr><td colspan="4">Course outcomes:
On completion of this course, students are able to
1. Solve first order differential equations.
2. Solve linear differential equations with constant coefficients.
3. Find the extrema of a function.
4. Solve partial differential equations
5. Evaluate multiple integrals
6. Verify vector integral theorems</td></tr>
</table>

Question paper pattern:
Text Books: 1. B.S. Grewal, **"Higher Engineering Mathematics"**, Khanna publishers, 44th edition, 2016. 2. Erwin Kreyszig, **"Advanced Engineering Mathematics**, Wiley, 9th edition, 2013.
Reference Books: 1. B.V. Ramana, **"Higher Engineering M athematics"**, Tata Mc Graw-Hill, 2006 2. N.P.Bali and Manish Goyal, **"A text book of Engineering mathematics"**, Laxmi publications, latest edition. 3. H.K. Dass and Er. RajnishVerma, **"Higher Engineerig Mathematics"**, S.Chand publishing, 1st edition, 2011.

ENGINEERING CHEMISTRY

SEMESTER - I

Subject Code	18CMCHT1030	Internal Marks	30
Number of Lecture Hours/Week	3(L) + 1(T)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 04

COURSE OBJECTIVES:

The objectives of this course, help the students to

1. Rationalize periodic properties like ionization potential, electronegativity and oxidation states.
2. Apply the concepts of electrochemistry.
3. Analyze bulk properties and processes using thermodynamic considerations.
4. List major chemical reactions that are used in the synthesis of molecules.
5. Understand the concepts of atomic and molecular orbitals.
6. Know various spectroscopic techniques.

Unit -1	
PERIODIC PROPERTIES Effective nuclear charge of fluorine 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 & 3 and geometries, hard soft acids and bases.	**Hours – 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 dissolved salts, chloride content, break point chlorination. **Corrosion:** Wet chemical theory, control methods – proper designing, cathodic protection-Sacrificial anodic and impressed current cathodic protection.	**Hours – 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.	**Hours – 10**
Unit – 4	
ATOMIC, MOLECULAR STRUCTURE AND ADVANCED MATERIALS Schrodinger equation. Particle in a box solution and their applications for conjugated molecules. **Nanoparticles**: Introduction, preparation methods – Sol-gel method, Chemical reduction method – properties and applications. **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.	**Hours – 10**
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.	**Hours – 10**

COURSE OUTCOMES:

On completion of the course student will be

1. Able to rationalise periodic properties like ionization potential, electro negativity and oxidation states.
2. Able to know the nature and working of various electrodes.
3. Able to analyze bulk properties and processes using thermodynamic considerations.
4. Able to synthesize organic molecules using different types of chemical reactions.
5. Able to understand the concepts of atomic and molecular orbitals.
6. Able to gain knowledge on spectroscopic techniques and the ranges of the electromagnetic spectrum used for exciting different molecular energy levels.

QUESTION PAPER PATTERN:

SECTION A:

1. This section contains ten one answer questions carrying 1 mark each.
2. Two questions from each unit should present.

SECTION B:

1. This section will have 5 questions with internal choice.
2. Each full question carries 12 marks.
3. Each full question will have sub question covering all topics under a unit.

TEXT BOOKS:

1. Stereochemistry of Carbon Compounds by Ernest Eliel; McGraw Hill Education.
2. Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
3. Concise Inorganic Chemistry, J.D.Lee, 5th Edition; Wiley India.
4. Engineering Chemistry – Fundamentals and applications by Shikha Agarwal; Cambridge University Press
5. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp
6. Engineering Chemistry by Jain & Jain; Dhanpat Rai Publishing Company

REFERENCE BOOKS:

1. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan.
2. Physical Chemistry, by P. W. Atkins.
3. Physical Chemistry, by Glasstone, S
4. Advanced inorganic chemistry by Wilkinson G and Cotton FA

BASIC ELECTRICAL ENGINEERING
SEMESTER-I

Subject Code	18CMEET1040	Internal Marks	30
Number of Lecture Hours/week	3(L)+1(T)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 04

Course Objectives:
This course will enable student to :
- Describe the basics electrical circuit concepts and how to apply the various theorems for given electrical network
- Describe the representation of sinusoidal waveform and also analysis of single phase ac circuit with various elements
- Describe the principle and operation of ac and dc electrical machines
- Describe the basic operation of different converters circuits
- Describe the necessity of the batteries and importance of the basic switch gear unit

Module -1	
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, Thevenins and Norton Theorems (Simple numerical problems). Time-domain analysis of first-order RL and RC circuits.	**Hours-10**
Module – 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.	**Hours-10**
Module – 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.	**Hours-10**
Module – 4	
Electrical Machines: Ac machines- Generation of rotating magnetic fields, construction details and working of three phase 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.	**Hours-10**
Module – 5	
Power Converters and Electrical Installations DC – DC Buck and boost converters, duty ratio control, PWM techniques, single phase voltage source inverters. Classification of batteries and Low Voltage switch gear.	**Hours-10**

Course outcomes:
On completion of the course student will be
1. Able to analyze DC circuits by using KCL, KVL and Network theorems
2. Able to analyze AC circuits
3. Able to explain the operation and compute performance of transformer
4. Able to explain the construction and working of rotating electrical machines
5. Able to describe DC-DC and DC-AC converters
6. Able to explain about types of LV switch gear and types of batteries

Question paper pattern:

Test books.

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010
2. D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. D.P. Kothari, I.J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010. T4. J.P. Tewari,

“Basic Electrical Engineering”, New Age International Publishers, 2003.

References

1. M.D. Singh, “Power Electronics”, 2nd edition.
2. “Battery Energy Storage for Smart Grid Applications”, Eurobat 2013.
3. L.S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 1996. R4. V.D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.
4. R.M. Dell, D.A.J. Rand, “Understanding Batteries”, 2001.
5. Bhavesh Bhalja, R.P., Maheshwari, Nilesh G. Chothani, “Protection and Switchgear”, Oxford University Press, 5th impression, 2014.

English Language Communication Skills Lab SEMESTER - I			
Subject Code	18CMEGL1050	Internal Marks	50
Number of Practical Hours/Week	02	External Marks	50
Total Number of Practical Hours	32	Exam Hours	03
Credits – 01			

Objectives: To enable the students to learn communication skills of Listening, Speaking, Reading and Writing by focusing on:

- Listening Comprehension
- Pronunciation
- Functional English in formal and Informal Situations
- Interpersonal Communication Skills
- Presentation Skills

List of Experiments

UNIT I

Listening Comprehension

UNIT II

Pronunciation , Stress, Intonation & Rhythm

UNIT III

Common Everyday Situations: Conversations & Dialogues, Communication at Workplace

UNIT IV

Interpersonal Communication Skills- Group discussions and debates

UNIT V

Formal Presentations

Outcomes:

By the end of the course the students will be able to acquire basic Proficiency in English by practicing the following:

- Listening Comprehension
- Pronunciation
- Dialogues
- Interpersonal Communication Skills
- Presentation Skills
- Discussions and Debates

Learning Resources:

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

ENGINEERING CHEMISTRY LABORATORY SEMESTER - I			
Subject Code	18CMCHL1060	Internal Marks	50
Number of Practice Hours/Week	03	External Marks	50
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

COURSE OBJECTIVES:

The objectives of this course, help the students to

1. Measure molecular properties like surface tension and viscosity
2. Determine chloride content of water of given water sample.
3. Familiarize the synthesis of a simple drug.
4. Determine rate constant as a function of time.
5. Determine the strength of acids using conductivity meter.
6. Determine amount of Fe (II) using potentiometer.

List of Experiments

(Any 10 experiments must be conducted)

1. Determination of surface tension
2. Determination of viscosity of a liquid by Ostwald viscometer
3. Thin layer chromatography
4. Determination of chloride content of water
5. Determination hardness of water by EDTA.
6. Determination of the rate constant of first order reaction (Ester hydrolysis)
7. Determination of strength of strong acid using conductometeric titration.
8. Determination of strength of weak acid using conductometeric titration .
9. Determination of Ferrous iron using potentiometer.
10. Synthesis of a drug – Aspirin
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Determination of strength of acetic acid using charcoal adsorption.

Demonstration Experiments:

1. Preparation of lattice structure and determination of atomic packing factor.
2. Chemical oscillations- Iodine clock reaction
3. Synthesis of Phenol formaldehyde resin
4. Saponification of oil

COURSE OUTCOMES:

On completion of the course student will be

1. Able to measure molecular properties like surface tension and viscosity
2. Able to determine chloride content of given water sample.
3. Able to synthesize a drug.
4. Able to determine rate constant as a function of time.
5. Able to determine strength of acids using conductivity meter.
6. Able to determine amount of Fe (II) using potentiometer.

BASIC ELECTRICAL ENGINEERING LAB SEMESTER-I			
Subject Code	18CMEEL1070	Internal Marks	50
Number of Practice Hours/Week	3P	External Marks	50
Total Number of Practice Hours	32	Exam Hours	03
Credits – 1.5			

The objectives of this course, help the students to

1. Learn how to find the frequency response and resonance of RL & RC circuits
2. Learn how to verify the given networks using theorems
3. Learn how to measure the power and determination of efficiency of a single phase transformer and how to measure the power in three phase transformer
4. Learn how to determine the Torque-slip characteristics of a dc shunt and induction motors.
5. Learn how to find the regulation of an alternator
6. Learn the operation of different converter circuits and know about the switch gear system

List of Experiments (Any Ten experiments must be conducted)

1. Study of R-L,R-C,R-L-C circuits.
2. Verification of superposition theorem.
3. Verification of Thevenin’s and Norton’s theorems.
4. Series and Parallel resonance of RL and RC circuits.
5. Open circuit & Short circuit tests on a single phase transformer.
6. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
7. Speed control of DC shunt motor.
8. Torque Speed Characteristic on single phase induction motor
9. Regulation of Alternator.
10. Demonstration of Buck and Book converter
11. Demonstration of Voltage Source Inverter
12. Demonstration of Low Voltage Switch gear.

COURSE OUTCOMES:

On completion of this course, students are

1. Able to determine the time response and resonance of given RL, RC and RLC circuits
2. Able to determine the response using Superposition, Norton and Thevinins.
3. Able to determine the power , efficiency and regulation of ac machines
4. Able to determine the speed torque characteristics of dc and induction motors
5. Able to analyze the operation of Buck and boost converter and voltage source inverter.
6. Able to analyze the operation of LV Switch gear system.

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS & HUMAN RIGHTS

SEMESTER - I

Subject Code	18CMMSN1080	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 00

COURSE OBJECTIVES:

The objectives of this course help the students to

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

Unit -1	
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.	**Hours – 10**
Unit -2	
Lesson: Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties. Union Executives – President, Prime Minister Parliament Supreme Court of India.	**Hours – 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 &91^{st} Amendments.	**Hours – 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 in Human Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchyats and Co - Operative Societies.	**Hours – 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.	**Hours – 10**

COURSE OUTCOMES:

On completion of the course student will

1. Have general knowledge and legal literacy and thereby to take up competitive examinations.
2. Understand state and central policies, fundamental duties.
3. Understand Electoral Process, special provisions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies, and
5. Understand Engineering ethics and responsibilities of Engineers
6. Understand Engineering Integrity & Reliability

QUESTION PAPER PATTERN:

SECTION A:

1. This section contains ten one answer questions carrying 1 mark each.
2. Two questions from each unit should present.

SECTION B:

1. This section will have 5 questions with internal choice.
2. Each full question carries 12 marks.
3. Each full question will have sub question covering all topics under a unit.

TEXT BOOKS:

Text Books:

1. Durga Das Basu: **"Introduction to the Constitution on India",** (Students Edn.) Prentice –Hall EEE, 19th / 20th Edn., 2001
2. Charles E. Haries, Michael S Pritchard and Michael J. Robins **"Engineering Ethics"** Thompson Asia, 2003-08-05.

REFERENCE BOOKS:

1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
2. M.Govindarajan, S.Natarajan, V.S.Senthilkumar, **"Engineering Ethics",** Prentice –Hall of India Pvt. Ltd. New Delhi, 2004
3. Brij Kishore Sharma,**" Introduction to the Constitution of India"**, PHI Learning Pvt. Ltd., New

Delhi, 2011.

4. Latest Publications of Indian Institute of Human Rights, New Delhi

ENGINEERING MATHEMATICS-II

SEMESTER - II

Subject Code	18CMMAT2010	Internal Marks	30
Number of Lecture Hours/Week	3(L)+ 1(T)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 04

Course objectives:

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

- To solve system of linear equations
- To find eigen values and eigen vectors of a matrix
- To solve initial value problems by using Laplace transforms
- To find the solution of algebraic/ transcendental equations and also interpolate the functions.
- To evaluate numerical integration and to solve ordinary differential equations by using numerical methods.
- To find Fourier series of a periodic function and to determine the Fourier transform of a function

Unit	Hours
Unit -1	
Linear Algebra: 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, Diagonalisation of a square matrix. Cayley-Hamilton theorem (without proof) - Reduction of Quadratic form to Canonical form.	**10 Hours**
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 Hours**
Unit – 3	
Numerical Methods: Numerical solution of algebraic and transcendental equations by 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 Hours**
Unit – 4	
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-Eulers method-Modified Eulers method-Runge-Kutta methods	**8 Hours**
Unit – 5	
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.	**12 Hours**

Course outcomes:

On completion of this course, students are able to,

1. Solve system of linear equations
2. Find eigen values and eigen vectors of a matrix
3. Solve initial value problems by using Laplace transforms
4. Find the solution of algebraic/ transcendental equations and also interpolate the functions.
5. Evaluate numerical integration and to solve ordinary differential equations by using numerical methods.
6. Find Fourier series of a periodic function and to determine the Fourier transform of a function

Question paper pattern:

Text Books:

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

Reference Books:

1. B.V.Ramana "Higher Engineering M athematics" Tata Mc Graw-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. Rajnish Verma ,"Higher Engineerig Mathematics", S. Chand publishing,1st edition, 2011.
4. Dr.K.V.Nageswara Reddy and Dr.B.Rama Bhupal Reddy, “Engineering Mathematics, Volume II” Scitech Publications, 2017.

ENGINEERING PHYSICS
(Mechanics)
Common to CE and ME
SEMESTER - II

Subject Code	18MEPHT2020, 18CEPHT2020	Internal Marks	30
Number of Lecture Hours/Week	3+1(T)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 04

COURSE OBJECTIVES:

The objectives of this course, help the students

- To impart the knowledge of Newton's law of motion in central force field
- To understand the Motion of rigid body systems in a Non inertial frames of reference
- To describe the Rigid body dynamics

Unit -1	
One Dimensional motion Newton's law, Equation of motion in one dimension, Invariance of Newton's equations-under shift of coordinate system rotation of coordinate system, time translation, Time reversal, Mirror reflection, Galileo transformation, Accelerating frames of reference. Simple harmonic motion-Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.	**Hours – 10**
Unit -2	
Two dimensional motion Two Dimensional motion in the Cartesian coordinate system and in the radial polar coordinate system, Kepler's law, Kepler's problem of planetary motion and its solutions , Classification of Kepler's orbits.	**Hours – 9**
Unit -3	
Three dimensional motion Three dimensional motion in the Cartesian coordinate system –Example of Motion of charged particle, motion in non referential plane- Accelerating reference plane along a straight plane, Reference frame rotating with a constant angular velocity, Earth as a reference frame- study of the effects of earth rotations-Apparent gravitational acceleration, Effect of Coriolis force on terrestrial experiments and freely falling body.	**Hours – 10**
Unit – 4	
Conservative and non conservative force fields: Conservative and non conservative force fields, Gradient of a potential field, Curl of a vector field, Newton equations for variable mass system (rocket), System of particles and centre of mass.	**Hours – 9**
Unit – 5	
Rigid body dynamics Angular momentum of a single particle and system of particle, Definition of a rigid body, Equation of motion of rigid body, Euler's equation describing rigid body motion, Angular velocity, Kinetic energy of rigid body and moment of inertia, Parallel axis theorem.	**Hours –10**

COURSE OUTCOMES:

On completion of the course student will able to

1. Understand the conditions for invariance and non invariance of Newton's second law.
2. Distinguish the various harmonic motions and resonance.
3. Apply Kepler's laws to understand the planetary motions.
4. Formulate Five-term acceleration formula with consideration of earth rotation effect.
5. Understanding the concept of conservative and non conservative force fields.
6. Describe the rigid body dynamics and moment of inertia.

QUESTION PAPER PATTERN:

TEXT BOOKS:

1. Introduction to Mechanics — MK Verma.
2. An Introduction to Mechanics — D Kleppner & R Kolenkow.

REFERENCE BOOKS:

1. Principles of Mechanics — JL Synge & BA Griffiths.

PROGRAMMING FOR PROBLEM SOLVING SEMESTER - II			
Subject Code:	18CMCST2030	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits - 03			

Unit-I: Introduction to computer systems and programming	**Teaching 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.	**Hours - 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.	**Hours-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).	**Hours-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.	**Hours-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.	**Hours-08**

Text Books:
1. Computer Programing ANSI C, E Balagurusamy, Mc Graw Hill Education(Private), Limited (TB1)
2. Programming in C, Reema Thareja, Second Edition, Oxford Higher Education (TB2)

Reference Books:
1. Computer Basics and C Programming, V Raja Raman, Second Edition, PHI (RB1)

Course Outcomes:
Student can able to

1) Formulate algorithms, translate them into programs and correct program errors.
2) Choose right control structures suitable for the problem to be solved.
3) Decompose reusable code in a program into functions.
4) Make use of arrays, pointers, structures and unions effectively.
5) Store and retrieve data from permanent storage.
6) Learn file operations

Question paper pattern:

<table>
<tr><td colspan="4">ENGINEERING GRAPHICS
SEMESTER - II</td></tr>
<tr><td>Subject Code</td><td>18CMMEL2040</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>1(L)+04(P)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
<tr><td colspan="4">COURSE OBJECTIVES:
1. Students should be able to construct Polygons using general methods, inscribe and describe polygons on circles, draw curves (parabola, ellipse and hyperbola, cycloids, involutes by general methods
2. Students should be able to read, interpret and construct plain scales, diagonal scales and vernier scales
3. Student should be able to draw orthographic projections of points, lines, Planes & Solids inclined to one reference plane. Students are should be able to apply various concepts to solve practical problems related to engineering.
4. Student should be able to draw sections and sectional views of Solids
5. Student should be able to draw isometric view of lines, plane figures and simple solids. Student should be able to convert given isometric views into orthographic views. Students should be able to apply various concepts to solve practical problems related to engineering
6. Student should be able to draw objects using draw and modify toolbars of AutoCAD</td></tr>
<tr><td colspan="3">Unit -1</td><td></td></tr>
<tr><td colspan="3">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;</td><td>Hours– 10</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">Projections of Points and lines inclined to both planes; Projections of planes inclined to one plane</td><td>Hours– 08</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="3">Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes</td><td>Hours– 10</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone</td><td>Hours– 10</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">Isometric Projections covering, 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</td><td>Hours– 12</td></tr>
<tr><td colspan="4">COURSE OUTCOMES:
1. Students will be able to construct Polygons using general methods, inscribe and describe polygons on circles, draw curves (parabola, ellipse and hyperbola, cycloids, involutes by general methods
2. Students will be able to read, interpret and construct plain scales, diagonal scales and vernier scales
3. Student will be able to draw orthographic projections of points, lines, Planes & Solids inclined to one reference plane. Students will be able to apply various concepts to solve practical problems related to engineering.
4. Student will be able to draw sections and sectional views of Solids
5. Student will be able to draw isometric view of lines, plane figures and simple solids. Student will be able to convert given isometric views into orthographic views. Students will be able to apply various concepts to solve practical problems related to engineering
6. Student will be able to draw objects using draw and modify toolbars of AutoCAD</td></tr>
<tr><td colspan="4">QUESTION PAPER PATTERN:
SECTION A: (14M)
1. This section contains four questions carrying different weightage.
SECTION B: (4x14=56M)
1. This section will have 5 questions with internal choice.
2. Each full question carries 14 marks.
3. Each full question will have sub question covering all topics under a unit.</td></tr>
</table>

Text/Reference Books:

1. Engineering Drawing by N.D. Bhatt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers
3. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
4. Engineering Graphics for Degree by K.C. John, PHI Publishers
5. Engineering Graphics by PI Varghese, McGrawHill Publishers
6. Engineering Drawing + AutoCAD – K Venugopal, V. Prabhu Raja, New Age

ENGINEERING PHYSICS LABORATORY Common to CE&ME SEMESTER - II			
Subject Code	18CEPHL2050, 18MEPHL2050	Internal Marks	50
Number of Practice Hours/Week	03	External Marks	50
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

COURSE OBJECTIVES:

The objectives of this course, help the students

- To apply the theoretical knowledge of Physics through hands on the experimental instruments
- To improve the experimental knowledge in the later studies
- To understand the basic need of experiments.
- To know how to measure the different physical quantities.

List of Experiments

1. To investigate the Motion of Coupled Oscillators
2. To determine the rigidity modulus η of wire-Torsional pendulum.
3. To determine acceleration due to gravity g and radius of gyration K - Compound pendulum.
4. To determine the Frequency of an electrically maintained tuning fork by Melde's Experiment.
5. To determine the velocity of sound in air-Volume resonator.
6. To verify the transverse law of vibrations-Sonometer.
7. To determine the young's modulus and draw load depression graph in uniform bending.
8. To determine the Moment of Inertia of a Flywheel.
9. To verify the parallel axis and perpendicular axis theorems and determine the moment of inertia of a regular rectangular body -Bifilar pendulum.
10. To study of oscillations Spiral spring.

COURSE OUTCOMES:

On completion of the course student will able to

1. Study the mode of vibrations in Coupled Oscillators
2. Determine the g & η values using the knowledge in simple harmonic motions.
3. Apply the phenomenon of resonance to verify the transverse laws of stretched string.
4. Determine the frequency of vibrating body, velocity of sound in air using resonance.
5. Determine the moment of inertia of a rigid body.
6. Verify the parallel axis and perpendicular theorems of moment of inertia.

PROGRAMMING FOR PROBLEM SOLVING LAB SEMESTER - II			
Subject Code	18CMCSL2060	Internal Marks	50
Number of Practice Hours/Week	04	External Marks	50
Total Number of Practice Hours	36	Exam Hours	03
Credits - 02			

Objectives:

- To apply programming for basic mathematical functions
- To design and program mathematical concepts.
- To create and use the functions and library functions
- Able to apply the theoretical knowledge of formatting of documents
- To create and apply user defined types to the real world problems.
- To create files and shapes of the concepts.

List of Experiments

Exercise 1 (Familiarization with programming environment)

a) Familiarization of CODE BLOCKS C++ Editor to edit, compile, execute, test and debugging C programs.
b) Familiarization of RAPTOR Tool to draw flow charts and understand flow of control.
c) Acquittance with basic LINUX commands.

Exercise 2 (Simple computational problems using arithmetic expressions)

a) Write a C Program to display real number with 2 decimal places.
b) Write a C Program to convert Celsius to Fahrenheit and vice versa.
c) Write a C Program to calculate the area of triangle using the formula
area = $\sqrt{s(s-a)(s-b)(s-c)}$ where $s = \frac{a+b+c}{2}$
d) Write a C program to find the largest of three numbers using ternary operator.
e) Write a C Program to swap two numbers without using a temporary variable.

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

a) Write a C Program to check whether a given number is even or odd using bitwise operator, shift operator and arithmetic operator.
b) Write a C program to find the roots of a quadratic equation.
c) Write a C Program to display grade based on 6 subject marks using if…else…if ladder.
d) Write a C program, which takes two integer operands and one operator form the user, performs the operation and then
e) prints the result using switch control statement. (Consider the operators +, -, *, /, %)

Exercise 4 (Iterative problems)

a) Write a C Program to count number of 0's and 1's in a binary representation of a given number.
b) Write a C program to generate all the prime numbers between two numbers supplied by the user.
c) Write a C Program to print the multiplication table corresponding to number supplied as input.

Exercise 5 (Iterative problems)

a) Write a C Program to Find Whether the Given Number is
i) Armstrong Number ii) Palindrome Number
b) 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 error message "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 it 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:

1. Attain knowledge on using CODE BLOCKS and RAPTOR tools in solving problems.
2. Examine and analyze alternative solutions to a problem.
3. Design an algorithmic solution to a problem using problem decomposition and step-wise refinement.
4. Demonstrate conversion of iterative functions to recursive and vice-versa.
5. Implement the concepts of arrays.
6. Implement the structures, Unions and files.

WORKSHOP/MANUFACTURING PRACTICE SEMESTER - II			
Subject Code	18CMMEL2070	Internal Marks	50
Number of Practice Hours/Week	03	External Marks	50
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

COURSE OBJECTIVES:

1. Students should be able to learn the basic manufacturing processes, study the various tools and equipment used and gain hands-on experience in different trades.
2. Students should be able to learn the engineering and technology involved in carpentry, fitting, black smithy, foundry, welding, machining and plastic moulding.
3. Students should understand the workmanship required, working of machinery or equipment necessary.

i. Lectures & videos: (10 hours)

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
2. CNC machining, Additive manufacturing **(1 lecture)**
3. Fitting operations & power tools **(1 lecture)**
4. Electrical & Electronics **(1 lecture)**
5. Carpentry **(1 lecture)**
6. Plastic moulding, glass cutting **(1 lecture)**
7. Metal casting **(1 lecture)**
8. Welding (arc welding & gas welding), brazing **(1 lecture)**

ii. Workshop Practice:

Sl. NO.	Name of Shop floor	Exercises
1.	Blacksmithy	1. S-Hook 2. Square Rod To Round Rod
2.	Carpentry	1. T-Lap Joint 2. Cross Lap Joint
3.	Foundry	1. Mould for a Solid 2. Mould for a Split Pattern.
4.	Fitting	1. Square Fitting 2. V-Fitting
5.	Welding	1. Butt Joint 2. Lap Joint
6.	Machine Tools	1. Turning 2. Knurling
7.	Plastic Moulding	1. Key chain

COURSE OUTCOMES:

1. Students will be able to make use of basic carpentry joints to make furniture.
2. Students will be able to fabricate mechanical engineering assemblies using fitting joints.
3. Students will be able to produce various machine components by using foundry, black smithy, machining and plastic moulding techniques.

<table>
<tr><td colspan="4">ENVIRONMENTAL SCIENCE
SEMESTER - II</td></tr>
<tr><td>Subject Code</td><td>18CMCHN2080</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>04</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 00</td></tr>
<tr><td colspan="4">COURSE OBJECTIVES:
The objectives of this course, help the students to
1. Know the importance of Environmental studies and the measures to be taken to overcome global environmental challenges.
2. Understand the concept of ecosystem and its diversity.
3. Gain knowledge on natural resources.
4. Understand the concept of biodiversity.
5. Gain knowledge on environmental pollution.
6. Gain knowledge on environmental legislation and global treaties.</td></tr>
<tr><td colspan="3">Unit -1</td><td></td></tr>
<tr><td colspan="3">MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES
Environment - Definition, Introduction - Scope and Importance - Global environmental challenges, 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 of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and
function of the different ecosystems</td><td>Hours – 10</td></tr>
<tr><td colspan="3">Unit -2</td><td></td></tr>
<tr><td colspan="3">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.</td><td>Hours – 12</td></tr>
<tr><td colspan="3">Unit – 3</td><td></td></tr>
<tr><td colspan="3">BIODIVERSITY AND ITS CONSERVATION
Introduction - Definition: genetic, species and ecosystem diversity. – Biogeographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss - Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.</td><td>Hours – 6</td></tr>
<tr><td colspan="3">Unit – 4</td><td></td></tr>
<tr><td colspan="3">ENVIRONMENTAL POLLUTION
Definition, Cause, effects and control measures of :
a. Air pollution
b. Water pollution
c. Soil pollution</td><td>Hours – 12</td></tr>
</table>

<table>
<tr><td>d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. 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.</td><td></td></tr>
<tr><td colspan="2">Unit – 5</td></tr>
<tr><td>SOCIAL ISSUES AND 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 Act - Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act -Issues involved in 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/ Agricultural Study of common plants, insects, birds. -Study of simple ecosystems - pond, river, hill slopes, etc.</td><td>Hours – 10</td></tr>
<tr><td colspan="2">COURSE OUTCOMES:
On completion of the course student will be
1. Able to know the importance of Environmental studies and the measures to be taken to overcome global environmental challenges.
2. Able to understand the concept of ecosystem and its diversity.
3. Able to gain knowledge on natural resources.
4. Able to understand the concept of biodiversity.
5. Able to gain knowledge on environmental pollution.
6. Gain knowledge on environmental legislation and global treaties.</td></tr>
<tr><td colspan="2">QUESTION PAPER PATTERN:</td></tr>
<tr><td colspan="2">TEXT BOOKS:
1. E. Bharucha (2003), “Environmental Studies”, University Publishing Company, New Delhi.
2. J.G. Henry and G.W. Heinke (2004), “Environmental Science and Engineering”, Second Edition, Prentice Hall of India, New Delhi
3. G.M. Masters (2004)” Introduction to Environmental Engineering and Science”, Second Edition, Prentice Hall of India, New Delhi</td></tr>
<tr><td colspan="2">REFERENCE BOOKS:
1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada.
3. Environmental Studies, P.N. Paliniswamy, P. Manikandan, A. Geeta and K. Manjula Rani, Pearson Education, Chennai.</td></tr>
</table>

B.Tech. (Mechanical Engineering)
Semester III (Second Year) Approved Course structure

S.No.	Course Code	CC	Course Title	L	T	P	C
1.	18CMMAT3010	BSC	Engineering Mathematics-III	3	1	0	4
2.	18MEMET3020	ESC	Engineering Mechanics	3	1	0	4
3.	18MEECT3030	ESC	Basic Electronics Engg.	3	0	0	3
4.	18MEMET3040	PCC	Manufacturing Processes	3	0	0	3
5.	18MEMET3050	PCC	Thermodynamics	3	0	0	3
6.	18MEMET3060	PCC	Materials Engineering	3	0	0	3
7.	18MEMEL3070	PCC	Manufacturing Processes Lab	0	0	3	1.5
8.	18MEMEL3080	PCC	CAEDP Lab	0	0	3	1.5
			Total	**15**	**2**	**06**	**23**

B.Tech. (Mechanical Engineering)
Semester IV (Second Year) Approved Course structure

S.No	Course Code	CC	Course Title	L	T	P	C
1	18MEMET4010	PCC	Strength of Materials	3	0	0	3
2	18MEMET4020	PCC	Fluid Mechanics & Fluid Machines	3	0	0	3
3	18MEMET4030	PCC	Theory of Machines-I	3	0	0	3
4	18MEMET4040	PCC	Applied Thermodynamics	3	0	0	3
5	18CMMST4050	PCC	Engineering Economics & Financial Management	3	0	0	3
6	18MEMEL4060	PCC	Fluid Mechanics & Fluid Machines Lab	0	0	3	1.5
7	18MEMEL4070	PCC	Mechanics of Solids & Materials Lab	0	0	3	1.5
8	18MEMEN4080	MC	Machine Drawing				
Total				15	0	6	18

ENGINEERING MATHEMATICS – III SEMESTER - III			
Subject Code	18CMMAT3010	Internal Marks	30
Number of Lecture Hours/Week	3(L) + 1(T)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable students to:

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

Unit -1	**Hours**
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.	**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	**10**
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.	**10**
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	**10**
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	**10**

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 distributions
5. Find the statistical parameters for continuous distributions
6. Test the hypothesis

Question paper pattern:
Text Books: 1. B.S. Grewal, "Higher Engineering Mathematics", Khanna publishers, 44th edition, 2016. **2.** Erwin Kreyszig, "Advanced Engineering Mathematics, Wiley, 9th Edition, 2013.
Reference Books: 1. B.V. Ramana, "Higher Engineering Mathematics", Tata Mc Graw-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.

ENGINEERING MECHANICS SEMESTER III			
Subject Code	18MEMET3020	Internal Marks	30
Number of Lecture Hours/Week	3(L)+1(T)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits - 04			

COURSE OBJECTIVES:

Students should be able to:

- Gain knowledge on system of forces and moments
- Describe the various types of friction
- Draw free-body diagrams and solve statics problems
- Acquire knowledge on centre of gravity and moment of inertia for different sections.
- Calculate velocity and acceleration of particles having rectilinear or curvilinear motion.
- Analyze the problems on work energy method and impulse-momentum method.

Unit -1	**Hours**
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. **Friction:** Introduction, limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, cone of friction	**10**
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 (Method of joints only)	**8**
Unit – 3	
Centroid and Centre of Gravity: 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.	**10**
Unit – 4	
Kinematics: Rectilinear and Curvilinear motions – Velocity and Acceleration – Motion of Rigid Bodies – Types and their analysis in Planar Motion. **Kinetics:** Analysis of a Particle and Rigid Body in Translation– Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.	**12**
Unit-5	
Work – Energy Method: Equations for Translation, Work-Energy Application to Particle Motion, Connected System - Fixed Axis Rotation and Plane Motion, Impulse momentum method.	**10**

Course Outcomes:

On completion of this course, students will be able to

1. Determine the resultant force and moment for a given system of forces
2. Apply laws of friction to simple mechanisms with consideration of friction
3. Draw free-body diagrams and solve statics problems
4. Determine centroid and moment of inertia of simple and composite bodies
5. Calculate the motion characteristics of a body subjected to a given force system
6. Solve the problems using work energy method and impulse-momentum method.

Question paper pattern:

Text Books:

1. Engineering Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw 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 Mc Graw Hill Publ.

5. Mechanics For Engineers, dynamics - F.P.Beer&E.R.Johnston –5th Edn Mc Graw 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 - Mc Graw 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.

Web Source References:

1. https://nptel.ac.in/courses/nptel_download.php?subjectid=122104015
2. http://myengineeringmechanics.com/

<table>
<tr><td colspan="4" align="center">BASIC ELECTRONICS ENGINEERING
SEMESTER III</td></tr>
<tr><td>Subject Code</td><td>18MEECT3030</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>03</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
<tr><td colspan="4">Course Objectives:
This course will enable students to:
• Understand the basics of analog electronics circuits
• Describe the basics of digital electronics.
• Discuss the concepts of electronic communications.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.</td><td>12</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.</td><td>12</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="3">Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.</td><td>8</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">Digital Electronics Fundamentals :Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.</td><td>8</td></tr>
<tr><td colspan="4">Course outcomes:
On completion of the course, student will be able to:
1. Understand the basics of semiconductor devices and their applications.
2. Describe the application using Operational amplifier.
3. Discuss the working of timing circuits and oscillators.
4. Understand building block of digital systems.
5. Interpret different sequential circuits
6. Summarize the basics of Electronic communication system.</td></tr>
<tr><td colspan="4">Question paper pattern:
Section A:
1. This section contains ten one or two line answer question carrying 1 mark each.
2. Two questions from each unit should present.
Section B:
1. This Section will have 10 questions, 2 from each unit
2. Each full question carry 12 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit</td></tr>
</table>

Text Books:

1. Integrated Electronics – J Millman, C. Halkies, C.D.Parikh, Tata Mc-Graw Hill, 2009.
2. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd.
3. Digital Design – M Morris Mano, Third Edition, Pearson Publications.
4. Electronic Communication Systems-George Kennedy,5th Edition, Tata Mc-Graw Hill

Reference Books:

1. Electronic Devices and Circuits – K Venkata Rao ,K Rama Sudha, Tata Mc-Graw Hill.
2. Electronic Devices and Circuits - Salivahanan, Kumar, Vallavaraj, 2nd Edition, Tata Mc- Graw Hill
3. Fundamentals of Logic Design- Charles H.Roth,Jr., 5th Edition, India Edition

Web Source References

1. https://nptel.ac.in/courses/117101106/
2. https://nptel.ac.in/courses/108102095/
3. http://www.nptelvideos.in/2012/11/communication-engineering.html

<table>
<tr><td colspan="4">MANUFACTURING PROCESSES
SEMESTER III</td></tr>
<tr><td>Subject Code</td><td>18MEMET3040</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>03(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits - 03</td></tr>
<tr><td colspan="4">Course Objectives:
This course will enable students to:
• Acquire the knowledge on casting process.
• Impart the knowledge on special casting processes.
• Learn the concept of on forming processes.
• Make familiars with the different welding parameters and other joining process.
• Understand the concept of advanced welding processes for various applications
• Compare the difference between injection and blow moulding.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">Introduction: Introduction to manufacturing processes and classification.
Casting: Steps involved in making a casting. Patterns and Pattern making: Types of patterns, Materials used for patterns, Pattern allowances. Moulding sand: Molding sand composition, sand properties, Sand preparation. Core: Core sands, Types of cores, Core prints, Chaplets. Principles of Gating, Gating ratio
and Design of Gating systems.</td><td>9</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">Melting and Solidification of casting: Cupola furnace, Steel making processes. Solidification of pure metal and alloys, Short & long freezing range alloys. Risers: Types, function and design, Casting design considerations.
Special casting processes: Centrifugal, Die and Investment casting. Casting defects-Causes and remedies.</td><td>9</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="3">Welding: Introduction, classification of welding processes, types of welded joints and their characteristics. Gas welding: Different types of flames and uses, Oxy – Acetylene Gas welding. Basic principles of Arc welding, Manual metal arc welding, Sub merged arc welding, TIG & MIG welding.
Resistance welding: Spot welding, Seam welding, Projection welding, Upset welding, and Flash butt welding. Special welding processes: Thermit welding, Friction welding, Electron beam welding, and Laser beam welding. Soldering and Brazing. welding defects – causes and remedies.</td><td>12</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">Metal Forming: Nature of plastic deformation, Hot and cold working. Rolling: Principle, Types of rolling mills and products, Roll passes, Forces in rolling and power requirements. Extrusion: Basic extrusion process and its characteristics, Hot extrusion and cold extrusion, Impact extrusion, Hydrostatic extrusion. Forging: Principles of forging, Tools and dies, Types: Smith forging, Drop Forging, Forging hammers, Rotary forging, forging defects. Wire drawing and tube drawing.</td><td>10</td></tr>
<tr><td colspan="4">Unit-5</td></tr>
<tr><td colspan="3">Sheet metal forming: Blanking, Bending, Piercing, Spring back effect, Stamping, Drawing, Coining, Embossing, Stretch forming, Hot and cold spinning. Special forming: Hydro forming, High energy rate forming.
Introduction to Powder Metallurgy – compaction and sintering, advantages and applications.
Processing of Plastics: Types of Plastics, Properties, Applications and their processing methods, Blow and Injection moulding.</td><td>10</td></tr>
<tr><td colspan="4">Course Outcomes:
On completion of the course, student will be able to
1. Recognize the different types of casting processes.
2. Select suitable manufacturing process for typical components.
3. Describe the various welding processes.
4. Analyze the processes of forging, rolling process and extrusion.
5. Recognize advanced welding processes for different applications.
6. Explain the concepts of Powder metallurgy and plastic processing methods</td></tr>
</table>

Question paper pattern:

Text Books:

1. Manufacturing Technology -Vol I- P.N. Rao- TMH
2. Manufacturing processes for engineering materials- Kalpakjain. S & Steven R Schmid-Pearson publ,5thEdn
3. Workshop Technology – B.S.Raghu Vamshi – Vol I
4. Manufacturing Engineering and Technology - Kalpakjain. S & Steven R Schmid-Pearson publ,4th Edn
5. Manufacturing Science – A.Ghosh&A.K.Malik – East West Press Pvt. Ltd.

Reference Books:

1. Production Technology-P C Sharma-S. Chand
2. Production Technology by R.K. Jain and S.C. Gupta.
3. Metal cutting Principles by M.C. Shaw
4. Production Technology by H.M.T. (Hindustan Machine Tools).

Web Source References:

1. http://nptel.ac.in/courses/112107144/metalcasting/lecture15.htm
2. http://web.iitd.ac.in/pmpandey/MEL120_html/Metal%20Forming%20Processes.pdf
3. https://onlinecourses.nptel.ac.in/noc19_me16/course

THERMODYNAMICS
SEMESTER III

Subject Code	18MEMET3050	Internal Marks	30
Number of Lecture Hours/Week	03(L)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to:

- Gain the knowledge on the fundamentals of thermodynamics and temperature scales.
- Apply First law of thermodynamics to various thermal engineering devices.
- Understand the direction of law.
- Explain the concept of increase in entropy of universe.
- Develop an idea on properties during various phases of pure substances, mixtures, usage of steam tables and Mollier chart, psychometric charts.
- Acquire the knowledge of thermodynamics to air standard cycles, vapour power cycle and the properties of gas mixtures.

Unit -1	**Hours**
Introduction: Basic Concepts Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers	**10**
Unit -2	
First Law of Thermodynamics: Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy-Demonstration as a property; Various modes of energy, Internal energy and Enthalpy. First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady, first law applications for system and control volume. Compressibility charts- Properties of two phase systems.	**10**
Unit – 3	
Second law of Thermodynamics: Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. **Clausius inequality** : Definition of entropy ; Demonstration that entropy is a property; Evaluation of entropy for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Principle of increase of entropy; Illustration of processes in T-S coordinates; **Irreversibility and Availability**: Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume and energy balance equation.	**12**
Unit – 4	
Pure Substance: Definition of Pure substance, - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart. Determination of entrophy from steam tables	**8**
Unit – 5	
Mixtures of Perfect Gases: Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures and Basics of compressible flow. **Thermodynamic Cycles:** Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericcson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles. Brayton and Rankine cycles – Performance Evaluation-improving methods – combined cycles, Bell- Coleman Cycle, Vapour compression cycle-performance Evaluation.	**10**

Course Outcomes:

On completion of the course, student will be able to

1. Identify type of thermodynamic systems in the energy perspective.
2. Solve the practical thermodynamic problems by applying first law and steady flow energy equation
3. Analyze the problems on heat engines, refrigeration and entropy by applying direction of law
4. Illustrate the concept of entropy by using second law of thermodynamics.
5. Calculate the thermodynamic properties of the
6. Evaluate the performance of air standard cycles and vapor power cycle and analyze the properties of gas mixtures.

Question paper pattern:

Section A:

1. This section contains ten one or two line answer question carrying 1 mark each.
2. Two questions from each unit should present.

Section B:

1. This Section will have 10 questions, 2 from each unit
2. Each full question carry 12 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit

Text Books:

1. Engineering Thermodynamics, PK Nag 4th Edn , TMH.
2. Fundamentals of Thermodynamics- Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J, 2003, 6th Edition, John Wiley and Sons.

Reference Books:

1. Engineering Thermodynamics – Jones & Dugan PHI
2. Thermodynamics – An Engineering Approach with student resources DVD Y.A.Cengel & M.A.Boles , 6th Edn – McGrawHill
3. Basic Engineering Thermodynamics – A.Venkatesh – Universities press.
4. An Introduction to Thermodynamics – Y.V.C.Rao – Universities press.
5. Engineering Thermodynamics – P.Chattopadhyay – Oxford Higher Edn Publ.
6. Engineering Thermodynamics – D.P.Misra, Cengage Publ.

Web Source References:

1. https://nptel.ac.in/courses/112108148/pdf/Module_1.pdf
2. https://nptel.ac.in/courses/112108148/pdf/Module_2.pdf
3. https://nptel.ac.in/courses/112108148/pdf/Module_3.pdf
4. https://nptel.ac.in/courses/112108148/pdf/Module_4.pdf
5. https://nptel.ac.in/courses/112108148/pdf/Module_6.pdf
6. https://nptel.ac.in/courses/112108148/pdf/Module_7.pdf

MATERIALS ENGINEERING SEMESTER III			
Subject Code	18MEMET3060	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:

- Classify different bonds in solids and understand crystallization of the metals, for the formation of the solid solutions and compounds.
- Understand different phase diagrams .
- Recognize the property requirements of a given application and suggest a suitable ferrous and non ferrous metal and their alloys.
- Illustrate the property requirements of a given application and suggest appropriate heat treatment
- Identify the property requirements of a given application and suggest a suitable ceramics, composite materials
- 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

Question paper pattern:

Section A:

1. This section contains ten one or two line answer question carrying 1 mark each.
2. Two questions from each unit should present.

Section B:

1. This Section will have 10 questions, 2 from each unit
2. Each full question carry 12 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit

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

MANUFACTURING PROCESSES LABORATORY SEMESTER III			
Subject Code	18MEMEL3070	Internal Marks	50
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 1.5			

Course objectives:

This course will enable students to:

- Determine the concepts of manufacturing process.
- Impart the design and manufacture of patterns for mould preparation.
- Make familiars with the different welding parameters and other joining process.
- Understand the practicalconcepts of TIG welding.
- impart hands-on practical exposure on metal forming processes.
- Compare the difference between injection and blow moulding.

I. METAL CASTING:

1. Preparation of a Sand mould using gear wheel pattern.
2. Preparation of a wax mould using.Split Piece Pattern
3. Preparation of a Stepped pulley pattern using wooden material.
4. Determination of Sand properties on Universal Strength Machine

II. WELDING PRACTICE:

1. Preparation of a Square Butt joint using arc welding.
2. Preparation of a Vertical joint using arc welding.
3. Preparation of a T-lap joint using Spot Welding.
4. Preparation of a Square Butt joint using TIG welding.
5. Joining of wires on circuit board using Soldering process.
6. Preparation of a lap joint using Oxy-acetylene gas welding process.

III. METAL FORMING:

1. Preparation of a washer using blanking & Piercing operations.
2. Preparation of Square tray.

IV. PROCESSING OF PLASTICS:

1. Preparation of a bottle cap using injection moulding.
2. Preparation of a bottle using blow moulding.

Course outcomes:

On completion of the course, student will be able to

1. Gain the knowledge of manufacturing process.
2. Know the design and manufacture of patterns for mould preparation.
3. Operate arc welding, gas welding and resistance welding equipment
4. Apply the practicalconcepts of TIG welding.
5. Acquire fundamental knowledge on metal forming processes.
6. Identify the difference between injection and blow moulding.

COMPUTER AIDED ENGINEERING DRAWING PRACTICE LAB (CAEDP) SEMESTER III			
Subject Code	18MEMEL3080	Internal Marks	50
Number of Lecture Hours/Week	04	External Marks	50
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 1.5

Course Objectives:

This course will enable students to:

- Gain knowledge on orthographic projections of solids inclined to both the planes and interpenetrations of solids.
- Identify and gain knowledge how to prepare a surface development of solids
- Identify various commands used in Auto CAD Screen to create 2D and 3D models
- Create 2D models by using various toolbars
- Reproduce solid models of various machine parts by using 3D modeling toolbars

Part-A	**Hours**
Unit -1	
Projections & Interpenetration of Solids **Projections of solids**: Projections of Regular Solids inclined to both planes. **Interpenetration of right regular solids:** Intersection of Cylinder Vs Cylinder, Prism Vs Prism.	**8**
Unit -2	
Development of Solids: Development of Surfaces of Right Regular Solids – Prisms, Cylinder, Pyramid , Cone.	**6**
Part-B	
Unit –3	
Review of Computer Aided Drafting: Introduction, history of CAD, advantages of CAD, auto CAD screen components, starting a new drawing, opening an existing drawing, setting drawing limits, saving a drawing file, exiting an autoCAD session, dynamic input/command prompt, coordinate system, choosing commands in autocad, object snaps. **Advanced Sketching**: Arcs, rectangles, ellipses, regular polygon, polylines, placing points, infinite lines commands, writing a single line text, Object Properties and excercises.	**12**
Unit –4	
Editing Sketched Objects and Dimensioning: Editing, moving, copying, offsetting, rotating, scaling, filleting, chamfering, trimming, extending, stretching of sketched objects, rectangular array,polar array path array, mirroring the sketched objects and text mirroring, creating text and tables, fundamental dimensioning terms and linear and angular dimensioning and excercises	**12**
Unit – 5	
Computer Aided Solid Modelling: Introduction to the 3D Modeling Workspace, Basic 3D Viewing Tools, 3D Navigation Tools, User Coordinate System, Solid Primitive Types**.** **Creating Solids & Surfaces from 2D Objects** :Extruded , Swept, Revolved, and Lofted Solids and Surfaces, Advanced Solid Editing, Creating Multiple Viewports, Modeling of simple solids, Modeling of machine parts and exercises’	**12**

Course Outcomes:

On completion of the course, student will be able to

1. Draw orthographic projections of solids inclined to both the planes and interpenetrations of solids.
2. Prepare a surface development of solids
3. Identify the commands in sketching
4. Describe various editing and dimensioning commands used drafting software
5. Create 2D models by using various toolbars
6. Reproduce solid models of various machine parts by using 3D modeling toolbars

Internal Assessment Pattern

Date to Date Work	:10 M
Mid Examination-I	:10 M
Computer Aided drafting Date to Date Work	:20 M

Internal Examination-	:10 M
Total Internal Assessment Marks	**: 50 M**

Question paper pattern:

Section A:

1. This section contains two questions carrying 10 marks each.
2. Two questions from each unit of part-A

Section B:

1. This Section will have 10 experiments from Part-B.
2. Each Experiment carries 30 marks.
3. The student will have to answer any one question from 10 Questions.

Text Books:

1. AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill, New Delhi.
2. Auto CAD 2014 for Engineers and Designers by Tickoo Sham, Dream Tech.

References Books:

1. Mastering Auto CAD 2013 and Auto CAD LT2013 – George Omura, Sybex
2. Engineering Drawing – KL Narayana, P Kannaiah, Scitech
3. Engineering Drawing – RK Dhawan, S Chand
4. Engineering drawing by N.D Bhatt, Charotar publications.

STRENGTH OF MATERIALS SEMESTER - IV			
Subject Code	18MEMET4010	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:

- Understand the Mechanical properties of materials, stresses, strains and their relations
- Draw the shear force and bending moment diagrams of beams under different loads.
- Analyze the shear stress distribution in solid and hollow members under transverse loading conditions.
- Calculate the slope and deflection at a specified point of a beam under different loads.
- Acquire the knowledge of stresses in thick and thin cylinders
- Distinguish the columns and struts

UNIT -1	Hours
Introduction: Stress and Strain definitions, types of stresses and strains, elasticity and plasticity. Hooke's law, stress-strain diagrams for engineering materials, modulus of elasticity. Poisson's ratio, relationship between elastic constants, linear and volumetric strains, bars of uniform strength, temperature stresses, compound bars.	**9**
Unit -2	
Beams: Definition of bending moment and shear force; relationship between intensity of loading, shear force and bending moment; bending moment and shear force diagrams for cantilever, simply supported and overhanging beams; simple theory of bending, moment of resistance, modulus of section.	**10**
Unit – 3	
Shear Stresses in Beams: Distribution of shear stresses in rectangular, I-section and T-section for solid and hollow sections. Compound stresses, principal stresses and strains. Mohr's circle of stress.	**8**
Unit – 4	
Slopes and Deflections: Slope and deflection measurements of cantilever, simply supported beams with Macaulay's and double integration methods subjected to point loads and uniformly distributed loads. Torsion: Derivation of torsion formula for circular sections, torsional stresses, angle of twist, power transmission, effect of combined bending and torsion	**13**
Unit – 5	
Cylinders: Stresses in thin and thick cylinders with internal and external pressures. Hoop and longitudinal stresses in cylinders, stresses in compound cylinders. **Columns and Struts:** Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.	**10**

Course Outcomes:

On completion of the course, student will be able to

1. Calculate stresses and strains in a member subjected to different loadings.
2. Construct shear force and bending moment diagrams for beams subjected to different loads
3. Compute bending stress and shear stresses of a beam
4. Estimate the deflections of different beams under various loads
5. Calculate the stresses in thick and thin cylindrical and spherical shells under different loads and directions
6. Distinguish the types columns and struts.

Question paper pattern:

Section A:

1. This section contains ten one or two line answer question carrying 1 mark each.
2. Two questions from each unit should present.

Section B:

1. This Section will have 10 questions, 2 from each unit
2. Each full question carry 12 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit

Text Books:

1. Bhavikatti. S. S., Strength of Materials, Vikas Publishing House (P) Ltd., New Delhi, Second

Edition, 2002. 2. R.K.Rajput, Strength of materials, S.Chand& Co revised edition, New Delhi-2007
Reference Books: 1. Punmia. B. C., Jain, A. K., and Jain, A. K., Strength of Materials and Theory of Structures, Vols. I & II, XI Edition, Laxmi Publications (P) Ltd, New Delhi, 2002. 2. Hearn, E. J., Strength of Materials, Pergamon Press, Oxford, 1997. 3. R.K.Bansal, Introduction to text book of Strength of materials, Laxmi publications 2004. 4. U.C. Jindal Introduction to text book of Strength of Material Galgotia publications. Second Edition 2001 5. Beer and Johnston, Mechanics of Materials, McGraw Hill, 4th Edition, 2005. 6. Gere and Timoshenko, Mechanics of Materials, PWS Publishing Company, 4th Edition, 1997. 7. S.B.Junarkar and H.J. Shah, Mechanics of Structures, 27th Revised and Enlarged, Charotar Publishing House, 2008.
Web Source References: 1. https://nptel.ac.in/courses/112107146/1 2. https://onlinecourses.nptel.ac.in/noc17_ce17 3. https://nptel.ac.in/courses/105105108/1 4. https://onlinecourses.nptel.ac.in/noc18_ce04/course

FLUID MECHANICS AND FLUID MACHINES SEMESTER IV			
Subject Code	18MEMET4020	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:

- Understand the fundamental properties of fluid and calculate fluid pressure using the manometer.
- Apply the differential conservation equations of mass, momentum, and energy to fluid flow problems.
- Evaluate major and minor losses in pipes and also discuss boundary layer concept.
- Solve problems on the turbo machinery using analytical method and velocity triangles.
- Classify the different types of turbines & evaluate work done and efficiency.
- 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.	**8**
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. **Boundary Layer Theory:** Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer.	**8**
Unit – 4	
Basics of Turbo Machinery: 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. **Hydraulic Turbines:** classification of turbines, Working and efficiencies of Pelton wheel, Francis and Kaplan turbines. Importance of Draft Tube.	**12**
Unit-5	
Hydraulic Quantities: Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. **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.	**12**

Course outcomes: Students will be able to:

1. Remember the various properties of fluids and pressure measurement devices.
2. Understand the kinematics and dynamics of fluids in detail.
3. Estimate the losses in pipes and understand the concept of Boundary layer theory
4. Solve problems on the turbo machinery using analytical method and velocity triangles.
5. Analyze the performance of hydraulic turbines, unit and specific quantities
6. Analyze the working of hydraulic pumps and their performance curves

Question paper pattern:
Section A:

1. This section contains ten one or two line answer question carrying 1 mark each.
2. Two questions from each unit should present.

Section B:

1. This Section will have 10 questions, 2 from each unit
2. Each full question carry 12 marks.
3. Each full question will have sub question covering all topics under a unit.

4. The student will have to answer 5 full questions selecting one full question from each unit
Text Books: 1. Hydraulics and fluid mechanics including hydraulic machines by Dr. P.N. Modi & Dr. S.M. Seth, Rajsons publications private Ltd. 2. A Text Book of Fluid Mechanics by R.K. Rajput, S. Chand publishers 3. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Revised 9th edition LP Publishers 4. Hydraulics, fluid mechanics and Hydraulic machines by R.S. Khurmi, S. Chand publishers
Reference Books: 1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons. 2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International. 3. Hydraulic Machines by Banga& Sharma, Khanna Publishers. 4. Instrumentation for Engineering Measurements by James W. Dally, William E. Riley, John Wiley & Sons Inc. 2004
Web Source References: 1. https://nptel.ac.in/courses/112104118/3 2. https://freevideolectures.com/course/3246/fluid-mechanics-iii 3. https://freevideolectures.com/course/89/fluid-mechanics

THEORY OF MACHINES – I
SEMESTER IV

Subject Code	18MEMET4030	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:

- Understand the basic terms used in mechanisms and inversions of different mechanisms
- Acquire knowledge on straight line motion mechanisms and other lower pairs.
- Calculate the velocity and acceleration of any point/link in a mechanism
- Understand types of cam mechanisms
- Draw the cam profile for different follower motions and to design cam mechanisms for specified output motions.
- Learn basic concepts of gears and gear trains

Unit -1	Hours
Mechanisms: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained . Grublers criterion , Grashoff's law , Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains	**10**
Unit -2	
Lower Pair Mechanism : Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph. Conditions for correct steering – Davis Steering gear, Ackermans steering gear – velocity ratio; Hooke's Joint: Single and double – Universal coupling– application–problems. –Mechanical advantage, Ratchets and Escapements	**09**
Unit – 3	
Plane Motion of Body: Instantaneous centre of rotation, centrode and axode –Procedure for locating instantaneous centres, relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of velocity of points and angular velocity of links. **Kinematics**: Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method four bar mechanism. Velocity and acceleration analysis for a given mechanism, Klein's construction, determination of Coriolis component of acceleration.	**12**
Unit – 4	
Cams and Followers: Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Analysis of motion of followers: Roller follower – circular arc cam with straight, concave and convex flanks	**09**
Unit-5	

Gears: Introduction, Higher pairs, friction wheels and toothed gears.Spur Gear Terminology and definitions –Gear tooth action – path of contact, arc of contact ,contact ratio. Law of toothed gearing – Involutes and cycloidal tooth profiles –– Interference and undercutting, condition for minimum number of teeth to avoid interference – gear teeth – Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. **Gear trains** –types, Speed ratio, train value – Parallel axis gear trains– Epicyclic Gear Trains – Differentials	**10**

Course outcomes:

On completion of the course, student will be able to

1. Explain the importance of kinematics, kinematic pairs and mechanisms
2. Describe the relative motion between the parts of a mechanism without considering the forces.
3. Summarize various mechanisms for straight line motion and steering gear, Hooke's joint with applications.
4. Analyse the velocity and acceleration concepts for four bar mechanism & slider crank mechanism using graphical method
5. Distinguish types of cam mechanisms and draw the cam profile for different follower motions
6. Calculate length of contact, arc of contact and minimum number of teeth to avoid interference. Also calculate speeds of different gears in a gear train.

Question paper pattern:

Section A:

1. This section contains ten one or two line answer question carrying 1 mark each.
2. Two questions from each unit should present.

Section B:

1. This Section will have 10 questions, 2 from each unit
2. Each full question carry 12 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit

Text Books:

1. Mechanism and Machine Theory by Ashok G. Ambekar, PHI Publishers
2. Theory of Machines – S. S Rattan- TMH
3. Theory of machines and Mechanisms – J.J Uicker, G.R.Pennock & J.E.Shigley - Oxford publishers.

Reference Books:

1. R L Norton, Kinematics and Dynamics of Machinery, 1st ed., Tata McGraw Hill Education Private Limited, Delhi,
2. Theory of Machines Sadhu Singh, PearsonsEdn
3. Theory of Machines by Thomas Bevan/ Oxford Universiy Press
4. Theory of Mechanisms and machines – A.Ghosh&A.K.Malik – East West Press Pvt. Ltd

Web Source References:

1. https://nptel.ac.in/courses/Webcourse- contents/IITDelhi/Kinematics%20of%20Machine/site/basickinematics/basickinematics08.htmL
2. https://nptel.ac.in/courses/112105236/21
3. https://nptel.ac.in/courses/112105236/34
4. https://nptel.ac.in/courses/112104121/
5. https://nptel.ac.in/courses/112106137/pdf/2_1.pdf

APPLIED THERMODYNAMICS

SEMESTER IV

Subject Code	18MEMET4040	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:

- Understand the concept of combustion of fuels and the concepts of psychrometry
- Knowledgeable in steam power plants and their components, performance and analysis of steam turbines.
- Gain the knowledge of steam nozzles and their performances in industries.
- Sketch the velocity diagrams of single and multi-stage steam turbines.
- Categorize the different gas turbine arrangements, their advantages and disadvantages and different applications
- Classify various types of air compressors and their working principles.

Unit -1	Hours
Basic Concepts: Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy. Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	**10**
Unit -2	
Vapour Power Cycles: Rankine cycles – Performance Evaluation-improving methods **Boilers :** Classification – working principles of L.P & H.P boilers with sketches, mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – draught, classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.	**12**
Unit – 3	
Steam Nozzles: Function of a nozzle – applications - types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line.	**8**
Unit – 4	
Steam Turbines: Classification, impulse turbine; mechanical details , velocity diagram, effect of friction Reaction Turbine: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction – velocity diagram-Analysis of steam turbines, velocity and pressure compounding of steam turbines	**10**
Unit – 5 **Gas Turbines:** Gas power cycles, Brayton cycle, effect of reheat, regeneration and intercooling-Combined gas and vapor power cycles **Compressors:** Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors	**10**

Course Outcomes:

On completion of the course, student will be able to

1. Calculate stoichiometric air fuel ratio, excess air and the properties of psychrometry.
2. Determine the methods of improving rankine cycle efficiency and design the constructional features of various types of boilers.
3. Evaluate critical pressure and other properties of steam in a steam nozzle.
4. Compute the efficiency of steam turbines through graphical and analytical methods.
5. Analyze, compare simple and modified Brayton cycles.
6. Estimate the performance of different types of compressors.

Question paper pattern:

Text Books:

1. Fundamentals of Thermodynamics, Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, , John Wiley and Sons.
2. Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.

Reference Books:

1. Heat Engineering – V.P Vasandani and D.S Kumar- Metropolitan Book Company, New Delhi
2. Thermodynamics and Heat Engines, Volume 2 - R.Yadav- Central book depot.
3. Engineering Thermodynamics, PK Nag 4th Edn , TMH.
4. Thermal Engineering – S. Domkundwar – 5th Edn – Dhanpat Rai publ.
5. Thermal Engineering-P.L.Bellaney/ Khanna publishers
6. Thermal Engineering- M.L.Mathur-Jain publ.

Web Source References:

1. https://nptel.ac.in/courses/112106133/
2. http://www.edurite.com/kbase/animation-of-thermal-power-plant
3. https://www.brighthubengineering.com/power-plants/25423-how-does-a-gas-turbine-power-plant-work-the-main-equipment/
4. https://www.brighthubengineering.com/power-plants/18336-combined-cycle-power-plants-the-basics/

ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT SEMESTER IV

Subject Code	18CMMST4050	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 the students to

- Understand the concept and nature of Managerial Economics and Concept of Demand and Demand forecasting.
- Analyse the Cost Concepts, Cost-Volume-Profit Analysis and Market structures.
- Learn different Accounting Systems, preparation of Financial Statements and Capital Budgeting proposals by using different methods.

Unit -I	Hours
Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics and Scope-Managerial Economics and its relation with other subjects-Concept of Demand-Types-Determents-Law of Demand its Exception-Elasticity of Demand-Types and Measurement- Demand forecasting and its Methods.	**10**
Unit –II	
Production and Cost Analysis: Production function-Isoquants and Isocost-Law of Variable proportions- Cobb-Douglas Production function-Economics of Sale-Cost Concepts-Opportunity Cost-Fixed vs Variable Costs-Explicit Costs vs Implicit Costs- Cost Volume Profit analysis- Determination of Break-Even Point (Simple Problems).	**10**
Unit-III	
Introduction To Markets, Pricing Policies & forms Organizations and Business Cycles: Market Structures: Perfect Competition, Monopoly and Monopolistic and Oligopoly – Features – Price Output Determination – Methods of Pricing: Market Skimming Pricing, And Internet Pricing: Flat Rate Pricing. Features and Evaluation of Sole Trader – Partnership – Joint Stock Company – State/Public Enterprises and their forms – Business Cycles – Meaning and Features – Phases of Business Cycle	**12**
Unit –IV	
Introduction to Accounting & Financing Analysis: Introduction to Double Entry Systems – Preparation of Financial Statements- Analysis and Interpretation of Financial Statements-Ratio Analysis (Simple Problems)	**10**
Unit-V	
Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Need for Capital Budgeting-Techniques of Capital Budgeting-Traditional and Modern Methods.	**08**

Course outcomes:

On completion of the course student will be able to:

1. Equipped with the knowledge of managerial economics and estimating demand for a product.
2. Examine the Production Concept and familiar with the concepts of iso-quants, iso-cost lines and MRTS
3. Predict the cost of production and its relevance to managerial decision making
4. Differentiate various the Markets and Pricing methods along with Business Cycles.
5. Prepare Financial Statements along with Analysis
6. Analyse and interpret various investment project proposals with the help of Capital Budgeting techniques.

Question paper pattern:

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Text Books:

1. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011.
2. Dr. B. Kuberudu and Dr. T. V. Ramana: Managerial Economics & Financial Analysis, Himalaya Publishing House 2011.

Reference Books:

1. Dr. P. Vijaya Kumar & Dr. N. Apparao Management Science Cengage, Delhi, 2012.
2. S. A. Siddiqui & A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2012
3. Vanitha Agarwal : Managerial Economics, Pearson Publications 2011.

Web References:

1. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_MEFA_LECTURE_NOTES_1.pdf
2. https://www.edx.org/course/introduction-to-managerial-economics

FLUID MECHANICS & FLUID MACHINES LAB
SEMESTER IV

Subject Code	18MEMEL4060	Internal Marks	50
Number of Practice Hours/Week	03	External Marks	50
Total Number of Practice Hours	48	Exam Hours	03

Credits – 1.5

Course Objectives:
This course will enable students to:

- Calculate different parameters such as coefficient of discharge, coefficient of impact, power, efficiency etc. of various experiments.
- Estimate pressure variation in a flowing fluid using Bernoulli's principle applications such as Venturi meter, Orifice meter.
- Compute the head losses in various diameter pipes.
- Analyze the working of hydraulic turbines and their performance curves
- Estimate the working of hydraulic pumps and their performance curves

i. Lectures & videos related to laboratory: (07 hours)

1. Measurement of various fluid properties **(1 lecture)**
2. Flow of fluids in closed channels **(1 lecture)**
3. Flow of fluids in open channels **(1 lecture)**
4. Working of hydraulic turbines **(2 lecture)**
5. Working of hydraulic pumps **(2 lectures)**

ii. Laboratory Practice:

1. Determination of coefficient of discharge of Venture meter
2. Determination of coefficient of discharge of Orifice meter
3. Determination of coefficient of discharge of a pipe line using Turbine flow meter
4. Determination of coefficient of discharge through an open channel using V – notch apparatus
5. Verification of Bernoulli's equation
6. Determination of Friction factor of a pipe
7. Determination of coefficient of impact of a jet striking a flat vane
8. Conduct performance test on Pelton Wheel
9. Conduct performance test on Francis turbine
10. Conduct performance test on single stage Centrifugal Pump
11. Conduct performance test on Reciprocating Pump

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

1. Calculate the coefficient of discharge of various fluids
2. Evaluate the flow of fluids in closed channels
3. Solve the flow of fluids in open channels
4. Test the impact of jet on vanes
5. Analyze the working of hydraulic turbines and their performance curves
6. Estimate the performance of hydraulic pumps

MECHANICS OF SOLIDS & MATERIALS LAB
SEMESTER IV

Subject Code	18MEMEL4070	Internal Marks	50
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 1.5

Course objectives:
This course will enable students to:
- Understand the mechanical properties of various materials.
- Identify the failures of brittle and ductile materials
- Find the deflection of different types of beams
- Determine modulus of rigidity of a specimen by torsion test
- Suggest a suitable ferrous and non-ferrous metal and their alloys for a given application
- Illustrate the property requirements of a given application and suggest appropriate heat treatment
- Relate the hardenability of steels by jominy end quench test with jominy distances

List of Experiments

Part-A
1. Direct Tension test
2. Young's Modulus of metal specimen by direct Tension test
3. Brinnel's and Rock well hardness test
4. Compression test
5. Impact test
6. Test on helical Spring to determine the rigidity modulus
7. Torsion Test to determine the rigidity modulus of a shaft
8. Deflection test on a simple or cantilever beam to determine the Young's modulus

Part-B
1. Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.
2. Preparation and study of the Microstructure of mild steels, low carbon steels, high – C steels.
3. Study of the micro structures of cast Irons.
4. Study of the micro structures of non-ferrous alloys.
5. Study of the micro structures of heat treated steels.
6. Hardeneability of steels by Jominy end quench test.
7. To find out the hardness of various treated and untreated steels.

Course Outcomes:
1. Compute the strength of members of various materials under different loads such as compressive, tensile, flexural and torsional.
2. Compute the elastic property of the beam material by measuring deflection
3. Determine the hardness of different types of materials
4. Measure the stiffness of a spring
5. Determine the modulus of rigidity of a shaft
6. Identify a suitable ferrous and non- ferrous metal and their alloys for a given application
7. Suggest appropriate heat treatment for a given application
8. Relate the hardenability of steels by jominy end quench test with jominy Distances

MACHINE DRAWING
SEMESTER IV

Subject Code	18MEMEN4080	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 00

COURSE OBJECTIVES:

This course will enable students to:

- Study the conventions and rules to be followed by engineers for making accurate drawings.
- Understand and apply national and international standards while drawing machine component.
- Acquire knowledge of fastening arrangements such as riveting.
- Familiarize in drawing assembly, orthographic and sectional views of various joints.
- Familiarize in drawing assembly, orthographic and sectional views of various couplings.

Unit -1	Hours
Drawing of Machine Elements and simple parts Selection of views, additional views for the following machine elements and parts. a) Popular forms of screw threads, bolts, nuts and foundation bolts b) Keys, cotter joints and knuckle joint. c) Riveted joints for plates d) Shaft coupling, spigot and socket pipe joint. e) Journal, pivot and collar and foot step bearings.	**10**
Unit -2	
Assembly Drawing - I Drawings of assembled views for the part drawings of the following using conventions. a) Engine parts – petrol engine connecting rod, piston assembly b) Machine parts - screws jack, machine vices	**10**
Unit – 3	
Assembly Drawing - II Drawings of assembled views for the part drawings of the following using conventions. a) Machine parts - Plummer block, Tailstock. b) Valves: spring loaded safety valve, air cock	**10**
Unit – 4	
Part Drawing - I Drawings of part views of the following using conventions. Socket and spigot joint, knuckle joint, Oldham coupling.	**10**
Unit – 5	
Part Drawing - II Drawings of part views of the following using conventions. Protected flanged coupling, Bushed-pin type flanged coupling, universal coupling.	**10**

COURSE OUTCOMES:

On completion of the course, student will be able to

1. Identify the national and international standards pertaining to machine drawing.
2. Illustrate various machine components through drawings.
3. Construct an assembly drawing of a machine unit
4. Interpret a set of working drawings of a machine assembly including detail drawings, bill of materials, part specifications
5. Analyze the part or assembly drawings as per the conventions.
6. Understanding the importance of the linking functional and visualization aspects in the preparation of the part drawings

Question paper pattern :

Section A:

1. This section contains three questions carrying 10 marks each.
2. Answer any Two questions in Section- A 10x2 = 20 marks.

Section B:

1. Question from Section-B is compulsory - 50x1= 50 marks

Text Books: 1. Machine Drawing – N.Siddeswar, K.Kannaiah & V.V.S.Sastry – TMH 2. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers
Reference Books: 1. Production and Drawing – K.L. Narayana & P. Kannaiah/ New Age 2. Machine Drawing – P.S.Gill 3. Machine Drawing – N.D. Junnarkar, Pearson 4. Machine Drawing – Ajeeth Singh, McGraw Hill

B.Tech. (Mechanical Engineering)

***Semester V (Third year)* Approved Course structure**

S.No.	Course Code	CC	Course Title	L	T	P	C
1.	18MEMET5010	PCC	Machine Tools & Metrology	3	0	0	3
2.	18MEMET5020	PCC	Design of Machine Elements -I	3	0	0	3
3.	18MEMET5030	PCC	Heat Transfer	3	0	0	3
4.	18MEMET5040	PCC	CAD/CAM/CIM	3	0	0	3
5.	18MEMET505X	PEC	Professional Elective-1	3	0	0	3
6.	18MEXXO506X	OEC	Open Elective-I	3	0	0	3
7.	18MEMEL5070	PCC	Heat Transfer Lab	0	0	3	1.5
8.	18MEMEL5080	PCC	Machine Tools & Metrology Lab	0	0	3	1.5
9.	18MEXXS5090	SOC	Soft Skills & Aptitude Builder - 1	0	0	4	2
10.	18MEMEM50100	ESC	Biology for Engineers	3	0	0	0
			Total	**18**	**00**	**10**	**23**

Professional Elective Course -I

S.No.	**Subject Code**	**Name of the subject**	**L**	**T**	**P**	**Cr**
1.	18MEMEP505A	Conventional & Non-Conventional Power Stations	3	0	0	3*
2.	18MEMEP505B	Nano Technology	3	0	0	3*
3.	18MEMEP505C	Industrial Robotics with Artificial Intelligence	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

B. Tech. (Mechanical Engineering)
Semester VI (Third year) Approved Course structure

S. No.	Course Code	CC	Course Title	L	T	P	C
1.	18MEMET6010	PCC	Theory of Machines-II	3	0	0	3
2.	18MEMET6020	PCC	Design of Machine Elements -II	3	0	0	3
3.	18MEMEP603X	PE	Professional Elective -II	3	0	0	3
4.	18MEMEP604X	PE	Professional Elective -III	3	0	0	3
5.	18MEXXO605X	OE	Open Elective-II	3	0	0	3
6.	18MEMEL6060	PCC	Theory of Machines Lab	0	0	3	1.5
7.	18MEMEL6070	PCC	Thermal Engineering Lab	0	0	3	1.5
8.	18MEMEL6080	PCC	CAD/CAM Lab	0	0	3	1.5
9.	18MEXXS6090	SOC	Soft Skills & Aptitude Builder – 2	0	0	4	2
			Total	**17**	**00**	**14**	**21.5**

Professional Elective Course -II

S. No.	Subject Code	Name of the subject	L	T	P	Cr
1.	18MEMEP603A	Prime Movers for Automobiles	3	0	0	3*
2.	18MEMEP603B	Synthesis and Characterization of Materials	3	0	0	3*
3.	18MEMEP603C	Additive Manufacturing	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

Professional Elective Course -III

S. No.	Subject Code	Name of the subject	L	T	P	Cr
1.	18MEMEP604A	Solar Energy Engineering and Applications	3	0	0	3*
2.	18MEMEP604B	Finite Element Methods	3	0	0	3*
3.	18MEMEP604C	Smart Manufacturing & IIOT	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

B. Tech. (Mechanical Engineering)

***Semester VII (Fourth Year)* Approved Course structure**

S. No.	Course Code		Course Title	L	T	P	C
1.	18MEMET7010	HSMC	Operations Research	3	0	0	3
2.	18MEMET7020	PCC	Instrumentation and Mechatronics	3	0	0	3
3.	18MEMET703X	PE	Professional Elective -IV	3	0	0	3
4.	18MEMEP704X	PE	Professional Elective -V	3	0	0	3
5.	18MEXXO705X	OE	Open Elective- III	3	0	0	3
6.	18MEXXO706X	OE	Open Elective- IV	3	0	0	3
7.	18MEMEL7070	PCC	Instrumentation and Mechatronics Lab	0	0	3	1.5
8.	18MEMER7080	PCC	Internship with Seminar	0	0	6	3
9.	18MEMES7090	SOC	Skill Oriented Course – 3 (Hyper Mesh)	0	0	4	2
			Total	**18**	**0**	**14**	**24.5**

Professional Elective Course -IV

S.No.	Course Code	Name of the subject	L	T	P	Cr
1.	18MEMEP703A	Refrigeration & Air Conditioning	3	0	0	3*
2.	18MEMEP703B	Mechanics of Composites	3	0	0	3*
3.	18MEMEP703C	Non – Destructive Evaluation	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

Professional Elective Course -V

S.No.	Course Code	Name of the subject	L	T	P	Cr
1.	18MEMEP704A	Gas Dynamics and Jet Propulsion	3	0	0	3*
2.	18MEMEP704B	Mechanical Vibrations	3	0	0	3*
3.	18MEMEP704C	Production Planning and Control	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

Semester VIII (Fourth Year) Approved Course structure

S. No.	Course Code	CC	Course Title	L	T	P	C
1.	18MEMER801X	PCC	Project Work, Seminar & Internship in industry	-	-	-	12
			Total	**-**	**-**	**-**	**12**

OPEN ELECTIVE COURSES

S.No.	Course 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

CREDIT DISTRIBUTION FOR B.TECH. ME PROGRAM

S.No.	Categories	ME											
		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	12	0	4			3		2	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	55	+7			12	15	12	11	5	
5	Professional Elective Courses	18	18	15	-3					3	6	6	
6	Open elective courses	18	12	12	-6					3	3	6	
7	Project work , Seminar and Internship	15	15	15	0							3	12
8	Skill Courses			06						2	2	2	
9	Mandatory Courses	-	-	-	-					-			
	Total Credits	**160**	**160**	**160**		**19**	**19**	**23**	**18**	**20**	**24**	**25**	**12**

B.Tech. (Mechanical Engineering)

Semester III (Second Year) Approved Course structure

S.No.	Course Code	CC	Course Title	L	T	P	C
1.	18CMMAT3010	BSC	Engineering Mathematics-III	3	1	0	4
2.	18MEMET3020	ESC	Engineering Mechanics	3	1	0	4
3.	18MEECT3030	ESC	Basic Electronics Engg.	3	0	0	3
4.	18MEMET3040	PCC	Manufacturing Processes	3	0	0	3
5.	18MEMET3050	PCC	Thermodynamics	3	0	0	3
6.	18MEMET3060	PCC	Materials Engineering	3	0	0	3
7.	18MEMEL3070	PCC	Manufacturing Processes Lab	0	0	3	1.5
8.	18MEMEL3080	PCC	CAEDP Lab	0	0	3	1.5
			Total	**15**	**2**	**06**	**23**

ENGINEERING MATHEMATICS – III

SEMESTER - III

Subject Code	18CMMAT3010	Internal Marks	30
Number of Lecture Hours/Week	3(L) + 1(T)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable students to:

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	Hours
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.	**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	**10**
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.	**10**
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	**10**
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	**10**

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 distributions
5. Find the statistical parameters for continuous distributions
6. Test the hypothesis

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

Text Books:

1. B.S. Grewal, **"Higher Engineering Mathematics"**, Khanna publishers, 44th edition, 2016.

2. Erwin Kreyszig, **"Advanced Engineering Mathematics**, Wiley, 9th Edition, 2013.
Reference Books: 1. B.V. Ramana, **"Higher Engineering Mathematics"**, Tata Mc Graw-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.

ENGINEERING MECHANICS

SEMESTER III

Subject Code	18MEMET3020	Internal Marks	30
Number of Lecture Hours/Week	3(L)+1(T)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits - 04

COURSE OBJECTIVES:

Students should be able to:

1. Gain knowledge on system of forces and moments
2. Describe the various types of friction
3. Draw free-body diagrams and solve statics problems
4. Acquire knowledge on centre of gravity and moment of inertia for different sections.
5. Calculate velocity and acceleration of particles having rectilinear or curvilinear motion.
6. Analyze the problems on work energy method and impulse-momentum method.

Unit -1	Hours
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. **Friction:** Introduction, limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, cone of friction	**10**
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 (Method of joints only)	**8**
Unit – 3	
Centroid and Centre of Gravity: 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.	**10**
Unit – 4	
Kinematics: Rectilinear and Curvilinear motions – Velocity and Acceleration – Motion of Rigid Bodies – Types and their analysis in Planar Motion. **Kinetics:** Analysis of a Particle and Rigid Body in Translation– Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.	**12**
Unit-5	
Work – Energy Method: Equations for Translation, Work-Energy Application to Particle Motion, Connected System - Fixed Axis Rotation and Plane Motion, Impulse momentum method.	**10**

Course Outcomes:

On completion of this course, students will be able to

1. Determine the resultant force and moment for a given system of forces
2. Apply laws of friction to simple mechanisms with consideration of friction
3. Draw free-body diagrams and solve statics problems
4. Determine centroid and moment of inertia of simple and composite bodies
5. Calculate the motion characteristics of a body subjected to a given force system
6. Solve the problems using work energy method and impulse-momentum method.

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

Text Books:

1. Engineering Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw 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 Mc Graw Hill Publ.
5. Mechanics For Engineers, dynamics - F.P.Beer&E.R.Johnston –5th Edn Mc Graw 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 - Mc Graw 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.

BASIC ELECTRONICS ENGINEERING SEMESTER III			
Subject Code	18MEECT3030	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. Understand the basics of analog electronics circuits
2. Describe the basics of digital electronics.
3. Discuss the concepts of electronic communications.

Unit -1	**Hours**
Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.	**12**
Unit -2	
Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.	**12**
Unit – 3	
Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.	**8**
Unit – 4	
Digital Electronics Fundamentals :Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications	**10**
Unit – 5	
Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.	**8**

Course outcomes:

On completion of the course, student will be able to:

1. Understand the basics of semiconductor devices and their applications.
2. Describe the application using Operational amplifier.
3. Discuss the working of timing circuits and oscillators.
4. Understand building block of digital systems.
5. Interpret different sequential circuits
6. Summarize the basics of Electronic communication system.

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

Text Books:

1. Integrated Electronics – J Millman, C. Halkies, C.D.Parikh, Tata Mc-Graw Hill, 2009.
2. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd.
3. Digital Design – M Morris Mano, Third Edition, Pearson Publications.
4. Electronic Communication Systems-George Kennedy,5th Edition, Tata Mc-Graw Hill

Reference Books:

1. Electronic Devices and Circuits – K Venkata Rao ,K Rama Sudha, Tata Mc-Graw Hill.
2. Electronic Devices and Circuits - Salivahanan, Kumar, Vallavaraj, 2^{nd} Edition, Tata Mc- Graw Hill
3. Fundamentals of Logic Design- Charles H.Roth,Jr., 5^{th} Edition, India Edition

Web Source References

1. https://nptel.ac.in/courses/117101106/
2. https://nptel.ac.in/courses/108102095/
3. http://www.nptelvideos.in/2012/11/communication-engineering.html

<table>
<tr><td colspan="4">MANUFACTURING PROCESSES
SEMESTER III</td></tr>
<tr><td>Subject Code</td><td>18MEMET3040</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>03(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits - 03</td></tr>
<tr><td colspan="4">Course Objectives:
This course will enable students to:
1. Acquire the knowledge on casting process.
2. Impart the knowledge on special casting processes.
3. Learn the concept of on forming processes.
4. Make familiars with the different welding parameters and other joining process.
5. Understand the concept of advanced welding processes for various applications
6. Compare the difference between injection and blow moulding.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">Introduction: Introduction to manufacturing processes and classification.
Casting: Steps involved in making a casting. Patterns and Pattern making: Types of patterns, Materials used for patterns, Pattern allowances. Moulding sand: Molding sand composition, sand properties, Sand preparation. Core: Core sands, Types of cores, Core prints, Chaplets. Principles of Gating, Gating ratio and Design of Gating systems.</td><td>9</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">Melting and Solidification of casting: Cupola furnace, Steel making processes. Solidification of pure metal and alloys, Short & long freezing range alloys. Risers: Types, function and design, Casting design considerations.
Special casting processes: Centrifugal, Die and Investment casting. Casting defects-Causes and remedies.</td><td>9</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="3">Welding: Introduction, classification of welding processes, types of welded joints and their characteristics. Gas welding: Different types of flames and uses, Oxy – Acetylene Gas welding. Basic principles of Arc welding, Manual metal arc welding, Sub merged arc welding, TIG & MIG welding.
Resistance welding: Spot welding, Seam welding, Projection welding, Upset welding, and Flash butt welding. Special welding processes: Thermit welding, Friction welding, Electron beam welding, and Laser beam welding. Soldering and Brazing. welding defects – causes and remedies.</td><td>12</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">Metal Forming: Nature of plastic deformation, Hot and cold working. Rolling: Principle, Types of rolling mills and products, Roll passes, Forces in rolling and power requirements. Extrusion: Basic extrusion process and its characteristics, Hot extrusion and cold extrusion, Impact extrusion, Hydrostatic extrusion. Forging: Principles of forging, Tools and dies, Types: Smith forging, Drop Forging, Forging hammers, Rotary forging, forging defects. Wire drawing and tube drawing.</td><td>10</td></tr>
<tr><td colspan="4">Unit-5</td></tr>
<tr><td colspan="3">Sheet metal forming: Blanking, Bending, Piercing, Spring back effect, Stamping, Drawing, Coining, Embossing, Stretch forming, Hot and cold spinning. Special forming: Hydro forming, High energy rate forming.
Introduction to Powder Metallurgy – compaction and sintering, advantages and applications.
Processing of Plastics: Types of Plastics, Properties, Applications and their processing methods, Blow and Injection moulding.</td><td>10</td></tr>
<tr><td colspan="4">Course Outcomes:
On completion of the course, student will be able to
1. Recognize the different types of casting processes.
2. Select suitable manufacturing process for typical components.
3. Describe the various welding processes.
4. Analyze the processes of forging, rolling process and extrusion.
5. Recognize advanced welding processes for different applications.
6. Explain the concepts of Powder metallurgy and plastic processing methods</td></tr>
<tr><td colspan="4">Question paper pattern:
1. Question paper contains 10 Questions, 2 from each course outcome. The student must answer 5 full</td></tr>
</table>

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

Text Books:

1. Manufacturing Technology -Vol I- P.N. Rao- TMH
4. Manufacturing processes for engineering materials- Kalpakjain. S & Steven R Schmid-Pearson publ,5thEdn
5. Workshop Technology – B.S.Raghu Vamshi – Vol I
6. Manufacturing Engineering and Technology - Kalpakjain. S & Steven R Schmid-Pearson publ,4th Edn
7. Manufacturing Science – A.Ghosh&A.K.Malik – East West Press Pvt. Ltd.

Reference Books:

1. Production Technology-P C Sharma-S. Chand
2. Production Technology by R.K. Jain and S.C. Gupta.
3. Metal cutting Principles by M.C. Shaw
4. Production Technology by H.M.T. (Hindustan Machine Tools).

Web Source References:

1. http://nptel.ac.in/courses/112107144/metalcasting/lecture15.htm
2. http://web.iitd.ac.in/pmpandey/MEL120_html/Metal%20Forming%20Processes.pdf
3. https://onlinecourses.nptel.ac.in/noc19_me16/course

THERMODYNAMICS SEMESTER III			
Subject Code	18MEMET3050	Internal Marks	30
Number of Lecture Hours/Week	03(L)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable students to:

1. Gain the knowledge on the fundamentals of thermodynamics and temperature scales.
2. Apply First law of thermodynamics to various thermal engineering devices.
3. Understand the direction of law.
4. Explain the concept of increase in entropy of universe.
5. Develop an idea on properties during various phases of pure substances, mixtures, usage of steam tables and Mollier chart, psychometric charts.
6. Acquire the knowledge of thermodynamics to air standard cycles, vapour power cycle and the properties of gas mixtures.

Unit -1	**Hours**
Introduction: Basic Concepts Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers	**10**
Unit -2	
First Law of Thermodynamics: Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy-Demonstration as a property; Various modes of energy, Internal energy and Enthalpy. First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady, first law applications for system and control volume. Compressibility charts- Properties of two phase systems.	**10**
Unit – 3	
Second law of Thermodynamics: Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. **Clausius inequality** : Definition of entropy ; Demonstration that entropy is a property; Evaluation of entropy for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Principle of increase of entropy; Illustration of processes in T-S coordinates; **Irreversibility and Availability**: Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume and energy balance equation.	**12**
Unit – 4	
Pure Substance: Definition of Pure substance, - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart. Determination of entrophy from steam tables	**8**
Unit – 5	
Mixtures of Perfect Gases: Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures and Basics of compressible flow. **Thermodynamic Cycles:** Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericcson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles. Brayton and Rankine cycles – Performance Evaluation-improving methods – combined cycles, Bell- Coleman Cycle, Vapour compression cycle-performance Evaluation.	**10**

Course Outcomes:

On completion of the course, student will be able to

1. Identify type of thermodynamic systems in the energy perspective.
2. Solve the practical thermodynamic problems by applying first law and steady flow energy equation.
3. Analyze the problems on heat engines, refrigeration and entropy by applying direction of law

4. Illustrate the concept of entropy by using second law of thermodynamics.
5. Calculate the thermodynamic properties of the
6. Evaluate the performance of air standard cycles and vapor power cycle and analyze the properties of gas mixtures

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

Text Books:

1. Engineering Thermodynamics, PK Nag 4^{th} Edn , TMH.
2. Fundamentals of Thermodynamics- Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J, 2003, 6^{th} Edition, John Wiley and Sons.

Reference Books:

1. Engineering Thermodynamics – Jones & Dugan PHI
2. Thermodynamics – An Engineering Approach with student resources DVD Y.A.Cengel & M.A.Boles , 6^{th} Edn – McGrawHill
3. Basic Engineering Thermodynamics – A.Venkatesh – Universities press.
4. An Introduction to Thermodynamics – Y.V.C.Rao – Universities press.
5. Engineering Thermodynamics – P.Chattopadhyay – Oxford Higher Edn Publ.
6. Engineering Thermodynamics – D.P.Misra, Cengage Publ.

Web Source References:

1. https://nptel.ac.in/courses/112108148/pdf/Module_1.pdf
2. https://nptel.ac.in/courses/112108148/pdf/Module_2.pdf
3. https://nptel.ac.in/courses/112108148/pdf/Module_3.pdf
4. https://nptel.ac.in/courses/112108148/pdf/Module_4.pdf
5. https://nptel.ac.in/courses/112108148/pdf/Module_6.pdf
6. https://nptel.ac.in/courses/112108148/pdf/Module_7.pdf

MATERIALS ENGINEERING SEMESTER III			
Subject Code	18MEMET3060	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
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
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

MANUFACTURING PROCESSES LABORATORY SEMESTER III			
Subject Code	18MEMEL3070	Internal Marks	50
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 1.5			

Course objectives:

This course will enable students to:

1. Determine the concepts of manufacturing process.
2. Impart the design and manufacture of patterns for mould preparation.
3. Make familiars with the different welding parameters and other joining process.
4. Understand the practical concepts of TIG welding.
5. impart hands-on practical exposure on metal forming processes.
6. Compare the difference between injection and blow moulding.

I. METAL CASTING:

1. Preparation of a Sand mould using gear wheel pattern.
2. Preparation of a wax mould using.Split Piece Pattern
3. Preparation of a Stepped pulley pattern using wooden material.
4. Determination of Sand properties on Universal Strength Machine

II. WELDING PRACTICE:

1. Preparation of a Square Butt joint using arc welding.
2. Preparation of a Vertical joint using arc welding.
3. Preparation of a T-lap joint using Spot Welding.
4. Preparation of a Square Butt joint using TIG welding.
5. Joining of wires on circuit board using Soldering process.
6. Preparation of a lap joint using Oxy-acetylene gas welding process.

III. METAL FORMING:

1. Preparation of a washer using blanking & Piercing operations.
2. Preparation of Square tray.

IV. PROCESSING OF PLASTICS:

1. Preparation of a bottle cap using injection moulding.
2. Preparation of a bottle using blow moulding.

Course outcomes:

On completion of the course, student will be able to

1. Gain the knowledge of manufacturing process.
2. Know the design and manufacture of patterns for mould preparation.
3. Operate arc welding, gas welding and resistance welding equipment
4. Apply the practicalconcepts of TIG welding.
5. Acquire fundamental knowledge on metal forming processes.
6. Identify the difference between injection and blow moulding.

COMPUTER AIDED ENGINEERING DRAWING PRACTICE LAB (CAEDP)

SEMESTER III

Subject Code	18MEMEL3080	Internal Marks	50
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 1.5

Course Objectives:

This course will enable students to:

1. Gain knowledge on orthographic projections of solids inclined to both the planes and interpenetrations of solids.
2. Identify and gain knowledge how to prepare a surface development of solids
3. Identify various commands used in Auto CAD Screen to create 2D and 3D models
4. Create 2D models by using various toolbars
5. Reproduce solid models of various machine parts by using 3D modeling toolbars

Part-A	Hours
Unit -1	
Projections & Interpenetration of Solids **Projections of solids**: Projections of Regular Solids inclined to both planes. **Interpenetration of right regular solids:** Intersection of Cylinder Vs Cylinder, Prism Vs Prism.	**8**
Unit -2	
Development of Solids: Development of Surfaces of Right Regular Solids – Prisms, Cylinder, Pyramid , Cone.	**6**
Part-B	
Unit –3	
Review of Computer Aided Drafting: Introduction, history of CAD, advantages of CAD, auto CAD screen components, starting a new drawing, opening an existing drawing, setting drawing limits, saving a drawing file, exiting an autoCAD session, dynamic input/command prompt, coordinate system, choosing commands in autocad, object snaps. **Advanced Sketching**: Arcs, rectangles, ellipses, regular polygon, polylines, placing points, infinite lines commands, writing a single line text, Object Properties and excercises.	**12**
Unit –4	
Editing Sketched Objects and Dimensioning: Editing, moving, copying, offsetting, rotating, scaling, filleting, chamfering, trimming, extending, stretching of sketched objects, rectangular array, polar array path array, mirroring the sketched objects and text mirroring, creating text and tables, fundamental dimensioning terms and linear and angular dimensioning and excercises	**12**
Unit – 5	
Computer Aided Solid Modelling: Introduction to the 3D Modeling Workspace, Basic 3D Viewing Tools, 3D Navigation Tools, User Coordinate System, Solid Primitive Types**.** **Creating Solids & Surfaces from 2D Objects** :Extruded , Swept, Revolved, and Lofted Solids and Surfaces, Advanced Solid Editing, Creating Multiple Viewports, Modeling of simple solids, Modeling of machine parts and exercises’	**12**

Course Outcomes:

On completion of the course, student will be able to

1. Draw orthographic projections of solids inclined to both the planes and interpenetrations of solids.
2. Prepare a surface development of solids
3. Identify the commands in sketching
4. Describe various editing and dimensioning commands used drafting software
5. Create 2D models by using various toolbars
6. Reproduce solid models of various machine parts by using 3D modeling toolbars

Text Books:

1. AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill, New Delhi.
2. Auto CAD 2014 for Engineers and Designers by Tickoo Sham, Dream Tech.

References Books:

1. Mastering Auto CAD 2013 and Auto CAD LT2013 – George Omura, Sybex
2. Engineering Drawing – KL Narayana, P Kannaiah, Scitech
3. Engineering Drawing – RK Dhawan, S Chand
4. Engineering drawing by N.D Bhatt, Charotar publications.

B.Tech. (Mechanical Engineering)

Semester IV (Second year) Approved Course structure

Sl. No.	**Course Code**	**CC**	**Course Title**	**L**	**T**	**P**	**C**
1.	18MEMET4010	PCC	Strength of Materials	3	0	0	3
2.	18MEMET4020	PCC	Fluid Mechanics & Fluid Machines	3	0	0	3
3.	18MEMET4030	PCC	Theory of Machines-I	3	0	0	3
4.	18MEMET4040	PCC	Applied Thermodynamics	3	0	0	3
5.	18CMMST4050	HSMC	Engg. Economics & Financial Management	3	0	0	3
6.	18MEMEL4060	PCC	Fluid Mechanics & Fluid Machines Lab	0	0	3	1.5
7.	18MEMEL4070	PCC	Mechanics of Solids & Materials Lab	0	0	3	1.5
8.	18MEMEM4080	MC	Machine Drawing Lab	1	0	4	0
			Total	**14**	**00**	**06**	**18**

STRENGTH OF MATERIALS SEMESTER - IV			
Subject Code	18MEMET4010	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. Understand the Mechanical properties of materials, stresses, strains and their relations
2. Draw the shear force and bending moment diagrams of beams under different loads.
3. Analyze the shear stress distribution in solid and hollow members under transverse loading conditions.
4. Calculate the slope and deflection at a specified point of a beam under different loads.
5. Acquire the knowledge of stresses in thick and thin cylinders
6. Distinguish the columns and struts

UNIT -1	Hours
Introduction: Stress and Strain definitions, types of stresses and strains, elasticity and plasticity. Hooke's law, stress-strain diagrams for engineering materials, modulus of elasticity. Poisson's ratio, relationship between elastic constants, linear and volumetric strains, bars of uniform strength, temperature stresses, compound bars.	**9**
Unit -2	
Beams: Definition of bending moment and shear force; relationship between intensity of loading, shear force and bending moment; bending moment and shear force diagrams for cantilever, simply supported and overhanging beams; simple theory of bending, moment of resistance, modulus of section.	**10**
Unit – 3	
Shear Stresses in Beams: Distribution of shear stresses in rectangular, I-section and T-section for solid and hollow sections. Compound stresses, principal stresses and strains. Mohr's circle of stress.	**8**
Unit – 4	
Slopes and Deflections: Slope and deflection measurements of cantilever, simply supported beams with Macaulay's and double integration methods subjected to point loads and uniformly distributed loads. Torsion: Derivation of torsion formula for circular sections, torsional stresses, angle of twist, power transmission, effect of combined bending and torsion	**13**
Unit – 5	
Cylinders: Stresses in thin and thick cylinders with internal and external pressures. Hoop and longitudinal stresses in cylinders, stresses in compound cylinders. **Columns and Struts:** Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.	**10**

Course Outcomes:

On completion of the course, student will be able to

1. Calculate stresses and strains in a member subjected to different loadings.
2. Construct shear force and bending moment diagrams for beams subjected to different loads
3. Compute bending stress and shear stresses of a beam
4. Estimate the deflections of different beams under various loads
5. Calculate the stresses in thick and thin cylindrical and spherical shells under different loads and directions
6. Distinguish the types columns and struts.

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

Text Books:

1. Bhavikatti. S. S., Strength of Materials, Vikas Publishing House (P) Ltd., New Delhi, Second Edition, 2002.
2. R.K.Rajput, Strength of materials, S.Chand& Co revised edition, New Delhi-2007

Reference Books:

1. Punmia. B. C., Jain, A. K., and Jain, A. K., Strength of Materials and Theory of Structures, Vols. I &

II, XI Edition, Laxmi Publications (P) Ltd, New Delhi, 2002.
2. Hearn, E. J., Strength of Materials, Pergamon Press, Oxford, 1997.
3. R.K.Bansal, Introduction to text book of Strength of materials, Laxmi publications 2004.
4. U.C. Jindal Introduction to text book of Strength of Material Galgotia publications. Second Edition 2001
5. Beer and Johnston, Mechanics of Materials, McGraw Hill, 4th Edition, 2005.
6. Gere and Timoshenko, Mechanics of Materials, PWS Publishing Company, 4th Edition, 1997.
7. S.B.Junarkar and H.J. Shah, Mechanics of Structures, 27th Revised and Enlarged, Charotar Publishing House, 2008.

Web Source References:

1. https://nptel.ac.in/courses/112107146/1
2. https://onlinecourses.nptel.ac.in/noc17_ce17
3. https://nptel.ac.in/courses/105105108/1
4. https://onlinecourses.nptel.ac.in/noc18_ce04/course

FLUID MECHANICS AND FLUID MACHINES

SEMESTER IV

Subject Code	18MEMET4020	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. 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 concept.
4. Solve problems on the turbo machinery using analytical method and velocity triangles.
5. Classify the different types of turbines & evaluate work done and efficiency.
6. 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.	**8**
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. **Boundary Layer Theory:** Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer.	**8**
Unit – 4	
Basics of Turbo Machinery: 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. **Hydraulic Turbines:** classification of turbines, Working and efficiencies of Pelton wheel, Francis and Kaplan turbines. Importance of Draft Tube.	**12**
Unit-5	
Hydraulic Quantities: Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. **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.	**12**

Course outcomes: Students will be able to:

1. Remember the various properties of fluids and pressure measurement devices.
2. Understand the kinematics and dynamics of fluids in detail.
3. Estimate the losses in pipes and understand the concept of Boundary layer theory
4. Solve problems on the turbo machinery using analytical method and velocity triangles.
5. Analyze the performance of hydraulic turbines, unit and specific quantities
6. Analyze the working of hydraulic pumps and their performance curves

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

Text Books:

1. Hydraulics and fluid mechanics including hydraulic machines by Dr. P.N. Modi & Dr. S.M. Seth, Rajsons publications private Ltd.
2. A Text Book of Fluid Mechanics by R.K. Rajput, S. Chand publishers
3. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Revised 9th edition LP Publishers

4. Hydraulics, fluid mechanics and Hydraulic machines by R.S. Khurmi, S. Chand publishers

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga& Sharma, Khanna Publishers.
4. Instrumentation for Engineering Measurements by James W. Dally, William E. Riley, John Wiley & Sons Inc. 2004

Web Source References:

1. https://nptel.ac.in/courses/112104118/3
2. https://freevideolectures.com/course/3246/fluid-mechanics-iii
3. https://freevideolectures.com/course/89/fluid-mechanics

THEORY OF MACHINES – I SEMESTER IV			
Subject Code	18MEMET4030	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. Understand the basic terms used in mechanisms and inversions of different mechanisms
2. Acquire knowledge on straight line motion mechanisms and other lower pairs.
3. Calculate the velocity and acceleration of any point/link in a mechanism
4. Understand types of cam mechanisms
5. Draw the cam profile for different follower motions and to design cam mechanisms for specified output motions.
6. Learn basic concepts of gears and gear trains

Unit -1	**Hours**
Mechanisms: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained . Grublers criterion , Grashoff's law , Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains	**10**
Unit -2	
Lower Pair Mechanism : Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph. Conditions for correct steering – Davis Steering gear, Ackermans steering gear – velocity ratio; Hooke's Joint: Single and double – Universal coupling– application–problems. –Mechanical advantage, Ratchets and Escapements	**09**
Unit – 3	
Plane Motion of Body: Instantaneous centre of rotation, centrode and axode –Procedure for locating instantaneous centres, relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of velocity of points and angular velocity of links. **Kinematics**: Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method four bar mechanism. Velocity and acceleration analysis for a given mechanism, Klein's construction, determination of Coriolis component of acceleration.	**12**
Unit – 4	
Cams and Followers: Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Analysis of motion of followers: Roller follower – circular arc cam with straight, concave and convex flanks	**09**
Unit-5	
Gears: Introduction, Higher pairs, friction wheels and toothed gears.Spur Gear Terminology and definitions –Gear tooth action – path of contact, arc of contact ,contact ratio. Law of toothed gearing – Involutes and cycloidal tooth profiles — Interference and undercutting, condition for minimum number of teeth to avoid interference – gear teeth – Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. **Gear trains** –types, Speed ratio, train value – Parallel axis gear trains– Epicyclic Gear Trains – Differentials	**10**

Course outcomes:
On completion of the course, student will be able to
1. Explain the importance of kinematics, kinematic pairs and mechanisms

2. Describe the relative motion between the parts of a mechanism without considering the forces.
3. Summarize various mechanisms for straight line motion and steering gear, Hooke's joint with applications.
4. Analyse the velocity and acceleration concepts for four bar mechanism & slider crank mechanism using graphical method
5. Distinguish types of cam mechanisms and draw the cam profile for different follower motions
6. Calculate length of contact, arc of contact and minimum number of teeth to avoid interference. Also calculate speeds of different gears in a gear train.

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

Text Books:

1. Mechanism and Machine Theory by Ashok G. Ambekar, PHI Publishers
2. Theory of Machines – S. S Rattan- TMH
3. Theory of machines and Mechanisms – J.J Uicker, G.R.Pennock & J.E.Shigley - Oxford publishers.

Reference Books:

1. R L Norton, Kinematics and Dynamics of Machinery, 1st ed., Tata McGraw Hill Education Private Limited, Delhi,
2. Theory of Machines Sadhu Singh, PearsonsEdn
3. Theory of Machines by Thomas Bevan/ Oxford Universiy Press
4. Theory of Mechanisms and machines – A.Ghosh&A.K.Malik – East West Press Pvt. Ltd

Web Source References:

1. https://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/Kinematics%20of%20Machine/site/basickinematics/basickinematics08.htm
2. https://nptel.ac.in/courses/112105236/21
3. https://nptel.ac.in/courses/112105236/34
4. https://nptel.ac.in/courses/112104121/
5. https://nptel.ac.in/courses/112106137/pdf/2_1.pdf

APPLIED THERMODYNAMICS SEMESTER IV			
Subject Code	18MEMET4040	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. Understand the concept of combustion of fuels and the concepts of psychrometry
2. Knowledgeable in steam power plants and their components, performance and analysis of steam turbines.
3. Gain the knowledge of steam nozzles and their performances in industries.
4. Sketch the velocity diagrams of single and multi-stage steam turbines.
5. Categorize the different gas turbine arrangements, their advantages and disadvantages and different applications
6. Classify various types of air compressors and their working principles.

Unit -1	**Hours**
Basic Concepts: Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy. Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	**10**
Unit -2	
Vapour Power Cycles: Rankine cycles – Performance Evaluation-improving methods **Boilers :** Classification – working principles of L.P & H.P boilers with sketches, mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – draught, classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.	**12**
Unit – 3	
Steam Nozzles: Function of a nozzle – applications - types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line.	**8**
Unit – 4	
Steam Turbines: Classification, impulse turbine; mechanical details , velocity diagram, effect of friction Reaction Turbine: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction – velocity diagram-Analysis of steam turbines, velocity and pressure compounding of steam turbines	**10**
Unit – 5 **Gas Turbines:** Gas power cycles, Brayton cycle, effect of reheat, regeneration and intercooling-Combined gas and vapor power cycles **Compressors:** Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors	**10**

Course Outcomes:

On completion of the course, student will be able to

1. Calculate stoichiometric air fuel ratio, excess air and the properties of psychrometry.
2. Determine the methods of improving rankine cycle efficiency and design the constructional features of various types of boilers.
3. Evaluate critical pressure and other properties of steam in a steam nozzle.
4. Compute the efficiency of steam turbines through graphical and analytical methods.
5. Analyze, compare simple and modified Brayton cycles.
6. Estimate the performance of different types of compressors.

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
Text Books: 1. Fundamentals of Thermodynamics, Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, , John Wiley and Sons. 2. Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.
Reference Books: 1. Heat Engineering – V.P Vasandani and D.S Kumar- Metropolitan Book Company, New Delhi 2. Thermodynamics and Heat Engines, Volume 2 - R.Yadav- Central book depot. 3. Engineering Thermodynamics, PK Nag 4th Edn , TMH. 4. Thermal Engineering – S. Domkundwar – 5th Edn – Dhanpat Rai publ. 5. Thermal Engineering-P.L.Bellaney/ Khanna publishers 6. Thermal Engineering- M.L.Mathur-Jain publ.
Web Source References: 1. https://nptel.ac.in/courses/112106133/ 2. http://www.edurite.com/kbase/animation-of-thermal-power-plant 3. https://www.brighthubengineering.com/power-plants/25423-how-does-a-gas-turbine-power-plant-work-the-main-equipment/ 4. https://www.brighthubengineering.com/power-plants/18336-combined-cycle-power-plants-the-basics/

ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT SEMESTER IV			
Subject Code	18CMMST4050	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 the students to

1. Understand the concept and nature of Managerial Economics and Concept of Demand and Demand forecasting.
2. Analyse the Cost Concepts, Cost-Volume-Profit Analysis and Market structures.
3. Learn different Accounting Systems, preparation of Financial Statements and Capital Budgeting proposals by using different methods.

Unit -I	Hours
Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics and Scope-Managerial Economics and its relation with other subjects-Concept of Demand-Types-Determents-Law of Demand its Exception-Elasticity of Demand-Types and Measurement- Demand forecasting and its Methods.	**10**
Unit –II	
Production and Cost Analysis: Production function-Isoquants and Isocost-Law of Variable proportions- Cobb-Douglas Production function-Economics of Sale-Cost Concepts-Opportunity Cost-Fixed vs Variable Costs-Explicit Costs vs Implicit Costs- Cost Volume Profit analysis- Determination of Break-Even Point (Simple Problems).	**10**
Unit-III	
Introduction To Markets, Pricing Policies & forms Organizations and Business Cycles: Market Structures: Perfect Competition, Monopoly and Monopolistic and Oligopoly – Features – Price Output Determination – Methods of Pricing: Market Skimming Pricing, And Internet Pricing: Flat Rate Pricing. Features and Evaluation of Sole Trader – Partnership – Joint Stock Company – State/Public Enterprises and their forms – Business Cycles – Meaning and Features – Phases of Business Cycle	**12**
Unit –IV	
Introduction to Accounting & Financing Analysis: Introduction to Double Entry Systems – Preparation of Financial Statements- Analysis and Interpretation of Financial Statements-Ratio Analysis (Simple Problems)	**10**
Unit-V	
Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Need for Capital Budgeting-Techniques of Capital Budgeting-Traditional and Modern Methods.	**08**

Course outcomes:

On completion of the course student will be able to:

1. Equipped with the knowledge of managerial economics and estimating demand for a product.
2. Examine the Production Concept and familiar with the concepts of iso-quants, iso-cost lines and MRTS
3. Predict the cost of production and its relevance to managerial decision making
4. Differentiate various the Markets and Pricing methods along with Business Cycles.
5. Prepare Financial Statements along with Analysis
6. Analyse and interpret various investment project proposals with the help of Capital Budgeting techniques.

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

Text Books:

1. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011.
2. Dr. B. Kuberudu and Dr. T. V. Ramana: Managerial Economics & Financial Analysis, Himalaya Publishing House 2011.

Reference Books:

1. Dr. P. Vijaya Kumar & Dr. N. Apparao Management Science Cengage, Delhi, 2012.
2. S. A. Siddiqui & A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2012
3. Vanitha Agarwal : Managerial Economics, Pearson Publications 2011.

Web References:

1. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_MEFA_LECTURE_NOTES_1.pdf
2. https://www.edx.org/course/introduction-to-managerial-economics

FLUID MECHANICS & FLUID MACHINES LAB SEMESTER IV			
Subject Code	18MEMEL4060	Internal Marks	50
Number of Practice Hours/Week	03	External Marks	50
Total Number of Practice Hours	48	Exam Hours	03
Credits – 1.5			

Course Objectives:

This course will enable students to:

1. Calculate different parameters such as coefficient of discharge, coefficient of impact, power, efficiency etc. of various experiments.
2. Estimate pressure variation in a flowing fluid using Bernoulli's principle applications such as Venturi meter, Orifice meter.
3. Compute the head losses in various diameter pipes.
4. Analyze the working of hydraulic turbines and their performance curves
5. Estimate the working of hydraulic pumps and their performance curves

i. Lectures & videos related to laboratory: (07 hours)

1. Measurement of various fluid properties **(1 lecture)**
2. Flow of fluids in closed channels **(1 lecture)**
3. Flow of fluids in open channels **(1 lecture)**
4. Working of hydraulic turbines **(2 lecture)**
5. Working of hydraulic pumps **(2 lectures)**

ii. Laboratory Practice:

1. Determination of coefficient of discharge of Venture meter
2. Determination of coefficient of discharge of Orifice meter
3. Determination of coefficient of discharge of a pipe line using Turbine flow meter
4. Determination of coefficient of discharge through an open channel using V – notch apparatus
5. Verification of Bernoulli's equation
6. Determination of Friction factor of a pipe
7. Determination of coefficient of impact of a jet striking a flat vane
8. Conduct performance test on Pelton Wheel
9. Conduct performance test on Francis turbine
10. Conduct performance test on single stage Centrifugal Pump
11. Conduct performance test on Reciprocating Pump

Course Outcomes:

On completion of the course, student will be able to

1. Calculate the coefficient of discharge of various fluids
2. Evaluate the flow of fluids in closed channels
3. Solve the flow of fluids in open channels
4. Test the impact of jet on vanes
5. Analyze the working of hydraulic turbines and their performance curves
6. Estimate the performance of hydraulic pumps

MECHANICS OF SOLIDS & MATERIALS LAB SEMESTER IV			
Subject Code	18MEMEL4070	Internal Marks	50
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 1.5

Course objectives:

This course will enable students to:

1. Understand the mechanical properties of various materials.
2. Identify the failures of brittle and ductile materials
3. Find the deflection of different types of beams
4. Determine modulus of rigidity of a specimen by torsion test
5. Suggest a suitable ferrous and non-ferrous metal and their alloys for a given application
6. Illustrate the property requirements of a given application and suggest appropriate heat treatment
7. Relate the hardenability of steels by jominy end quench test with jominy distances

List of Experiments

Part-A

1. Direct Tension test
2. Young's Modulus of metal specimen by direct Tension test
3. Brinnel's and Rock well hardness test
4. Compression test
5. Impact test
6. Test on helical Spring to determine the rigidity modulus
7. Torsion Test to determine the rigidity modulus of a shaft
8. Deflection test on a simple or cantilever beam to determine the Young's modulus

Part-B

1. Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.
2. Preparation and study of the Microstructure of mild steels, low carbon steels, high – C steels.
3. Study of the micro structures of cast Irons.
4. Study of the micro structures of non-ferrous alloys.
5. Study of the micro structures of heat treated steels.
6. Hardenabality of steels by Jominy end quench test.
7. To find out the hardness of various treated and untreated steels.

Course Outcomes:

1. Compute the strength of members of various materials under different loads such as compressive, tensile, flexural and torsional.
2. Compute the elastic property of the beam material by measuring deflection
3. Determine the hardness of different types of materials
4. Measure the stiffness of a spring
5. Determine the modulus of rigidity of a shaft
6. Identify a suitable ferrous and non- ferrous metal and their alloys for a given application
7. Suggest appropriate heat treatment for a given application
8. Relate the hardenability of steels by jominy end quench test with jominy Distances

MACHINE DRAWING SEMESTER IV			
Subject Code	18MEMEM4080	Internal Marks	30
Number of Lecture Hours/Week	01(L)+03(P)	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 00			

COURSE OBJECTIVES:

This course will enable students to:

1. Study the conventions and rules to be followed by engineers for making accurate drawings.
2. Understand and apply national and international standards while drawing machine component.
3. Acquire knowledge of fastening arrangements such as riveting.
4. Familiarize in drawing assembly, orthographic and sectional views of various joints.
5. Familiarize in drawing assembly, orthographic and sectional views of various couplings.

Unit -1	**Hours**
Drawing of Machine Elements and simple parts Selection of views, additional views for the following machine elements and parts. a) Popular forms of screw threads, bolts, nuts and foundation bolts b) Keys, cotter joints and knuckle joint. c) Riveted joints for plates d) Shaft coupling, spigot and socket pipe joint. e) Journal, pivot and collar and foot step bearings.	**10**
Unit -2	
Assembly Drawing - I Drawings of assembled views for the part drawings of the following using conventions. a) Engine parts – petrol engine connecting rod, piston assembly b) Machine parts - screws jack, machine vices	**10**
Unit – 3	
Assembly Drawing - II Drawings of assembled views for the part drawings of the following using conventions. a) Machine parts - Plummer block, Tailstock. b) Valves: spring loaded safety valve, air cock	**10**
Unit – 4	
Part Drawing - I Drawings of part views of the following using conventions. Socket and spigot joint, knuckle joint, Oldham coupling.	**10**
Unit – 5	
Part Drawing - II Drawings of part views of the following using conventions. Protected flanged coupling, Bushed-pin type flanged coupling, universal coupling.	**10**

COURSE OUTCOMES:

On completion of the course, student will be able to

1. Identify the national and international standards pertaining to machine drawing.
2. Illustrate various machine components through drawings.
3. Construct an assembly drawing of a machine unit
4. Interpret a set of working drawings of a machine assembly including detail drawings, bill of materials, part specifications
5. Analyze the part or assembly drawings as per the conventions.
6. Understanding the importance of the linking functional and visualization aspects in the preparation of the part drawings

Question paper pattern :

Section A:

1. This section contains three questions carrying 10 marks each.
2. Answer any Two questions in Section- A 10x2 = 20 marks.

Section B:

1. Question from Section-B is compulsory - 50x1= 50 marks

Text Books:
1. Machine Drawing – N.Siddeswar, K.Kannaiah & V.V.S.Sastry – TMH 2. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers
Reference Books: 1. Production and Drawing – K.L. Narayana & P. Kannaiah/ New Age 2. Machine Drawing – P.S.Gill 3. Machine Drawing – N.D. Junnarkar, Pearson 4. Machine Drawing – Ajeeth Singh, McGraw Hill

B.Tech. (Mechanical Engineering)

***Semester V (Third year)* Approved Course structure**

Sl. No.	Course Code	CC	Course Title	L	T	P	C
11.	18MEMET5010	PCC	Machine Tools & Metrology	3	0	0	3
12.	18MEMET5020	PCC	Design of Machine Elements -I	3	0	0	3
13.	18MEMET5030	PCC	Heat Transfer	3	0	0	3
14.	18MEMET5040	PCC	CAD/CAM/CIM	3	0	0	3
15.	18MEMET505X	PEC	Professional Elective-1	3	0	0	3
16.	18MEXXO506X	OEC	Open Elective-I	3	0	0	3
17.	18MEMEL5070	PCC	Heat Transfer Lab	0	0	3	1.5
18.	18MEMEL5080	PCC	Machine Tools & Metrology Lab	0	0	3	1.5
19.	18MEXXS5090	SOC	Soft Skills & Aptitude Builder - 1	0	0	4	2
20.	18MEMEM50100	ESC	Biology for Engineers	3	0	0	0
			Total	**18**	**00**	**10**	**23**

Professional Elective Course -I

S. No.	Subject Code	Name of the subject	L	T	P	Cr
1.	18MEMEP505A	Conventional & Non-Conventional Power Stations	3	0	0	3*
2.	18MEMEP505B	Nano Technology	3	0	0	3*
3.	18MEMEP505C	Industrial Robotics with Artificial Intelligence	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

MACHINE TOOLS & METROLOGY SEMESTER - V			
Subject Code	18MEMET5010	**Internal Marks**	30
Number of Lecture Hours/Week	3	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

Course Objectives:

The course should enable the students to:

1.Acquire the knowledge on theory of metal cutting and mechanisms of machining

2.Understand about the various lathe machines cutting processes

3.Understand about the various slotting, planning drilling & boring cutting processes

4.Understand the features of Milling process, milling machines, Milling operations and different types of indexing.

5.Understand the basics of Metrology like Surface roughness, surface finish, limits and tolerances etc.

Unit -1	**Hours**
Metal Cutting: Elements of metal cutting process, geometry of single point cutting tool, tool signature, chip formation and types of chips, chip breakers, mechanics of orthogonal cutting – Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, coolants, tool materials. **Jigs & Fixtures:** Principles of design of jigs and fixtures, principles of location and clamping, applications.	**10**
Unit -2	
Lathe Machines: Engine lathe – principle of working, specification of lathe, types of lathes, construction of engine lathe, lathe operations, work holders & tool holders – lathe attachments, turret and capstan lathes. Principal features of automatic lathes – classification – single spindle and multi spindle automatic lathes	**08**
Unit – 3	
Shaping, Slotting & Planning Machines: Introduction - principle of working – principle parts – specifications - operations performed - slider crank mechanism **Drilling & Boring Machines:** Introduction – construction of drilling machines – types of drilling machines– specifications- types of drills – geometry of twist drill - operations performed – tool holding devices – deep hole drilling machines- Boring Machines – fine Boring Machines – jig	**10**

boring machines	
Unit – 4	
Milling Machines: Principles of working – specifications – classification of milling machines, principal features of horizontal, vertical and universal milling machines, machining operations, types of cutters and geometry of milling cutters, accessories to milling machines, introduction to indexing, classification, methods of indexing- simple & compound. **Finishing Processes:** Theory of grinding, classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds and selection of a grinding wheel.	**12**
Unit – 5	
Systems Of Limits and Fits: Introduction, nominal size, tolerance, limits, deviations, fits - Unilateral and bilateral tolerance system, hole and shaft basis systems, and problems. **Linear Measurements:** Slip gauges, dial indicators, vernier caliper and micrometers. **Angular Measurements:** Bevel protractor, angle slip gauges, angle dekkor and sine bar	**10**

Course outcomes: At the end of the course the student will be in a position to:

1. Analyze mechanics of orthogonal cutting to metal machining.
2. Acquire the knowledge on operations in conventional, automatic, Capstan & turret lathes.
3. Explain shaping, slotting, planning, drilling and boring machines.
4. Make gear and keyway in milling machines using indexing mechanisms and principles of finishing processes
5. Outline the linear and angular measuring instruments

Text Books:

1. Production Technology by R.K. Jain and S.C. Gupta/ Hanna Publishers
2. Workshop Technology – B.S.Raghu Vamshi – Vol II/ Dhanpat Rai & Co
3. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill
4. Engineering Metrology / R.K.Jain / Khanna Publishers

Reference Books:

1. Metal cutting Principles by M.C. Shaw/ Oxford University Press
2. Metal cutting and machine tools by Boothroyd/ CRC Press
3. Engineering Metrology / Mahajan / Dhanpat Rai Publishers

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

<table>
<tr><td colspan="4" align="center">DESIGN OF MACHINE ELEMENTS-I

SEMESTER - V</td></tr>
<tr><td>Subject Code</td><td>18MEMET5020</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 03</td></tr>
<tr><td colspan="4">Course Objectives:

Students will be able to

1. Understand the customers’ need, formulate the problem and observe the behavior of components subjected to loads, different types of modes of failure.

2. Gain the knowledge of fluctuating stresses, endurance limit and fatigue failure.

3. Design and analyze permanent joints (riveted, welded, etc.) under concentric and eccentric loading conditions.

4. Develop the knowledge of designing detachable joints (bolts, cotters, etc.) under various loading conditions.

5. Design and analyze coil springs (compression, tension, torsion) under various loads.</td></tr>
</table>

Unit -1	**Hours**
Introduction: Principles of mechanical design; Factor of safety, strength, rigidity, fracture, wear, and material considerations; Stress concentrations; Design for fatigue; Limits and fits. **Design**: Types of loads, stresses and strain, modes of failure, Principal stresses, theories of failure, Rankine theory, Guests theory, Von Mises theory, selection of failure theories.	**10**
Unit -2	
Strength of Machine Elements: Theoretical stress concentration factor – fatigue stress concentration factor, notch sensitivity – design for fluctuating stresses – endurance limit – estimation of endurance strength – Goodman’s line – Soderberg’s line – modified Goodman’s line methods.	**8**
Unit – 3	
Design of Riveted Joints: Types of riveted joints, rivet heads, terminology, caulking and fullering, analysis of riveted joints, efficiency of riveted joints, eccentrically loaded riveted joints. **Design of Welded Joints:** Welding process, merits and demerits of welded joints over riveted joints, Types of welded joints, weld symbols, strength of parallel and fillet weld, strength of a welded joint, eccentrically loaded welded joints, welds subjected to bending moment, torsional	**12**

moment.	
Unit – 4	
Design of simple machine parts, design of cotter and knuckle joints. **Design of Threaded Joints**: Forms of screw threads, nomenclature, thread series, designation, power screws, and advantages over v-threads, stress in screwed threads, bolts of uniform strength, empirical relation for initial tightening, eccentrically loaded joints.	**10**
Unit – 5	
Mechanical Springs: Stresses and deflections of helical springs, extension, compression springs, springs for fatigue loading, Wahl's stress concentration factor, energy storage capacity – helical torsion springs – co-axial springs, leaf springs, Nipping of leaf springs.	**10**

Course outcomes:

On the completion of this course, students are able to

1. Identify the customers' need, formulate the problem and different types of failure modes and criteria to observe the behavior of component subjected to loads.
2. Define fluctuating stresses, endurance limit and fatigue failure.
3. Analyze permanent joints (riveted, welded, etc.) under concentric and eccentric loading conditions.
4. Analyze detachable joints (bolts, cotters, etc.) under various loading conditions.
5. Evaluate stiffness, number of coils and length etc., of coil springs (compression, tension, torsion) under various loads.

TEXT BOOKS

1. Machine Design/V.Bandari/ TMH Publishers
2. Machine design / NC Pandya& CS Shah/Charotar Publishing House Pvt. Limited

REFERENCES BOOKS

1. Design of Machine Elements / V.M.Faires /McMillan
2. Machine design / Schaum Series/McGraw Hill Professional
3. Machine Design/ Shigley, J.E/McGraw Hill
4. Machine Design –Norton/ Pearson publishers

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.

HEAT TRANSFER SEMESTER - V			
Subject Code	18MEMET5030	**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 modes of heat transfer and their applications in different energy systems.
2. **Gain** the knowledge on effectiveness and efficiency of fins for various heat transfer applications.
3. **Understand** the concepts of continuity, momentum and energy principles of fluid flow problems in heat transfer.
4. **Select appropriate** correlations to evaluate heat transfer coefficients for forced and natural convection over exterior surfaces and flow through pipes.
5. **Acquire** the knowledge on heat exchanger performance by using LMTD and NTU methods and Familiarize radiation heat transfer concepts of black body surfaces and gray body surfaces

Unit -1	**Hours**
Introduction: Modes and mechanisms of heat transfer – basic laws of heat transfer – General discussion about applications of heat transfer. **Conduction Heat Transfer:** Fourier rate equation – general heat conduction equation in Cartesian, cylindrical and spherical coordinates. Steady, unsteady and periodic heat transfer – initial and boundary conditions. **One Dimensional Steady State Heat Conduction:** Conductive heat transfer through slab, cylinder, sphere – Homogeneous slabs, hollow cylinders – overall heat transfer coefficient– critical radius of insulation – Variable thermal conductivity – systems with heat sources or heat generation	**10**
Unit -2	
Extended Surfaces (Fins): Types, applications, fin materials, heat transfer from fins with uniform cross section – long fin, fin with insulated tip and short fin, Fin efficiency and Effectiveness – application to error measurement of temperature. **One Dimensional Transient Conduction:** Lumped heat capacity systems– significance of Biot and Fourier numbers- chart solutions of transient conduction systems	**10**

Unit – 3	
Convection: Dimensional analysis– Buckingham Pi Theorem for forced and free convection – non-dimensional numbers and their significance – concepts of continuity, momentum and energy equations. **Forced Convection:** Concepts about hydrodynamic and thermal boundary layers and their thicknesses – use of empirical correlations for convective heat transfer – flat plates, cylinders, horizontal pipe flow and annulus flow.	**10**
Unit – 4	
Natural Convection: Development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for vertical plates and cylinders, horizontal plates and cylinders. **Boiling:** Pool boiling – regimes- calculations on nucleate boiling, critical heat flux and film boiling. **Condensation:** Film wise and drop wise condensation –Nusselt"s theory of condensation on a vertical plate – film condensation on vertical and horizontal cylinders using empirical correlations.	**10**
Unit – 5	
Heat Exchangers: Classification of heat exchangers, temperature distribution, – overall heat transfer coefficient, fouling factor –concepts of LMTD and NTU methods – Effectiveness of the heat exchanger. **Radiation Heat Transfer:** Basic concepts and definitions: Absorptivity, Reflectivity, Transmissivity – concept of black body – Laws of radiation – heat transfer between two finite black surfaces and two grey surfaces – concept of shape factor – Emissivity — radiation shields.	**10**

Course outcomes:

After the completion of the course students will be able to

1. **Formulate** heat transfer conduction equations on engineering systems.
2. **Analyze** the conduction and convection heat transfer coefficients on fins which are used in real time applications.
3. **Solve** fluid flow problems using continuity, momentum and energy principles.
4. **Evaluate** heat transfer coefficients for forced convection and natural convection.
5. **Determine** heat exchanger performance and effectiveness by using the method of LMTD & NTU and calculate the radiation heat transfer between black body & gray body surfaces.

TEXT BOOKS:

1. Fundamentals of Engg. Heat and Mass Transfer / R. C. Sachdeva / New Age

   International.

2. Heat and Mass Transfer – R. K. Rajput / S. Chand revised 9th edition

REFERENCE BOOKS:

1. Heat and Mass Transfer –Cengel- McGraw Hill
2. Heat and Mass Transfer – Arora and Domkundwar, Dhanpatrai & Sons.
3. Heat and mass transfer - D.S.Kumar, katson publishers.

Note: Heat and Mass transfer Data Book by C P Kothandaraman and Subrahmanyan is used to design and analyze various thermal processes and thermal equipment.

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 sub question covering all topics under a course outcome

CAD/CAM/CIM
SEMESTER - V

Subject Code	18MEMET5040	**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. Describe the structure and usage of a graphic system in an industry by the knowledge gained on CAD/CAM systems
2. Use the knowledge on curves in calculating the and data points used in generating various curves with the help of modeling software and generation techniques.
3. Outline the working and application of NC machines and develop the part programs necessary for manufacturing a machine component using NC/CNC machines
4. Modify the conventional manufacturing system to an organized system for increasing the production using proper planning and group technology techniques.
5. Demonstrate the implementation of CAD/CAM techniques in a completely integrated manufacturing industry using CAQC and CIM knowledge

Unit -1	Hours
Introduction to CAD/CAM: Introduction to CAD/CAM/CIM, Sequential and concurrent engineering Fundamentals of CAD, Product cycle, Design process, CAD/CAM hardware CAD standards: Graphical Kernel System (GKS), Data exchange standards- IGES, STEP, CALS etc., and Communication standards **Fundamentals of Computer Graphics:** Raster scan graphics coordinate system, Database structure for graphics modeling, clipping, hidden surface removal.	**8**
Unit -2	
Transformations of Geometry: Translation, Scaling, Reflection, Rotation, Homogeneous representation of transformation, Concatenation of transformations. **Geometric Modelling of Curves:** Wire frame modelling, Wireframe entities, Curve representation, Parametric representation of analytic curves, Parametric representation of Hermite cubic spline, Bezier and B-spline curves. **Geometric Modelling of Surfaces:** Surface modeling, Basic surface entities, Parametric representation of analytic & Synthetic surfaces. **Geometric Modelling of Solids:** Solid modeling, Solid entities, Boolean operations, Boundary representation of Solid Modelling, CSG approach of Solid Modelling.	**8**
Unit – 3	
DRAFTING AND MODELING SYSTEMS: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modelling. **Computer Aided Manufacturing (CAM):** Introduction to Computer Numerical Control (CNC), Basic components of NC system, NC coordinate system, Motion control systems, Feedback devices, CNC tooling, features of machining center, turning center. **CNC Programming:** Part programming fundamentals, Manual Part Programming, Computer assisted part programming, APT Programming, Geometric & motion commands, Post processor commands.	**12**
Unit – 4	
Group Technology: Introduction, part families, parts classification and coding, features of parts classification of coding system, OPITZ, MICLASS and Production Flow Analysis, composite part concept, machine cell design and applications. **Computer Aided Process Planning (CAPP)**: Introduction to CAPP, Variant & Generative methods of CAPP, Benefits of CAPP.	**10**
Unit – 5	
Computer Aided Quality Control: Introduction, Terminology in Quality control, Computer in QC, contact and noncontact inspection techniques, computer aided testing, integration of CAQC with CAD/CAM. **Computer Integrated Manufacturing Systems (CIMS):** Introduction to CIM, Scope of CIM, Types of manufacturing systems, machine tools and related equipment, material handling systems,	**10**

material requirement planning, computer control systems, human labor in manufacturing systems, CIMS benefits.	

Course outcomes:

1. Demonstrate computer graphic system used for design & manufacturing in industries for production and services.
2. Develop newly transforms entities for 2D, 3D representations and generation of curves, surfaces and solids entities for a graphic system using the mathematical modeling techniques for a computer graphic system.
3. Develop designs and suitable part programs for working of a NC/CNC/DNC machine for machining any given component using the knowledge gained on the design tools and CNC machines.
4. Choose the best production system applicable for manufacturing a machine component using the planning and group technology techniques
5. Examine the adaptable automation in a manufacturing system for increasing the production using the computer aided quality control and computer integrated manufacturing techniques

TEXT BOOKS:

1. CAD/CAM- Computer Aided Design & Manufacturing/M.D. Groover & E.W. Zimmer.
2. CAD/CAM/Ibrahim Zeid/Tata McGrawhill, Delhi.

REFERENCES:

1. CAD/CAM/CIM/Radhakrishna/New age international.
2. CAD/CAM/P.N.Rao/Tata McGrawhill , Delhi
3. CAD/CAM/CIM/P. Radhakrishna & S. subramanyan

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

PROFESSIONAL ELECTIVE COURSES -I

<table>
<tr><td colspan="4" align="center">CONVENTIONAL & NON-CONVENTIONAL POWER STATIONS
SEMESTER - V</td></tr>
<tr><td>Subject Code</td><td>18MEMEP505A</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 03</td></tr>
</table>

Course Objectives:
Enable the students to

1. Acquire knowledge on sources of energy and understand the working of Thermal Power Plants.
2. Acquire knowledge on Diesel and Hydro Power Stations and their auxiliaries
3. Apply the basic knowledge of nuclear energy and identify Different types of nuclear power plants and their auxiliaries.
4. Understand the principles and working of solar, wind and Bio gas plants
5. Understand the Principles and working of Geothermal energy, tidal, wave energy power plants and apply the principles of direct energy conversion systems

Unit -1	Hours
Introduction to the sources of energy: Resources and development of power in India. **Steam Power Plant:** Plant layout, working of different circuits, overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, cyclone furnace, design and construction, dust collectors. **Gas Turbine Plant:** Introduction- classification - construction – layout with auxiliaries	12
Unit -2	
Diesel Power Plant: Plant layout with auxiliaries – fuel supply system, air starting equipment. combined cycle power plants and comparison. **HydroElectric Power Plant:** Water power – hydrological cycle / flow measurement– hydrographs – storage and pondage – classification of dams and spillways. **Hydro Projects and Plant:** Classification – typical layouts – plant auxiliaries – plant operation pumped storage plants.	10
Unit – 3	
Nuclear Power Station: Nuclear fuel – breeding and fertile materials – nuclear reactor – reactor operation. **Types of Reactors:** Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding – radioactive waste disposal.	10
Unit – 4	
Solar Power plant: classification of concentrating collectors, Flat plate and concentrating collectors, solar ponds. Solar plants, photovoltaic energy conversion **Wind Energy:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics. **Bio-Mass:** Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters.	10
Unit – 5	
Geothermal Energy: Resources, types of wells, methods of harnessing the energy. **Tidal and Wave energy:** Potential and conversion techniques, mini-hydel power plants. **Direct Energy Conversion:** Thermoelectric generators, principles and working of MHD	8

generator, Fuel cells	

Course outcomes:

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

1. List, describe the main sources of energy and describe the functions of the major equipment and auxiliaries of a Thermal power plants
2. Identify, demonstrate the components of an IC Engine and hydro power plant and compare the various combined cycle power plants.
3. Explain the basic principles of nuclear reactions and explain working principle of different types of nuclear power plants.
4. Apply the knowledge of Solar, Wind energy and Biomass, in generation of power.
5. Identify the principles of direct energy conversion systems and explain the basic principles of Geothermal, Tide and Wave Energy

Text Books:

1. A Text Book of Power Plant Engineering – R.K. Rajput – Laxmi Publications.
2. A Course in Power Plant Engineering – Arora, Domkundwar – Dhanpat Rai & Co
3. Power Plant Engineering – P.C.Sharma / S.K.Kataria Publications
4. Non- conventional Energy Sources / G.D. Rai/ Khanna Publishers

Reference Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill
2. Renewable Energy Resources / Tiwari and Ghosal / Narosa
3. An Introduction to Power Plant Technology / G.D. Rai/Khanna Publishers.
4. Power Plant Engineering – G. R. Nagpal – Khanna Publishers

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 sub question covering all topics under a course outcome

<table>
<tr><td colspan="4" align="center">NANO TECHNOLOGY
SEMESTER - V</td></tr>
<tr><td>Subject Code</td><td>18MEMEP505B</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 03</td></tr>
<tr><td colspan="4">Enable the students to
1. Acquire knowledge on importance of Nanoscience & Nanotechnology
2. Identify the properties of nanomaterials & their applications in material science.
3. Apply the concept of synthesis & fabrication of nanomaterials.
4. Understand the various characterization techniques of nanomaterials.
5. Understand the concept of carbon nanotechnology & its applications.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">Introduction to Nanotechnology: Importance of nano-technology, Emergence of Nanotechnology, History of nanoscience, Definition of nanometer, nanomaterial & nanotechnology, classification of nanomaterials, basic applications of nanotechnology in science & technology.</td><td>08</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">Properties of Materials: Mechanical, thermal, and magnetic properties of nanomaterials, effect of size reduction on properties. Applications of nanotechnology in surface science, energy & environment.</td><td>08</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="3">Synthesis: Synthesis of bulk polycrystalline samples, growth of single crystals, preparation of nanoparticle- bottom-up approach- sol gel synthesis
Fabrication: Hydro thermal growth, thin film growth, PVD and CVD, top-down approach- Ball milling, micro fabrication, lithography, requirements for realizing semiconductor nanostructures.</td><td>12</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">Characterization Techniques: X-Ray diffraction, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezo response microscopy, diffuse reflectance spectra, Raman spectroscopy. Applications of nano structured thin films, applications of quantum dots.</td><td>12</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">Carbon Nanotechnology: Allotropes of Carbon, Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology.
Applications of nanocrystalline diamond films, grapheme, and applications of carbon nanotubes, applications of carbon nanotechnology in biology and medicine.</td><td>10</td></tr>
<tr><td colspan="4">Course outcomes:
On completion of this course, students are able to
1. Explain the importance of Nanotechnology & its emergence in various fields.
2. Identify various properties of nanomaterials in different applications.
3. Select synthesis and fabrication methods, techniques and process parameters for processing of nanomaterials.
4. Evaluate the properties of nanomaterials using different characterization tools & equipment.
5. Discuss the concept of carbon allotropes in Nano Technology & their applications</td></tr>
<tr><td colspan="4">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 sub question covering all topics under a course outcome</td></tr>
<tr><td colspan="4">Text Books:
1. Nanoscience and nanotechnology: M.S. Ramachandra Rao & Shubra singh/ Wiley publishers.
Reference Books:
1. Introduction to nanotechnology by Charles P.Poole., J.Owens/ Wiley publishers.
2. Nanotechnology by Jermy J Ramsden, Elsevier publishers
3. Nano Essentials- T Pradeep/TMH</td></tr>
</table>

INDUSTRIAL ROBOTICS WITH ARTIFICIAL INTELLIGENCE SEMESTER - V			
Subject Code	18MEMEP505C	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

Enable the students to

1. Gain the knowledge of industrial robots, configurations and actuators.
2. Apply spatial transformations to obtain forward and inverse kinematics.
3. Generate trajectory planning for path description and generation.
4. Describe the functioning of sensors and the specific applications of robots in industry.
5. Understand the concepts of Artificial Intelligence in manufacturing industry.

Unit -1	**Hours**
Introduction: An overview of Robotics, Automation and Robotics, CAD/CAM and Robotics — present and future applications – classification by coordinate system. Components of industrial robotics: Components, common types of arms, number of degrees of freedom, end effectors, requirements and challenges of end effectors, Actuators-Pneumatic, Hydraulic actuators, electric & stepper motors.	**10**
Unit -2	
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 – 3	
Trajectory planning: General considerations in path description and generation. Trajectory planning, path planning, Skew motion, joint integrated motion –straight line motion- Robot programming, languages and software packages.	**10**
Unit – 4	
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**
Unit – 5	
Artificial Intelligence In Manufacturing Industry: Introduction, developments of Artificial intelligence in manufacturing Industry; Advantages, limitations and applications of Artificial Intelligence in Manufacturing industry- fault diagnosis, Quality inspection, inventory control, industrial safety and maintenance.	**10**

Course outcomes:

1. Identify various robot configurations, actuators and sensors for a robot based on specific application.
2. Carry out the motion analysis and kinematic analysis for forward and inverse kinematics
3. Perform trajectory planning for a robot manipulator
4. Explain the specific applications of a robot in industry.
5. Apply the concepts of Artificial Intelligence in manufacturing industry.

TEXT BOOKS 1. Industrial Robotics / Groover M P /Pearson Edu/ McGraw Hill 2. Robotics and Control / Mittal R K &Nagrath I J / TMH 3. Robotics / Fu K S/ McGraw Hill 4. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
REFERENCE BOOKS 1. Robotic Engineering / Richard D. Klafter/ Prentice Hall 2. Introduction of robotics/ John J Craig/ Pearson Edu 3. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley **4.** Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-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

HEAT TRANSFER LAB			
Subject Code	18MEMEL5070	IA Marks	15
Number of Lecture Hours/Week	3	Exam Marks	35
Total Number of Lecture Hours	48	Exam Hours	3
Credits –1.5			

Course objectives: On successful completion of the course, students shall be able to:

1. Illustrate basic heat transfer principles and test the thermal conductivity of a metal rod.
2. Evaluate overall heat transfer coefficient in case of composite wall and heat exchanger.
3. Analyze the efficiency and temperature distribution of a pin fin.
4. Compare the emissivity of black and grey bodies.
5. Estimate heat transfer coefficient in case of external flows.

LIST OF EXPERIMENTS

1. Determination of overall heat transfer co-efficient of a composite slab
2. Determination of heat transfer rate through a lagged pipe.
3. Determination of heat transfer rate through a concentric sphere.
4. Determination of thermal conductivity of a metal rod.
5. Determination of efficiency of a pin-fin.
6. Determination of heat transfer coefficient in forced convection & natural convection.
7. Determination of COP of VCR system.
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzman constant.
11. Determination of critical heat flux.
12. Determination of heat transfer rate in drop and film wise condensation.

ADDITIONAL EXPERIMENTS

1. Determination of heat transfer rate in radiator using radiator test rig.
2. Determination of heat transfer rate in twisted tape inserted co-axial heat exchanger.
3. Demonstration of heat pipe.

Course Outcomes:

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

1. Find thermal conductivity of different common metallic materials.
2. Find the quantity of heat transfer between fluids and solid boundaries.
3. Evaluate the amount of heat exchanged between fluids flowing within heat exchangers.
4. Determine the heat transfer coefficient of radiator.
5. Analyze different heat exchangers.

MACHINE TOOLS & METROLOGY LAB			
Subject Code	18MEMEL5080	IA Marks	15
Number of Lecture Hours/Week	3	Exam Marks	35
Total Number of Lecture Hours	48	Exam Hours	3
Credits – 1.5			

Course objectives: The students should be able to:

1. Know the basic operations such as turning, shaping, slotting, milling, grinding, etc
2. Describe the effect of process parameters.
3. Gain the knowledge of different coolants used in drilling and grinding operations.
4. Measure lengths, diameters and heights
5. Determine the pitch of screws and gears

EXPERIMENTS

1. Step turning and thread cutting on lathe machine
2. Producing a hole on given specimen using drilling machine
3. Producing a flat surface on given work piece using shaping machine
4. Machining a spur gear using slotting machine
5. Producing a keyway slot using milling machine
6. Producing a cylindrical surface using cylindrical grinding machine
7. Producing a flat surface using surface grinding machine
8. Producing a flat surface using planer machine
9. Grinding of single point cutting tool angles using tool & cutter grinding machine
10. Measuring lengths, heights, diameters using vernier calipers, micrometer, height gauge
11. Measuring bore diameter using internal micrometer and dial bore indicator
12. Measuring taper angle using bevel protractor, sine bar
13. Measurement of pitch of screw and gear and clearance angle of cutting tool by tool maker's microscope.

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

1. Understand the mechanism of chip formation.
2. Analyze various cutting tool parameters in different machining operations.
3. Operate different machine tools.
4. Apply the knowledge of different instruments for linear and angular measurements.
5. Choose the appropriate measuring instrument for a specific requirement.

Soft Skills & Aptitude Builder – 1			
Subject Code	18MEXXS5090	**IA Marks**	**15+15**
Number of Lecture Hours/Week	**2**	**Exam Marks**	**35+35**
Total Number of Lecture Hours	**32**	**Exam Hours**	**3**
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	**6**
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	**6**
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	**6**
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 , Problems on Weighted Average, Finding Average using Assumed Mean Method **Alligation and Mixture:** Problems on Mixtures, Alligation Rule, Problems on Alligation	**7**
Unit – 5: Mental Ability	
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,	**7**

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	Analyse the problems logically and critically

<table>
<tr><td colspan="4">BIOLOGY FOR ENGINEERS
SEMESTER - V</td></tr>
<tr><td>Subject Code</td><td>18MEMEM50100</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 00</td></tr>
<tr><td colspan="4">Course Objectives
1. Convey that Biology is as important as scientific discipline as Mathematics, Physics and Chemistry.
2. Convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”.
3. Convey that without catalysis life would not have existed on earth.
4. Molecular basis of coding and decoding genetic information is universal.
Analyze biological processes at the reductionist level.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">Introduction: 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 the 18th Century 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.</td><td>10</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="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 passesfrom parent to offspring.
Molecules of life: Monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">Microbiology & Metabolism: Thermodynamics as applied to biological systems - Exothermic and endothermic 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 CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis).
Concept of single celled organisms: Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms</td><td>10</td></tr>
<tr><td colspan="4">Course outcomes:
1. Understanding how biological observations of the 18th Century that lead to major discoveries.
2. Convey that classification per say 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</td></tr>
</table>

one can imagine.

5. Convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”.

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 Education Ltd.
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons.

REFERENCE BOOKS

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.
3. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm,C.Brown Publishers.

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 sub question covering all topics under a course outcome.

Course structure for the Academic Year 2020-21

B. Tech. (Mechanical Engineering)

Semester VI (Third year) Approved Course structure

Sl. No.	Course Code	CC	Course Title	L	T	P	C
10	18MEMET6010	PCC	Theory of Machines-II	3	0	0	3
11	18MEMET6020	PCC	Design of Machine Elements -II	3	0	0	3
12	18MEMEP603X	PE	Professional Elective -II	3	0	0	3
13	18MEMEP604X	PE	Professional Elective -III	3	0	0	3
14	18MEXXO605X	OE	Open Elective-II	3	0	0	3
15	18MEMEL6060	PCC	Theory of Machines Lab	0	0	3	1.5
16	18MEMEL6070	PCC	Thermal Engineering Lab	0	0	3	1.5
17	18MEMEL6080	PCC	CAD/CAM Lab	0	0	3	1.5
18	18MEXXS6090	SOC	Soft Skills & Aptitude Builder – 2	0	0	4	2
			Total	**17**	**00**	**14**	**21.5**

Professional Elective Course -II

S. No.	Subject Code	Name of the subject	L	T	P	Cr
4.	18MEMEP603A	Prime Movers for Automobiles	3	0	0	3*
5.	18MEMEP603B	Synthesis and Characterization of Materials	3	0	0	3*
6.	18MEMEP603C	Additive Manufacturing	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

Professional Elective Course -III

S. No.	Subject Code	Name of the subject	L	T	P	Cr
4.	18MEMEP604A	Solar Energy Engineering and Applications	3	0	0	3*
5.	18MEMEP604B	Finite Element Methods	3	0	0	3*
6.	18MEMEP604C	Smart Manufacturing & IIOT	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

THEORY OF MACHINES -II SEMESTER - VI			
Subject Code	18MEMET6010	**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. Demonstrate the gyroscopic and analyze effects under different forces and torques
2. Analyze the existence of friction and its importance in rotating parts like clutches, brakes and dynamometers.
3. Identify the dynamic forces and torques developed in the rotating parts like cranks, flywheels and governors.
4. Estimate the unbalanced forces and torques developed in rotating and reciprocating parts of an engine.
5. Identify different types of vibrations in machine parts and evaluate their effects.

Unit -1	**Hours**
Precession: Gyroscopes, effect of precessional motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and naval ships.	**8**
Unit -2	
Friction: Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis **Clutches**: Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch. **Brakes and Dynamometers**: Simple block brakes, internal expanding brake, band brake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission	**12**
Unit – 3	
Turning Moment Diagrams: Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.	**12**

Governors: Watt, porter and proell governors, spring loaded governors– Hartnell and Hartung with auxiliary springs, effort, sensitiveness, isochronism and hunting.	
Unit – 4	
Balancing: Balancing of rotating masses single and multiple – single and different planes, using analytical and graphical methods. Primary and secondary balancing of reciprocating masses. **Unbalanced forces and couples in multi cylinder engines:**V-engines, in-line and radial engines for primary and secondary balancing. Locomotive balancing, hammer blow, swaying couple, variation of tractive effort.	**8**
Unit – 5	
Vibrations: Introduction, Terms used in vibrations, Applications. **Longitudinal Vibrations**: Free vibration of spring mass system – Natural frequency-types of damping – damped free vibration. **Forced Vibration:** Simple problems on forced damped vibration, magnification factor, vibration isolation and transmissibility. **Transverse Vibrations:** Transverse loads, vibrations of beams with concentrated and distributed loads. Dunkerly's method, Rayleigh's method, whirling of shafts, critical speeds. **Torsional Vibrations:** Two and Three rotor systems.	**10**

Course outcomes:

1. Demonstrate the gyroscopic effect on moving bodies like aeroplane, ship, 2-wheeler and 4-wheeler vehicles in various conditions using the concepts of gyroscope
2. Analyze the application and effect of friction in moving bodies like clutches, brakes and dynamometers in producing and transmission of energy.
3. Identify the dynamic forces and torques developed in the rotating parts like cranks, flywheels and governors.
4. Estimate the balanced and unbalanced forces and torques developed in rotating and reciprocating parts of an engine due to the presence of various components on the shaft.
5. Evaluate various types of vibrations and its effects produced like whirling, resonance and others in machine parts during stationary and working conditions.

TEXT BOOKS:

1. Theory of Machines / S.S. Rattan/ Mc. GrawHill
2. Mechanism and Machine Theory /Ashok G.Ambedkar/ PHI Publications

REFERENCES:

1. Theory of Machines / Thomas Bevan / Oxford UniversityPress
2. Theory of machines /Khurmi/S.Chand
3. Mechanism and Machine Theory / JS Rao and RV Dukkipati / NewAge

4. Theory of Machines / Shigley /MGH

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

DESIGN OF MACHINE ELEMENTS-II SEMESTER - VI			
Subject Code	18MEMET6020	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03
Credits – 03			

Students will be able to
1. Design and Analyze the pressure distribution in journal bearings.
2. List out engine components such as cylinder, piston, connecting rod and crankshaft.
3. Summarize the design procedure for shafts and couplings with different geometrical features under various loading conditions.
4. Determine geometrical relations for length of belt and chain.
5. Distinguish types of pulleys/sprockets for belt and chain drives from manufacturer's catalogue and explain procedure for beam strength and wear strength, effective load and module based on beam strength.

Unit -1	Hours
Bearings: Classification of bearings- applications, types of journal bearings – lubrication – bearing modulus – full and partial bearings – clearance ratio – heat dissipation of bearings, bearing materials – journal bearing design – ball and roller bearings – static loading of ball & roller bearings, bearing life.	**10**
Unit -2	
Engine Parts: Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends – cranks and crank shafts, strength and proportions of overhung and center cranks – crank pins, crank shafts. Pistons, forces acting on piston – construction design and proportions of piston, cylinder, cylinder liners.	**10**
Unit – 3	
Design of Shafts: Design of solid and hollow shafts for strength and rigidity, Design of shafts for combined bending and axial loads – Shaft sizes. **Design of Shaft Couplings:** Rigid couplings: Muff, Split-muff and flange couplings – Flexible couplings, Flange coupling (modified).	**10**
Unit – 4	
Design of Belt and Rope Drives: Selection of flat belts, Pulleys for flat belts, Arms of cast iron pulley, Selection of V-belts and V-grooved pulley, Construction of wire rope, Stresses in wire ropes, Rope sheaves and drums. **Design of Chain Drives:** Introduction to chain drives, Roller chains, geometric relationships, Polygonal effect, Power rating of roller chains, Proportions of sprocket wheels, Design of chain drive.	**10**
Unit – 5	
Design of Spur Gear Drives: Force analysis on spur gear tooth, Gear blank design, module and face width, Beam strength of gear tooth, Effective load on gear tooth, Lewis Fatigue equation, Estimation of module based on beam strength, Wear strength of gear tooth, Estimation of module based on wear strength, **Design of Helical Gear Drives:** Force analysis on helical gear tooth, Beam strength of helical gears, Effective load on gear tooth, Wear strength of helical gears, Herringbone gears.	**10**

Course outcomes:

On the completion of this course, students are able to
1. **Analyze** the pressure distribution in journal bearings.
2. **Compute** design parameters of engine components such as cylinder, piston, connecting rod and crankshaft.
3. **Analyze** shafts and couplings with different geometrical features under various loading conditions.
4. **Calculate** geometrical relations for length of belt and chain.
5. **Identify** types of pulleys/sprockets for belt and chain drives from manufacturer's catalogue and learned calculation procedure for beam strength and wear strength, effective load and module based on beam strength.

TEXT BOOKS
1. Machine Design/V. Bandari/ TMH Publishers 2. Machine design / NC Pandya& CS Shah/Charotar Publishing House Pvt. Limited
REFERENCES BOOKS
1. Design of Machine Elements / V.M.Faires/McMillan 2. Machine design / Schaum Series/McGraw Hill Professional 3. Machine Design/ Shigley, J.E/McGraw Hill 4. Machine Design –Norton/ Pearson publishers
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.

PROGRAM ELECTIVE COURSES-II

<table>
<tr><td colspan="4" align="center">PRIME MOVERS FOR AUTOMOBILES

SEMESTER - VI</td></tr>
<tr><td>Subject Code</td><td>18MEMEP603A</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 03</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Course Objectives:

Enable the students to:

1. To make the student learn and understand the reasons and affects of various losses that occur in the actual engine operation.

2. To familiarize the student with the various engine systems along with their function and necessity.

3. To learn about normal combustion phenomenon and knocking in S.I. and C.I. Engines and to find the several engine operating parameters that affect the smooth engine operation.

4. To make the student learn to perform testing on S.I and C.I Engines for the calculations of performance

5. To learn about engine emission control, alternate fuels and electric vehicles.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.</td><td>10</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">I C ENGINES: Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburetor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of wankle engine, principles of supercharging and turbo charging.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="3">Combustion in S.I. Engines: Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Types of Abnormal combustion, pre-ignition and knocking (explanation of) – Fuel requirements and fuel rating, anti-knock additives – combustion chamber – requirements, types.

Combustion in C.I. Engines: Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel</td><td>10</td></tr>
</table>

requirements and fuel rating	
Unit – 4	
Measurement, Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.	**10**
Unit – 5	
Engine Emissions: SI and CI engine emissions. Harmful effects. Emissions measurement methods. Methods for controlling emissions. EURO and BHARAT emission norms. **Alternate Fuels for IC Engines:** Need for use of alternate fuels. Use of alcohol fuels. Biodiesel. Biogas and Hydrogen in engine **Batteries:** Battery: Battery parameters; Types of batteries- Technical characteristics-Ragone plots. **Electric Vehicles:** Introduction: History of EVs, EV system, basic structure- Electric vehicle drive train-advantages and limitations.	**10**

Course outcomes:

After the completion of the course students will be able to:

1. **Illustrate** and analyze the Air Standard Cycles, Fuel Air Cycles and Actual Cycles
2. **Explain** various internal combustion engines and analyze its underlying thermodynamic cycles and to gain knowledge in engine systems
3. **Illustrate** various combustion processes and design of combustion chambers in S.I. & C.I. engines.
4. **Examine** the performance testing of IC engines and to evaluate various performance parameters.
5. **Outline** emission formation mechanism of IC engines, its effects and the legislation standards and understand the latest developments in IC Engines, alternate fuels Electric Vehicles.

TEXT BOOKS:

1. I.C. Engines / V. Ganesan- TMH
2. Heat engines, Vasandani& Kumar publications Thermal

REFERENCE BOOKS:

1. Thermal Engineering / RK Rajput/ Lakshmi Publications
2. IC Engines – M.L.Mathur & R.P.Sharma – Dhanpath Rai & Sons.
3. I.C.Engines–AppliedThermosciences–C.R.Ferguson&A.T.Kirkpatrick-2ndEdition-Wiley Publ

Question paper pattern:

4. 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)
5. CO1- CO5 questions carries 14 marks each

6.	Each full question will have sub question covering all topics under a course outcome

SYNTHESIS AND CHARACTERIZATION OF MATERIALS SEMESTER - VI			
Subject Code	18MEMEP603B	**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. Students gains deeper knowledge and understanding about the synthesis of materials.
2. To understand the importance of improvement of synthesis and characterization of their materials.
3. Understand the requirements for suitable techniques for each deposition techniques used.
4. To understand various advanced characterization equipment used to characterize different types of materials.
5. Gain knowledge about thermal testings and characterizations on composite materials

Unit -1	**Hours**
Synthesis of nano materials: Gold, Silver, different types of nano oxides, TiO_2, ZnO by using sol-gel method, Co-precipitation, Hydrothermal, Microwave, thermal and bio synthesis methods, Nano tubes and Nano wires, Carbon nano tubes, Graphene preparation, powder syntheses, crystal growth techniques, zone refining, properties and applications.	**10**
Unit -2	
Top down and bottom-up synthesis- Mechanical alloying, Mechanical ball-milling, Ion implantation, Inert gas condensation, Arc discharge, RF-plasma arc technique, Laser ablation, Template assisted synthesis, Clusters, Colloids, Zeolites, Porous silicon	**10**
Unit – 3	
Deposition techniques: Chemical vapour deposition (CVD), Metal Organic chemical vapour deposition (MOCVD) **Epitaxial growth techniques**: Molecular beam epitaxy, Atomic layer deposition, Pulsed laser deposition, Pulsed electrochemical deposition, Magnetron sputtering, Spin coating, Introduction to Lithography techniques	**10**
Unit – 4	

Principle, Theory, Working and Application; X-Ray Diffraction, Field Emission Scanning Electron Microscopy, High Resolution-Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunnelling Microscopy.	**10**
Unit – 5	
Photoluminescence Spectroscopy, Raman Spectroscopy, X-Ray Photoelectron Spectroscopy(XPS), Thermal analysis – Differential Scanning Calorimetry (DSC) – Thermo gravimetric Analysis (TGA)– Differential Thermal Analysis (DTA) – Dynamic Mechanical Analysis(DMA), Mechanical Testing- Nano Indentation -Vibrating Sample Magnetometer, Zeta Potential and Particle size measurement..	**10**

Course outcomes:

After the completion of the course students will be able to:

1. The students are expected to understand basic principles of the synthesis and characterization techniques presented in the course, specific usage, their advantages and limitations
2. To understand the role of Top down and bottom-up synthesis and their importance in materials property.
3. Students should be able to understand the requirements for suitable techniques for each deposition techniques used.
4. They should be able to operate the instruments based on the knowledge gained on various applications.
5. To analyze various thermal testings and mechanical nano Indentation

TEXT BOOKS:

1. Nano material, A.K. Bandyopadyay, New age Publishers
2. Material science and Technology: A comprehensive treatment, Robert W.Cahn, VCH
3. Engineering Mechanics of Composite Materials, Isaac and M Daniel, Oxford University Press

REFERENCE BOOKS:

1. Mechanics of Composite Materials R. M. Jones, McGraw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures, L. R. Calcote/Van NostrandRainfold, New York 1969
3. Analysis and performance of fibre Composites, B. D. Agarwal and L. J. Broutman, Wiley

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 sub question covering all topics under a course outcome

ADDITIVE MANUFACTURING

SEMESTER - VI

Subject Code	18MEMEP603C	**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

1. To understand the fundamental concepts of Additive Manufacturing (i.e. Rapid Prototyping) and its advantages and limitations.
2. To classify various types of Liquid Based Rapid Prototyping Systems Processes and know their working principle, advantages, limitations etc.
3. To classify various types of Solid Based Rapid Prototyping Systems Processes and know their working principle, advantages, limitations etc.
4. To classify various types of Powder Based Rapid Prototyping Systems Processes and know their working principle, advantages, limitations etc.

To have a holistic view of various applications of these technologies in relevant fields such as Mechanical, Bio-medical, Aerospace, electronics etc.

Unit -1	Hours
Introduction: Prototype, Roles of Prototype, Need for time compression in product development, Need of Additive Manufacturing (AM), Generic AM process, Distinction between AM and CNC, Classification of AM Processes, Steps in AM process, Advantages of AM, Major Applications. Stereolithography (SL), Materials, SL resin curing process, Micro-stereolithography, Process Benefits and Drawbacks, Applications of Photopolymerization Processes.	**10**
Unit -2	
Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. **Solid Ground Curing (SGC):** Models and specifications, process, working principle, applications, advantages and disadvantages, case studies.	**10**
Unit – 3	
Laminated object manufacturing (LOM): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. **Fused deposition modelling (FDM)**: Models and specifications, process, working principle, applications, advantages and disadvantages, case studies.	**10**
Unit – 4	
Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. **3-D Printing:** Models and specifications, process, working principle, applications, advantages and disadvantages, case studies.	**10**
Unit – 5	
Engineering Applications of Additive Manufacturing: Analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. **RP Applications in Medical and Bioengineering:** planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of bimolecular.	**10**

Course outcomes:

1. To study the working principles and process parameters of Additive Manufacturing processes
2. To understand the liquid based Additive Manufacturing process parameters and application of these techniques
3. To learn the solid based Additive Manufacturing process parameters and application of these techniques
4. To understand about the powder based Additive Manufacturing process parameters and application of these techniques
5. To study the applications of Additive Manufacturing processes in various fields

TEXT BOOKS

1. Rapid prototyping: Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific

publications

REFERENCE BOOKS

1. Rapid Manufacturing / D.T. Pham and S.S. Dimov/Springer
2. Wohlers Report 2000 /Terry T Wohlers/Wohlers Associates
3. Rapid Prototyping & Manufacturing / Paul F.Jacobs/ASME Press

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
   Each full question will have sub question covering all topics under a course outcome

PROGRAM ELECTIVE COURSES-III

SOLAR ENERGY ENGINEERING AND APPLICATIONS SEMESTER - VI			
Subject Code	18MEMEP604A	**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. To understand the basics of the Solar Radiation.
2. To understand the concept of Photo Voltaics.
3. To understand the Solar Cell Technologies.
4. To understand thin film technologies.
5. To understand the methods of solar energy collections.

Unit -1	**Hours**
Solar Radiation: Solar energy option, solar power, structure of the sun, the solar constant, sun-earth relationships, solar radiation types, solar radiation on titled surface, instruments for measuring solar radiation and sun shine. Solar Tracking Systems – Single axis – Dual axis	**10**
Unit -2	
Photovoltaic Fundamentals: Place of PV in energy supply – PV Cells - Modules and arrays - Review of semiconductor physics and operating principle - Introduction to P-N and P-I-N junctions - Cell parameters limits-Losses in solar cells-Solar cell design for high Isc,, Voc and FF.	**8**
Unit – 3	
Solar Cell Technologies: Silicon based technologies (mono-crystalline, poly-crystalline – ribbon - silicon film) - Flow of silicon material - Manufacturing processes (wafer, cell and module) for Mono and poly Si technologies - Efficiency of Si cells	**12**
Unit – 4	
Thin film technologies (Silicon and Non-silicon): Material-deposition techniques - Amorphous Si cells/modules - micro-morph cell - Silicon film- non-silicon technologies viz Cadmium telluride - Cu Indium Gallium Diselenide.	**10**
Unit – 5	

SOLAR ENERGY COLLECTION: Solar Flat plate collectors - Concentrating Collectors - Compound Parabolic Collector - Collector Efficiency, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney	**10**

Course outcomes:

On the completion of this course, students are able to

1. Discuss the basics of the Solar Radiation
2. Describe the concept of Photo Voltaics.
3. Describe the Solar Cell Technologies
4. Differentiate Thin film technologies
5. Illustrate the methods of solar energy collections

Text Books:

1. Sukhatme S.P. and J.K.Nayak, *Solar Energy – Principles of Thermal Collection and Storage*, TMH.
2. Khan B.H., Non-Conventional Energy Resources, Tata McGrawHill, New Delhi, 2006
3. Green Manufacturing Processes and Systems, Edited by J. PauloDavim, Springer 2013

References Books:

1. Principles of Solar Energy / Frank Krieth & John F Kreider.
2. Non-Conventional Energy / Ashok V Desai /Wiley Eas
3. Renewable Energy Technologies/ G.D Roy

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.

<table>
<tr><td colspan="4" align="center">FINITE ELEMENT METHODS

SEMESTER - VI</td></tr>
<tr><td>Subject Code</td><td>18MEMEP604B</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 03</td></tr>
</table>

Course Objectives:

Students will be able to

1. Understand basic principles and procedure of finite element analysis.
2. Study the theory and characteristics of finite elements that represent engineering structures.
3. Apply finite element solutions to structural, thermal, dynamic problem.
4. Solve the complex geometry problems and solution techniques.
5. Understand the concept of dynamic analysis in finite element methods.

<table>
<tr><td>Unit -1</td><td>Hours</td></tr>
<tr><td>INTRODUCTION: Introduction to finite element method, stress and equilibrium, strain–displacement relations, stress–strain relations, plane stress and plane strain conditions, variational and weighted residual methods, concept of potential energy, Formulation of Finite element characteristic matrices and vectors (Element Stiffness Matrix and Load Vectors), Assembly of element stiffness for one dimensional problem.</td><td>10</td></tr>
<tr><td colspan="2">Unit -2</td></tr>
<tr><td>FINITE ELEMENT FORMULATION: Concept of discretization, Interpolation, Compatibility, Assembly and boundary considerations. Shape functions for one dimensional quadratic and cubic elements in natural coordinates, treatment of boundary conditions, Temperature effects, node numbering, mesh generation, local and global coordinates, convergence requirements.</td><td>8</td></tr>
<tr><td colspan="2">Unit – 3</td></tr>
<tr><td>Analysis of Plane Trusses: Plane Trusses, Local and Global Coordinate systems, Element Stiffness Matrix, Stress Calculations, Example of plane Truss with three members.

Analysis of Beams: Two node beam Element, shape functions, element stiffness matrix and load vectors, simple problems on beams with distributed and point loads.</td><td>12</td></tr>
<tr><td colspan="2">Unit – 4</td></tr>
<tr><td>Finite element modeling of two-dimensional stress analysis with constant strain triangles, Shape functions of CST element.

Higher Order and Iso Parametric Elements: Two dimensional four nodded isoparametric elements, Lagrangian interpolation functions and Numerical Integration.</td><td>10</td></tr>
</table>

Unit – 5	
Steady State Heat Transfer Analysis: one dimensional analysis of a fin and two-dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion. **Dynamic Analysis:** Formulation of finite element model, element consistent and lumped mass matrices, evaluation of Eigen values and Eigen vectors, free vibration analysis.	**10**

Course outcomes:

On the completion of this course, students are able to

1. Identify and formulate different stress and strain relations, displacement relations on a particular object using FEM methods.
2. Apply and solve different element shapes using stiffness matrix.
3. Differentiate and analyse different types of trusses and beams.
4. Apply one dimensional quadratic equation on isoparametric elements and numerical integrations.
5. Apply the dynamic analysis on various beam elements.

TEXT BOOKS

1. J.N. Reddy, An Introduction to Finite Element Method, Tata McGraw Hill
2. P.Seshu. Text Book of Finite Element Analysis, Prentice Hall
3. S.S.Rao, TheFiniteElementMethodinEngineering,3rd.,ButterworthHeinemann
4. Chandraputla & Belegundu, Introduction to Finite Elements in Engineering,

   Prentice Hall

REFERENCES BOOKS

1. S.S. Bavakati, Finite Element Analysis, New age Publishers
2. R.D Cook, Finite Element Modeling for Stress Analysis, John Wiley & Sons Inc.
3. O.C. Zienkiewicz and R.L. Taylor, Finite Element Methods, Butterworth Heinemann

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.

SMART MANUFACTURING & IIOT

SEMESTER - VI

Subject Code	18MEMEP604C	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Enable the students to

1. Learn different types of FMS layouts
2. Gain the knowledge of Automated Production Lines
3. Understanding the performance of material handling and storage techniques
4. Describe the Automated Assembly Systems

Understanding the characteristics of IIoT

Unit -1	**Hours**
Introduction to Flexible Manufacturing System: Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications. **Classification of FMS Layouts:** Layouts and their Salient features, Single line, dual line, loop, ladder, robot center type etc.	**10**
Unit -2	
Automated Production Lines: Fundamentals- System configurations, work part transfer mechanisms, Storage buffers, and Control of the production line. Applications — Machining systems and System Design Considerations. Analysis of Transfer lines — Transfer lines with No internal parts storage, Transfer lines with internal storage buffers.	**08**
Unit – 3	
Automated Material Handling: Automated Guided Vehicle (AGV) Systems, Types and applications, Vehicle Guidance Technology, Vehicle Management and Vehicle safety. **Automated Storage Systems:** Automated Storage/Retrieval Systems (AS/RS) and Carousel Storage Systems.	**10**
Unit – 4	
Automated Assembly Systems: System configurations, Parts delivery at workstations, and applications, quantitative analysis of assembly systems-Parts Delivery System at Workstations, Multi-Station Assembly Machines, Single Station Assembly Machines, Partial Automation.	**12**

Unit – 5

Introduction to IIoT: Characteristics of IIoT, levels & deployment templates, Sensing, Actuation, Communication Protocols, Machine-to-Machine Communications, Difference between IIoT and M2M, Communication modules - RFID, Bluetooth, Wi-Fi, Zigbee.	**10**

Course outcomes: At the end of the course the student will be in a position to:

1. Apply FMS with manufacturing systems including job- shop and mass production systems.
2. Determine the basic components and their functions of automated production lines.
3. Analyze materials handling and storage systems in manufacturing.
4. Differentiate various automated assembly systems.
5. Assess the characteristics of IIoT and Analyze the difference between M2M and IIoT.

1.

TEXT BOOKS

1. Groover, M.P “Automation, Production Systems and Computer Integrated Manufacturing 3rd Edition, Prentice Hall Inc., New Delhi, 2007.
2. William W Luggen, “Flexible Manufacturing Cells and System” Prentice Hall of Inc New Jersey, 1991
3. A. Bahga and V. Madisetti, Internet of Things, A hands-on approach, VPT, 1st edition, 2014.

REFRENCE BOOKS

1. Automation by Buckinghsm W, Haper& Row Publishers, New York, 1961
2. Reza A Maleki “Flexible Manufacturing system” Prentice Hall of Inc New Jersey, 1991
3. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0, CRC Press, 2020.

Question paper pattern:

2. 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)

3. All questions carries 14 marks each

Each full question will have sub question covering all topics under a course outcome

THEORY OF MACHINES LAB			
Subject Code	18MEMEL6060	IA Marks	15
Number of Lecture Hours/Week	03(P)	Exam Marks	35
Total Number of Lecture Hours	48	Exam Hours	03
Credits –1.5			

Course objectives:

Students should be able to

1. Demonstrate working of gears, gear trains and kinematic mechanisms
2. Evaluate moment of inertia of flywheel, coefficient of friction for belt drive
3. Examine speed regulations of hart nell governor, observe the effect of gyroscopic couple and cam jump phenomena
4. Estimate unbalanced forces in static and dynamic balancing of rotating masses and determine performance characteristics of a screw jack
5. Understand the characteristics of vibrations in beams and shafts.

Experiments:

1. Slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/four bar mechanism
2. Demonstration of various types of gears: Spur, Helical, Worm and Bevel Gears
3.
4. Determination of coefficient of friction between belt and pulley
5. Moment of inertia of a flywheel
6. Analysis of motion of a motorized gyroscope when the couple is applied along its spin axis
7. Determination of the position of sleeve against controlling force and speed of a governor and to plot the characteristic curves of radius of rotation
8. Follower displacement vs cam rotation for various cam follower systems
9. Study of static and dynamic balancing using rigid blocks
10. Study of simple and compound screw jack and determination of the mechanical advantage, velocity ratio and efficiency
11. Determination of the frequency of undamped free vibration of spring mass system
12. Determination of the frequency of damped force vibration of a spring mass system
13. Determination of whirling speed of shaft theoretically and experimentally.

Course outcomes: Upon Completion of this course, the students will be able to:

1. Study different types of four bar mechanism, gears and gear trains.
2. Estimate the coefficient of friction between belt and pulley drive and also find the moment of inertia of a flywheel.
3. Calculate the gyroscopic couple of a rotating disc under various loads and speed conditions and analyse speed regulations of Hartnell governor and cam jump phenomenon.
4. Distinguish between static and dynamic balancing of rotating masses and performance characteristics of a screw jack.
5. Find the natural frequency of a vibratory system with various beams and critical speed of a shaft for different configurations.

THERMAL ENGINEERING LAB			
Subject Code	18MEMEL6070	IA Marks	15
Number of Lecture Hours/Week	03(P)	Exam Marks	35
Total Number of Lecture Hours	48	Exam Hours	03
Credits –1.5			

Course objectives: Students should be able to

1. Impart knowledge in testing of fuels properties.
2. Understand the working scenario of Port and Valve timing of IC engines
3. Study different performance parameters of four stroke diesel engines.
4. Know different performance parameters of petrol engines.
5. Recognize the performance parameters of Air compressors & learn the working of different types of boilers.

Experiments:

1. To find the flash point / fire point, viscosity, calorific value & carbon residue by using fuel property testing apparatus
2. To draw:
    a) Valve timing diagram of a four-stroke diesel engine
    b) Valve timing diagram of a four-stroke petrol engine
    c) Port timing diagram of 2-stroke petrol engine
3. Performance test on four stroke diesel engine test rig.
4. Heat balance test on four stroke diesel engine test rig.
5. Retardation test on four stroke diesel engine test rig.
6. Morse test on four stroke multi cylinder petrol engine test rig.
7. Performance test on variable compression ratio petrol engine test rig
8. Assembly and disassembly of a four-stroke single cylinder petrol engine.
9. Performance test on two stroke petrol engine test rig.
10. Economical speed test on two stroke petrol engine test rig.
11. Study of steam boilers
12. Performance test on reciprocating air compressor test rig

Course outcomes: Upon Completion of this course, the students will be able to:

1. To calculate given fuel properties.
2. To draw Port and Valve timings of IC engines
3. To find performance parameter values of four stroke diesel engines.
4. To determine performance parameter values of petrol engines.
5. To calculate efficiency of Air compressors & summarize the working of different types of boilers and able to suggest suitable boiler based on requirement

CAD/CAM LAB			
Subject Code	18MEMEL6080	IA Marks	15
Number of Lecture Hours/Week	03(P)	Exam Marks	30
Total Number of Lecture Hours	48	Exam Hours	03
Credits –1.5			

Course objectives: Students should be able to

1. Understand modeling tools for drawing machine components
2. Gain the knowledge of 3D drawing of machine components
3. Gain the knowledge of Assembly drawing of machine components
4. Study the NC and CNC codes
5. Prepare simple parts on the CNC Machining center.

Introduction

Introduction to various modeling and simulation packages, their importance and applications in industries.

1. DRAFTING:

Development of part drawings for various components in the form of orthographic and isometric. representation of dimensioning and tolerances scanning and plotting. study of script, DXE and IGES files.

2. PART MODELING

1. 3D Solid part modeling of mechanical components
2. 3D Part modeling of mechanical components using revolve option
3. 3D Part modeling of mechanical components using hollow
4. 3D Part modeling of mechanical components using sweep
5. 3D Part modeling of mechanical components using swept boss
6. 3D Part modeling of mechanical components using boundary boss
7. 3D Part modeling of mechanical components using rib, pattern, draft

3. ASSEMBLY MODELING

8. Assembly of screw jack using Bottom-up approach
9. Assembly of any one cotter joint using Bottom-up approach

4. CNC MACHINING 10. Study of NC and CNC codes used in CNC machining. 11. NC Programming Practice for machining various components related to turning 12. NC Programming Practice for machining various components related to milling 13. Automated CNC Tool path & G-Code generation using Pro-E/Master CAM
Course outcomes: Upon Completion of this course, the students will be able to: 1. Identify the various sketch and part design tools in modeling software 2. Draw machine components by modeling software 3. Apply the knowledge of part drawing 4. Apply the knowledge of assembly drawing 5. Prepare part programme for engineering components on CNC Machining center

Soft Skills & Aptitude Builder – 2

Subject Code	18MEXXS6090	**IA Marks**	**15+15**
Number of Lecture Hours/Week	**2**	**Exam Marks**	**35+35**
Total Number of Lecture Hours	**32**	**Exam Hours**	**3**

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	**6**
Unit 2: Career and Employability Skills	
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	**6**

Section B,Aptitude Builder

Unit – 3: Time and Work	
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	**6**
Unit – 4: Logical and Analytical Reasoning	
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	**7**

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

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**

sasi autonomous INSTITUTE OF TECHNOLOGY & ENGINEERING

Accredited by NAAC with "A" Grade
Recognised by UGC under section 2(f) &12(B)
Approved by AICTE - NEW Delhi
Permanently Affiliated to JNTUK, SBTET
Ranked as "A" Grade by Govt. of A.P.

Department of Mechanical Engineering

Course structure for the Academic Year 2020-21

B. Tech. (Mechanical Engineering)

***Semester VII (Fourth Year)* Approved Course structure**

Sl. No.	Course Code	CC	Course Title	L	T	P	C
10.	18MEMET7010	HSMC	Operations Research	3	0	0	3
11.	18MEMET7020	PCC	Instrumentation and Mechatronics	3	0	0	3
12.	18MEMET703X	PE	Professional Elective -IV	3	0	0	3
13.	18MEMEP704X	PE	Professional Elective -V	3	0	0	3
14.	18MEXXO705X	OE	Open Elective- III	3	0	0	3
15.	18MEXXO706X	OE	Open Elective- IV	3	0	0	3
16.	18MEMEL7070	PCC	Instrumentation and Mechatronics Lab	0	0	3	1.5
17.	18MEMER7080	PCC	Internship with Seminar	0	0	6	3
18.	18MEMES7090	SOC	Skill Oriented Course – 3 (Hyper Mesh)	0	0	4	2
			Total	**18**	**0**	**14**	**24.5**

Professional Elective Course -IV

S.No.	Subject Code	Name of the subject	L	T	P	Cr
1.	18MEMEP703A	Refrigeration & Air Conditioning	3	0	0	3*
2.	18MEMEP703B	Mechanics of Composites	3	0	0	3*
3.	18MEMEP703C	Non – Destructive Evaluation	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

Professional Elective Course -V

S.No.	Subject Code	Name of the subject	L	T	P	Cr
1.	18MEMEP704A	Gas Dynamics and Jet Propulsion	3	0	0	3*
2.	18MEMEP704B	Mechanical Vibrations	3	0	0	3*
3.	18MEMEP704C	Production Planning and Control	3	0	0	3*
NPTEL/SWAYAM/MOOCs (Course of 12 Weeks duration) to be offered						

Operations Research SEMESTER - VII			
Subject Code	18MEMET7010	**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:

6. 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
7. Apply the concepts of linear programming for decision making like simplex and dual simplex algorithms in production industries.
8. Calculate the optimal values of cost, job distribution and placement using transportation, assignment and sequencing methods

9. 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.
10. 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:

11. Operation Research /Premkumar Gupta, D.S.Hira / S.Chand
12. Operations Research / S.D.Sharma-KedarnathRamnath(JNTU)

REFERENCES:

4. Operations Research / R. Pannerselvam / PHI Publications.
5. Operation Research /J.K.Sharma/MacMilan.
6. Operation Research An Introduction / Taha / Pearson
7. 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

<table>
<tr><td colspan="4" align="center">INSTRUMENTATION AND MECHATRONICS
SEMESTER - VII</td></tr>
<tr><td>Subject Code</td><td>18MEMET7020</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 03</td></tr>
</table>

Course Objectives:

Enable the students to

1. To provide basic knowledge of measurement techniques, different errors measuring from the instruments. and provide basic knowledge of displacement measuring instruments.
2. To learn about various temperature and pressure measuring instruments.
3. To describe various instruments used to measure level, flow, speed, acceleration & vibrations.
4. To Identify and calculate methods of stress and strains in measurements and various instruments to measure humidity, force, torque and power.
5. To categorize the importance of control systems in instruments

Unit -1	Hours
Definition–Basic principles of measurement – measurement systems, generalized configuration and functional Descriptions of measuring instruments – examples. Dynamic performance characteristics – sources of error, classification and elimination of error. **Measurement of Displacement:** Theory and construction of various transducers to measure displacement – piezoelectric, inductive, capacitance, resistance, ionization and photoelectric transducers, calibration procedures.	**12**
Unit -2	
Measurement of Temperature: Classification – ranges – various principles of measurement – expansion, electrical resistance – thermistor – thermocouple – pyrometers – temperature indicators. **Measurement of Pressure:** Units – classification – different principles used. Manometers, piston, bourdon pressure gauges, bellows-diaphragm gauges. low pressure measurement – thermal conductivity gauges, Ionization pressure gauges, Mcleod pressure gauge.	**10**
Unit – 3	
Measurement of Level: Direct method – indirect methods- capacitive, ultrasonic, magnetic, cryogenic fuel level indicators – bubbler level indicators. **Flow Measurement:** Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser Doppler anemometer (LDA). **Measurement of Speed:**Mechanical tachometers- electrical tachometers – stroboscope, non-contact type of tachometer **Measurement of Acceleration and Vibration:** Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle.	**10**
Unit – 4	
Stress Strain Measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes. **Measurement of Force, Torque and Power-** Elastic force meters, load cells, torsion meters, Dynamometers.	**10**
Unit – 5	
Control Systems: Introduction, importance – classification – open and closed systems, Servo mechanisms–examples with block diagrams **Introduction to Mechatronics:** Mechatronics systems – elements & levels of mechatronics system, advantages and disadvantages of mechatronics systems Mechatronics design process, microprocessor-based controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control	**8**

Course outcomes:

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

1. **Interpret** the methods of measurement techniques, errors of the instruments and explain the working of various displacement measuring instruments.
2. **Select** the temperature and pressure measuring instruments based on their applications
3. **Choose** a suitable instrument required to measure the variables like level, flow, speed and vibration

4. **Identify** the various types of stress strain measuring gauges and explain the working of various force, torque and power measuring devices 5. **Distinguish** between open and closed loop control systems
Text Books: 1. Measurement Systems: Applications & design by D.S Kumar. 2. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers 3. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran, GK Vijaya Raghavan & MS Balasundaram/WILEY India Edition
Reference Books: 1. Mechanical Measurements / BeckWith, Marangoni, Linehard, PHI/PE. 2. Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik and Dhanesh/ TMH. 3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, Mcgraw-Hill: New Yark, 1999 4. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
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.

PROGRAM ELECTIVE COURSES-IV

<table>
<tr><td colspan="4">REFRIGERATION & AIR CONDITIONING
SEMESTER VII</td></tr>
<tr><td>Subject Code</td><td>18MEMEP703A</td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits - 03</td></tr>
<tr><td colspan="4">COURSE OBJECTIVES: Enable the students to
1. To impart the basic concepts of Refrigeration and Air Conditioning.
2. To develop a sound physical understanding of the subject so that the learner will demonstrate the ability to design a refrigeration or air-conditioning equipment that meets the required specifications.
3. Comparative study of different refrigerants with respect to properties, applications and Environmental issues, air conditioning processes on psychrometric charts.
4. Calculate cooling load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Teaching Hours</td></tr>
<tr><td colspan="3">Introduction to Refrigeration: Necessity and applications – unit of refrigeration and C.O.P., Mechanical refrigeration – types of ideal cycles of refrigeration,
Air Refrigeration: Air Refrigeration Cycles-reversed Carnot cycle, Bell- Coleman cycle analysis, Air Refrigeration systems-merits and demerits – refrigeration systems used in air crafts and problems.</td><td>Hours – 10</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">Vapour Compression Refrigeration (VCR): Working principle and essential components of the plant, Simple vapour compression refrigeration cycle – COP – representation of cycle on T-S and p-h charts, effect of subcooling and superheating – cycle analysis actual cycle influence of various parameters on system performance – use of p- h charts– numerical problems.
VCR System Components: Compressors, Condensers, Evaporators, Expansion devices – classification – working principles.</td><td>Hours – 8</td></tr>
<tr><td colspan="4">Unit - 3</td></tr>
<tr><td colspan="3">Refrigerants – Desirable properties – classification - refrigerants used – nomenclature – ozone depletion –global warming.
Vapour Absorption Systems: Other types of Refrigeration systems – Vapour Absorption Refrigeration Systems, Absorbent – Refrigerant combinations, Water-Ammonia Systems, Water-Lithium Bromide System, Contrast between the two systems, Modified Version of Aqua- Ammonia System with Rectifier and Analyser Assembly.</td><td>Hours – 10</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">Psychrometry: Introduction to Psychrometry, Psychrometric Properties & Processes, Air-water vapour mixtures, Psychrometric Chart. Numerical problems
Load calculations: Concepts of RSHF, GSHF & ERSHF-ADP temperature, problems.</td><td>Hours – 12</td></tr>
<tr><td colspan="4">Unit-5</td></tr>
<tr><td colspan="3">Introduction to Air conditioning: Classification, Applications of Air-Conditioning, Requirements of human comfort and concept of effective temperature- comfort chart – comfort air conditioning – need for ventilation and consideration of infiltrated air-requirements of industrial air-conditioning.
Air conditioning equipment: cooling, heating, humidification and dehumidification, filters, grills and registers fans and blowers. heat pump – heat sources – different heat pump circuits.</td><td>Hours – 10</td></tr>
<tr><td colspan="4">COURSE OUTCOMES: On completion of this course, students should be able to:
1. Determine the COP for Bell-Coleman cycle and various types of aircraft refrigeration system.
2. Calculate the COP of the VCR cycle and indicate on T-S and P-H diagrams.
3. Select the suitable refrigerant for the refrigeration system as per the requirements, various vapour absorption refrigeration systems and non-conventional refrigeration systems.
4. Analyze the cooling load and heating load using the principle of psychrometry.</td></tr>
</table>

5. Decide suitable components for the air condition system as per need and compare the heat pump circuits.

Text Books:

1. A Course in Refrigeration and Air conditioning / SC Arora & Domkundwar/Dhanpatrai
2. Refrigeration and Air Conditioning / CP Arora / TMH.

Reference Books:

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age.
2. Principles of Refrigeration /Dossat / Pearson Education.
3. Refrigeration and Air-conditioning, Stoecker W.F., and Jones J.W., Mc Graw - Hill, New Delhi
4. Refrigeration and Air-conditioning by R K Rajput

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 sub question covering all topics under a course outcome.

MECHANICS OF COMPOSITES
SEMESTER VII

Subject Code	21 MEME P703B	**IA Marks**	30
Number of Lecture Hours/Week	3(L)	**Exam Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits - 03

COURSE OBJECTIVES: Enable the students to
1. Understand the mechanics of composite materials.
2. Study the Elastic behaviour of composite lamina
3. Study the aspects of the Macromechanical Analysis of a Lamina
4. Develop the Macromechanical Analysis of a Lamina
5. Study the Failure, Analysis, and Design of Laminates

Unit	Teaching Hours
Unit -1	
Introduction to composite materials, Geometric definitions, Classification of composites, Types of fibers, Types of the matrix, Hybrid composite, scale of analysis-micro and macro mechanics approaches, Degree of Anisotropy. Manufacturing methods of the composites, Autoclave moulding, Filament winding, Resin transfer moulding..	**Hours – 8**
Unit -2	
Elastic behaviour of composite lamina (Micro mechanics),Micro mechanics methods, Geometric aspects and elastic symmetry, Longitudinal elastic properties(Continuous fibers), Transverse elastic properties, In-plane shear properties(Continuous fibers),Longitudinal properties(short fibers)	**Hours – 10**
Unit - 3	
Elastic behaviour of composite lamina (Macro mechanics approach), stress strain relations: General anisotropic material, Specially orthotropic material, transversely isotropic material, Orthotropic material under plane stress, isotropic material.	**Hours – 10**
Unit – 4	
Standard sizes of the specimen for tensile and compressive, Fatigue tests, impact test of unidirectional composites. Failure of the composite materials: fibre failures, matrix failure, interface failure. Failure Theories Tsai-Wu, Tsai-hill, Puck criterion, Maximum stress, maximum strain, Hashin	**Hours – 12**
Unit-5	
Failure, Analysis, and Design of Laminates: Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, static analysis of laminated plates	**Hours – 10**

COURSE OUTCOMES: On completion of this course, students should be able to:
1. Understand the composite materials and manufacturing methods
2. Study the behaviour of composite Lamina
3. Study the properties of various types of composite materials. .
4. Apply Failure theories to calculate stresses in composite materials
5. Study the Failure, Analysis, and Design of Laminates

Text Books:
1. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley- Interscience, New York, 1980.
3. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw ,Publisher: CRC.

Reference Books:
1. R. M. Jones, Mechanics of Composite Materials, McGraw Hill Company, New York, 1975
2. Mechanics of Composite Materials Recent Advances by ZviHashin, Carl T.Herakovich
3. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.
4. Principles of composite material mechanics by Ronald F.Gibson

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 sub question covering all topics under a course outcome.

NON – DESTRUCTIVE EVALUATION

SEMESTER - VII

Subject Code	21MEMEP703C	**Internal Marks**	30
Number of Lecture Hours/Week	3(L)	**External Marks**	70
Total Number of Lecture Hours	50	**Exam Hours**	03

Credits – 03

Enable the students to
1. Know basics of NDE methods and Learn concepts & principles of Visual and Liquid penetrant testing methods.
2. Explore the concepts of Ultrasonic testing equipment, its techniques and applications.
3. Determine the importance of Magnetic particle testing, testing procedure, Calibration techniques, evaluation and Industrial applications.
4. Explain the principles of radiography, its techniques, safety aspects and industrial applications.
5. Understand the concept of Eddy current test system, its effectiveness, advantages and applications.

Unit -1	Hours
Introduction: Introduction to non-destructive testing, Visual testing. Liquid Penetrant Testing: Basic Concepts, Liquid Penetrant System, Test Procedure, LPT Equipment, Standardization and Calibration, Interpretation and Evaluation, Advantages, Effectiveness, Limitations, Applications of LPT	**10**
Unit -2	
Ultrasonic Testing: Basic Principles, Ultrasonic Equipment and Variables affecting Ultrasonic Test, Ultrasonic Techniques, Standardization and Calibration, Interpretation and Guidelines for Acceptance, Rejection - Advantages, Effectiveness and Limitations of Ultrasonic Testing, Applications	**10**
Unit – 3	
Magnetic Particle Testing: Basic Principles of Magnetic Particle Testing, Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Magnetic Particle Test equipment, Magnetic Particle Test Procedure, Standardization and Calibration, advantages, limitations of the Magnetic Particle Test and applications	**10**
Unit – 4	
Radiographic Testing: Basic Principles of Radiographic test, Sources of X and Gamma Rays, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography, Advantages, Effectiveness, Limitations and applications of Radiographic Testing	**10**
Unit – 5	
Eddy Current Testing: Principles of Eddy Current testing, Eddy Current Test System, Test Procedure, Applications of Eddy Current Testing, Effectiveness of Eddy Current Testing, Advantages, Limitations and applications of Eddy Current Testing	**10**

Course outcomes:

On completion of this course, students are able to

1. Explain the working of Visual Inspection and Liquid penetrant test methods and its applications.
2. Describe the working of Ultrasonic testing, its calibration procedure, effectiveness, limitations and applications.
3. Explain the working of Magnetic particle testing procedure, the variables of the process, measure defects of using MPT.
4. Illustrate the working of Radiographic testing equipment & its sources, safety aspects, industrial applications.
5. Explain the working of Eddy current testing equipment & procedure, advantages, limitations, industrial applications.

TEXT BOOKS
1. Non-destructive Test and Evaluation of Materials by J Prasad, CGK Nair, TMH Publishers.
2. Non-Destructive Testing by Dr. S.Ramachandran, Airwalk Publications.
3. Non-Destructive Testing Techniques by Ravi Prakash, New Age International Private Limited.

REFERENCE BOOKS
1. Non-Destructive Testing of Materials by V. Jayakumar, Lakshmi Publications.
2. Basics of Non-Destructive Testing by Lari& Kumar, S.K.Kataria& Sons Publishers.
3. Ultrasonic Inspection Training for NDT: E. A. Gingel, Prometheus Press.
4. ASTM Standards, Vol 3.01, Metals and alloys

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 sub question covering all topics under a course outcome.

PROGRAM ELECTIVE COURSES-V

<table>
<tr><td colspan="4">GAS DYNAMICS & JET PROPULSION
SEMESTER - VII</td></tr>
<tr><td>Subject Code</td><td>18MEMEP704A</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits - 03</td></tr>
<tr><td colspan="4">Course Objectives
Enable the students to
1. Define Gas Dynamics, mach number, classification of fluid flow based on Mach number.
2. Analyze Steady 1-D isentropic flow, De laval nozzle, nozzle coefficients.
3. Frictional flow, Rayleigh line, entropy change caused by heat transfer-conditions of maximum enthalpy and entropy.
4. Analyze Effect of Heat transfer on flow parameters, C-D nozzle flow with shock thickness
5. Evaluation of Air craft propulsion, performance of propeller engines, comparison of various propulsion systems.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Teaching Hours</td></tr>
<tr><td colspan="3">Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity - mach number - classification of fluid flow based on mach number - mach cone-compressibility factor - general features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.</td><td>12</td></tr>
<tr><td colspan="4">Unit – 2</td></tr>
<tr><td colspan="3">Isentropic flow of an ideal gas: basic equation - stagnation enthalpy, temperature, pressure and density- stagnation, acoustic speed - critical speed of sound- dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function.
Steady one dimensional isentropic flow with area change-effect of area change on flow parameters- chocking- convergent nozzle - performance of a nozzle under decreasing back pressure -De lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.</td><td>16</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="3">Simple frictional flow: adiabatic flow with friction in a constant area duct- governing equations - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct- governing equations - limiting conditions.
Steady one dimensional flow with heat transfer in constant area ducts- governing equations - Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy.</td><td>16</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">Effect of heat transfer on flow parameters: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations - Rankine Hugoniot equations - Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.</td><td>14</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">Propulsion: Air craft propulsion: - types of jet engines - energy flow through jet engines, thrust, thrust power and propulsive efficiency turbojet components- diffuser, compressor, combustion chamber, turbines, exhaust systems.
Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines. Rocket propulsion - rocket engines, Basic theory of equations - thrust equation - effective jet velocity - specific impulse - rocket engine performance - solid and liquid propellant rockets - comparison of various propulsion systems.</td><td>10</td></tr>
<tr><td colspan="4">Course Outcomes
On completion of this course, students will be able to:
1. Classify fluid flow systems based on Mach number.
2. Analyze the isotropic flow of an ideal gas, steady 1D flow and its parameters.
3. Study simple frictional flow in a constant area duct, fanno line limiting condition, steady 1D flow with heat transfer.</td></tr>
</table>

4. Analyze the impact of heat transfer on flow parameters.
5. Evaluation of Performance of various propulsion systems.

Text Books:

1. Compressible fluid flow /A. H. Shapiro / Ronald Press Co., 1953
2. Fundamentals of compressible flow with aircraft and rocket propulsion/S. M. Yahya/New Age International Publishers.
3. Fundamental of Gas dynamics-2nd edition/ M J Zucker/ Wiley publishers

Reference Books:

1. Elements of gas dynamics / HW Liepman & A Roshko/Wiley
2. Aircraft & Missile propulsion /MJ Zucrow/Wiley
3. Gas dynamics / M.J. Zucrow & Joe D.Holfman / Krieger Publishers

Question paper pattern

1. Question paper contains 10 Questions, 2 from each course outcome. 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 out comes.

MECHANICAL VIBRATIONS
SEMESTER-VII

Subject code	18MEMEP704B	**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. Learn basic principles of mathematical modelling of vibrating systems
2. Learn working principles of free and forced vibration in single and multi-degree freedom systems
3. Learn the basic concepts free and forced multi degree freedom systems.
4. Learn concepts involved in the torsional vibrations.
5. Learn the principals involved in the critical speed of shafts and transient vibrations.

Unit-1	Hours
INTRODUCTION: Relevance of and need for vibrational analysis – Basics of SHM - Mathematical modelling of vibrating systems - Discrete and continuous systems - single-degree freedom systems - free and forced vibrations, damped and undamped systems.	**8**
Unit-2	
MULTI DEGREE FREEDOM SYSTEMS: Free and Forced vibration of undamped systems. Forced Vibration of Damped with Harmonic Excitation System, Vibration isolation - Vibrometers and accelerometers - Response to Arbitrary and non - harmonic Excitations – Transient Vibration –Impulse Loads-Critical Speed of Shaft-Rotor systems.	**10**
Unit-3	
TORSIONAL VIBRATIONS: Vibration Isolation methods - Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber - Damped Vibration absorbers. Specification of vibration limits –Vibration severity standards - Vibration as condition monitoring tool.	12
Unit-4	
CONTINUOUS SYSTEMS: Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams – Governing equations of motion - Natural frequencies and normal modes - Energy methods, Introduction to nonlinear and random vibrations	**10**
Unit-5	
CRITICAL SPEEDS OF SHAFTS: Critical speed of a light shaft having a single disc without damping and with damping, critical speeds of shaft having multiple discs, secondary critical speed, critical speeds light cantilever shaft with a large heavy disc at its end. **TRANSIENT VIBRATIONS:** Laplace transformations response to an impulsive input, response to a step input, response to pulse (rectangular and half sinusoidal pulse), phase plane method.	**10**

Course outcomes:
1. Understand the concepts of vibrational analysis
2. Describe the free and forced vibrations in single degree freedom system
3. Understand the concepts of free and forced multi degree freedom systems.
4. Summarize the concepts of torsional vibrations.
5. Analyze and solve the problems on critical speed of shafts and transient vibrations

Text books:

1. S.S.Rao, “Mechanical Vibrations ", 5th Edition, Prentice Hall, 2011.
2. L.Meirovitch, “Elements of vibration Analysis", 2nd Edition, McGraw-Hill, New York, 1985.
3. Vibration and Control, D. J. Inman, John Willey & Sons Inc, 2002

Reference books:

1. W.T. Thomson, M.D. Dahleh and C Padmanabhan, “Theory of Vibration with Applications”, 5th Edition,Pearson Education, 2008.
2. M.L.Munjal, “Noise and Vibration Control”, World Scientific, 2013.
3. Beranek and Ver, “Noise and Vibration Control Engineering: Principles and Applications”,JohnWiley and Sons, 2006

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 subquestion covering all topics under a course outcome

PRODUCTION PLANNING AND CONTROL SEMESTER - VII			
Subject Code	18MEMEP704C	**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 should 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.

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.

INSTRUCTIONS			
INSTRUMENTATION & MECHATRONICS LAB SEMESTER - VII			
Subject Code	18MEMEL7070	IA Marks	15
Number of Lecture Hours/Week	3	Exam Marks	35
Total Number of Lecture Hours	39	Exam Hours	3
Credits – 1.5			

Course objectives: The students should be able to:

1. Understand the experimental work in the laboratory and calibration of various instruments for measuring temperature, displacement
2. Measure low and medium pressures using Mechanical and Electrical sensors.
3. Measure flow, speed and vibration using analogue and digital sensors.
4. Characterize the load and displacement using transducer kit
5. Develop PLC programs for control of traffic lights, water level and lifts.

EXPERIMENTS

1. Instrumentation & Measurement

1. Displacement measurement by using capacitive trainer
2. Temperature measurement by using thermocouples
3. Pressure measurement by using bourdon tube pressure gauge.
4. Pressure measurement by using Mcleod gauge.
5. Flow measurement by using Rotameter.
6. Speed measurement by using Digital tachometer.
7. Vibration measurement by using seismic pickup.

2. DYNA 1750 Transducers Kit

8. Displacement measurement by using LVDT.
9. Load measurement by using strain gauge load cell.
10. Temperature measurement by using thermistors/RTD

3. PLC PROGRAMMING

11. Ladder Programming for digital & Analogy sensors
12. Ladder programming for Traffic Light control, Water level control and Lift control Modules

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

1. Know requirement of calibration, errors in measurement of displacement and temperature
2. Select proper measuring instrument for measuring low and medium pressures.
3. Select proper measuring instrument for measuring flow, speed and vibration measurement.
4. Measure load, displacement and temperature using analogue and digital sensors.
5. Develop the PLC programs for Lift, water level control and traffic light

Modeling & Analysis (Skill Oriented Course)			
Subject Code	18MEMES7080	IA Marks	15
Number of Lecture Hours/Week	01(L)+02(P)	Exam Marks	35
Total Number of Lecture Hours	39	Exam Hours	03
Credits –2			

Course objectives: Students should be able to

1. Know importance and applications of FEA package in industries
2. Analyze the structural analyses problems
3. Analyze the thermal & model analyses problems

INTRODUCTION

Introduction to various Finite Element Analysis (FEA) packages and their importance and applications in industries.

STRUCTURAL AND THERMAL ANALYSIS USING HYPER MESH

1. Determination of deflection and stresses in 2D and 3D trusses.
2. Determination of deflections in beams component and principal and Von-mises stresses in plane stress, plane strain and axi-symmetric components.
3. Determination of stresses in 3D and shell structures (at least one example in each case)
4. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
5. Steady state heat transfer analysis of plane and Axi-symmetric components.

Course outcomes: Upon Completion of this course, the students will be able to:

1. Apply the knowledge of FEA package for industrial applications
2. Solve 2D structural and axi-symmetric problems using analysis software
3. Compute heat transfer problems using analysis software

Course structure for the Academic Year 2020-21
B. Tech. (Mechanical Engineering)
Semester VIII (Fourth Year) Approved Course structure

Sl. No.	Course Code	CC	Course Title	L	T	P	C
1.	18MEMER801X	PCC	Project Work, Seminar & Internship in industry	-	-	-	12
			Total	**-**	**-**	**-**	**12**

OPEN ELECTIVE COURSES

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

<table>
<tr><td colspan="4">Operations Research
SEMESTER - XX</td></tr>
<tr><td>Subject Code</td><td>18XXMEOX0XA</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit -2</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 3</td></tr>
<tr><td colspan="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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">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</td><td>10</td></tr>
<tr><td colspan="4">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</td></tr>
</table>

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

<table>
<tr><td colspan="4">Fundamentals of Mechanical Engineering
SEMESTER - XX</td></tr>
<tr><td>Subject Code</td><td>18XXMEOX0XB</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3(L)</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
<tr><td colspan="4"></td></tr>
</table>

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.

<table>
<tr><td>Unit -1</td><td>Hours</td></tr>
<tr><td>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.</td><td>10</td></tr>
<tr><td colspan="2">Unit -2</td></tr>
<tr><td>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.</td><td>10</td></tr>
<tr><td colspan="2">Unit – 3</td></tr>
<tr><td>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..</td><td>10</td></tr>
<tr><td colspan="2">Unit – 4</td></tr>
<tr><td>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.</td><td>10</td></tr>
<tr><td colspan="2">Unit – 5</td></tr>
<tr><td>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</td><td>10</td></tr>
</table>

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
Understand various applications of robotics and classification of coordinate system and control systems
Build the concepts of components of industrial robotics.
Determine kinematic analysis with D-H notation, forward and inverse kinematics
Model trajectory planning for a manipulator by avoiding obstacles
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:
Understand various applications of robotics and classification of coordinate system and control systems
Build the concepts of components of industrial robotics.
Apply kinematic analysis with D-H notation, forward and inverse kinematics
Model trajectory planning for a manipulator by avoiding obstacles.
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: 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) All questions carries 14 marks each 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
5. Associate the usage of hoists and monorails 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.

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

Course Objectives

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	**10**

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.	
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

Open Elective
Courses Offered by CE to other Departments

Civil Engineering - Societal & Global Impact			
Subject Code	18xxCEOxxxx	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			
Course Objectives: 1. Awareness of the importance of Civil Engineering and the impact it has on the Society and at global levels 2. Awareness of the impact of Civil Engineering for the various specific fields of human endeavour 3. Need to think innovatively to ensure Sustainability			
Unit -1			
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	Hours – 10		
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)	Hours – 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.	Hours – 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	Hours – 10		
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	Hours – 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	3	External Marks	70
Total Number of Lecture Hours	50	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 -1 History of Civil engineering	
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	**Hours – 10**
Unit -2 Fundamentals 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.	**Hours – 10**
Unit – 3 Basics 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	**Hours – 10**
Unit – 4 Surveying & Geomatics	
Surveying & Geomatics: Overview of Surveying, Traditional surveying techniques- , Total Stations; GPS & GIS Applications	**Hours – 10**
Unit-5 Geotechnical Engineering	
Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunnelling	**Hours – 10**

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	3	External Marks	70
Total Number of Lecture Hours	50	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 useful in mitigation.
5. Identify the regulatory controls used in hazard management.
6. Describe public awareness and economic incentive possibilities.

Unit	Hours
Unit -1 Natural Hazards And Disaster Management	
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.	**Hours – 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 air craft's accidents, and Emerging infectious diseases & Aids and their management.	**Hours – 10**
Unit – 3 Risk And Vulnerability	
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	**Hours – 10**
Unit – 4 Role Of Technology In Disaster Managements:	
Disaster management for infra structures, taxonomy of infra structure – treatment plants and process facilities-electrical substations- roads and bridges- mitigation programme for earth quakes –flowchart, geospatial information in agriculture drought assessment-multimedia technology in disaster risk management and training- transformable indigenous knowledge in disaster reduction.	**Hours – 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.	**Hours – 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 & R Krishnamurthy (2009), Universities press.

2. Disaster Science & Management' by Tushar Bhattacharya, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

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	3	External Marks	70
Total Number of Lecture Hours	50	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	
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.	**Hours – 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.	**Hours – 10**
Unit – 3 Solid Waste Management	
Solid waste characteristics – basics of on-site handling and collection – separation and processing - Incineration- Composting-Solid waste disposal methods – fundamentals of Land filling.	**Hours – 10**
Unit – 4 Environmental Sanitation	
Environmental Sanitation Methods for Hostels and Hotels, Hospitals, Swimming pools and public bathing places, social gatherings (melas and fares), Schools and Institutions, Rural Sanitation-low cost waste disposal methods.	**Hours – 10**
Unit-5 Hazardous Waste	
Characterization - Nuclear waste – Biomedical wastes – Electronic wastes - Chemical wastes – Treatment and management of hazardous waste-Disposal and Control methods.	**Hours – 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 standards and air emission standards.
3. Differentiate the treatment techniques used for sewage and industrial wastewater 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 of environmental sanitation and the management of community facilities without spread of epidemics.

TEXT BOOKS

1. Environmental Engineering, by Ruth F. Weiner and Robin Matthews – 4th Edition Elesevier, 2003.
2. Environmental Science and Engineering by J.G. Henry and G.W. Heinke – Pearson Education.
3. Environmental Engineering by Mackenzie L Davis & David A Cornwell. McGraw Hill Publishing1. 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. Sasi Kumar, S.A. Gopi Krishna. PHI New Delhi.
3. Environmental Engineering by Gerard Kiley, Tata McGraw Hill.
4. Environmental Sanitation by KVSG Murali Krishna, Reem Publications, New Delhi.

BUILDING MATERIALS

Subject Code	18xxCEOxxxx	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	50	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	
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	**Hours – 10**
Unit -2 Masonry	
Types of masonry, English and Flemish bonds, Rubble and Ashlar 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	**Hours – 10**
Unit – 3 Lime 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.	**Hours – 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	**Hours – 10**
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	**Hours – 10**

paints – Painting of new/old wood- Varnish. Form Works and Scaffoldings.	

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 roleof 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	3	External Marks	70
Total Number of Lecture Hours	50	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	
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	**Hours – 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,	**Hours – 10**
Unit – 3	
SUSTAINABILITY Introduction, Human development index, Sustainable development and social ethics, definitions of sustainability, populations and consumptions	**Hours – 10**
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	**Hours – 10**
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	**Hours – 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 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	Hours
Unit -1	
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

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-on-Approach)", 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 to other Departments

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	18ETETOXXXX	Signals and Systems	3	0	0	3
2	18ETETOXXXX	Principles of Signal Processing	3	0	0	3
3	18ETETOXXXX	Consumer Electronics	3	0	0	3
4	18ETETOXXXX	Transducers and Sensors	3	0	0	3
5	18ETETOXXXX	IOT and Applications	3	0	0	3
6	18ETETOXXXX	IC Applications	3	0	0	3
7	18ETETOXXXX	Principles of Communications	3	0	0	3
8	18ETETOXXXX	Data Communications	3	0	0	3
9	18ETETOXXXX	Digital Logic design	3	0	0	3
10	18ETETOXXXX	Remote Sensing and GIS	3	0	0	3

Signals And Systems
Open Elective

Subject Code	18ETETOXXXX	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", 2ndedition, 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, TM

Principles of Signal Processing
Open Elective

Subject Code	18ETETOXXXX	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	
Multirate signal processing: Basic building blocks of multirate 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

<table>
<tr><td colspan="4" align="center">CONSUMER ELECTRONICS
Open Elective</td></tr>
<tr><td>Subject Code</td><td>18ETETOXXXX</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>03</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>48</td><td>Exam Hours</td><td>03</td></tr>
<tr><td>Pre-requisite</td><td>Analog Communications</td><td colspan="2">Credits – 03</td></tr>
<tr><td colspan="4">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</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">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</td><td>10</td></tr>
<tr><td colspan="3">Unit -2</td><td></td></tr>
<tr><td colspan="3">Digital Audio Fundamentals: Audio as Data and Signal, Digital Audio Processes Outlined, Time Compression and Expansion.</td><td>9</td></tr>
<tr><td colspan="4">Unit -3</td></tr>
<tr><td colspan="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, Camera tube, PAL TV Receiver, NTSC, PAL, SECAM</td><td>10</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">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</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">Introduction to different type of domestic/commercial appliances: Operation of Micro-wave oven, Food Processors, Digital Electronic Lock, Vacuum cleaner, Xerox Machine, scanner .
.</td><td>09</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="4">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</td></tr>
<tr><td colspan="4">Reference Books:
1. Consumer Electronics by S. P. Bali; Pearson Education, New Delhi</td></tr>
</table>

TRANSDUCERS AND SENSORS
Open Elective

Subject Code	18ETETOXXXX	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

1. Understand measurements and instrumentation and its need.
2. Explain the Characteristics of Transducers.
3. Explain the Characteristics of resistive, inductive and capacitive transducers

Unit	Hours
Unit -1	
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

<table>
<tr><td colspan="4">IOT and APPLICATIONS
Open Elective</td></tr>
<tr><td>Subject Code</td><td>18ETETXXXX</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>03</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>48</td><td>Exam Hours</td><td>03</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="3">Unit -2</td><td></td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit -3</td></tr>
<tr><td colspan="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.</td><td>9</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">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.</td><td>9</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="4">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</td></tr>
</table>

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,and Use Cases”,CRCPress,2017.

IC APPLICATIONS
Open Elective

Subject Code	18ETETOXXXX	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	Hours
Unit -1	
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, Non linear 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, Demultiplexers, 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. Analyse 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	18ETETOXXXX	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.

<table>
<tr><td colspan="4">Data Communications
Open Elective</td></tr>
<tr><td>Subject Code</td><td>18ETETOXXXX</td><td>Internal Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>03</td><td>External Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>48</td><td>Exam Hours</td><td>03</td></tr>
<tr><td>Pre-requisite</td><td>Communication</td><td colspan="2">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="3">Unit -1</td><td>Hours</td></tr>
<tr><td colspan="3">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,</td><td>10</td></tr>
<tr><td colspan="3">Unit -2</td><td></td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit -3</td></tr>
<tr><td colspan="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</td><td>9</td></tr>
<tr><td colspan="4">Unit – 4</td></tr>
<tr><td colspan="3">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</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5</td></tr>
<tr><td colspan="3">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</td><td>9</td></tr>
</table>

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.	

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	18ETETOXXXX	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. FundamentalsofLogicDesignbyCharlesH.RothJr,JaicoPublishers,2006
2. DigitalelectronicsbyRSSedha.S.Chand&companylimited,2010
3. SwitchingTheoryandLogicDesignbyA.AnandKumar,PHILearningpvtltd,2016.
4. DigitallogicapplicationsanddesignbyJohnMYarbough,Cengagelearning,2006.
5. TTL74-Seriesdatabook.

REMOTE SENSING AND GIS **Open Elective**			
Subject Code	18ETETXXXX	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 Electives Offered by CST to other Departments

<table>
<tr><td colspan="4" align="center">INTERNET OF THINGS</td></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="3">Unit -1: The Internet of Things</td><td>Hours</td></tr>
<tr><td colspan="3">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</td><td>08</td></tr>
<tr><td colspan="4">Unit -2 :Business Models</td></tr>
<tr><td colspan="3">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</td><td>10</td></tr>
<tr><td colspan="4">Unit – 3:Design Principles for the Web Connectivity</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 4:Internet Connectivity Principles</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5:Data Collection</td></tr>
<tr><td colspan="3">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.</td><td>12</td></tr>
</table>

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.

<table>
<tr><td colspan="4">BLOCK CHAIN</td></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="3">Unit -1: Introduction</td><td>Hours</td></tr>
<tr><td colspan="3">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.</td><td>08</td></tr>
<tr><td colspan="4">Unit -2 :Understanding block chain with crypto currency</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 3:Permissioned Block Chain</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 4:Enterprise application of Block chain</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5:Block chain application development</td></tr>
<tr><td colspan="3">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.</td><td>12</td></tr>
<tr><td colspan="4">Text(T) / Reference(R) Books:</td></tr>
<tr><td>T1</td><td colspan="3">Block Chain: Blueprint for a new economy, Melanie Swan, O’Reilly, 2015.</td></tr>
<tr><td>T2</td><td colspan="3">Block Chain: The Block Chain for Beginners- Guide to Block Chain Technology and Leveraging Block Chain Programming, Josh Thompsons</td></tr>
<tr><td>R1</td><td colspan="3">Block Chain Basics, Daniel Drescher, Apress; 1st edition, 2017</td></tr>
<tr><td>R2</td><td colspan="3">Block Chain and Crypto Currencies, Anshul Kaushik, Khanna Publishing House, Delhi.</td></tr>
<tr><td>R3</td><td colspan="3">Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained, Imran Bhashir, Packt Publishing.</td></tr>
<tr><td>W1</td><td colspan="3">https://www.edx.org/learn/blockchain</td></tr>
</table>

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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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,, Major players in industry, Origin of Quantum Computing, overview of major concepts in Quantum Computing.	**08**
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	**10**
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.

<table>
<tr><th colspan="5">VIRTUAL REALITY</th></tr>
<tr><td>Subject Code</td><td colspan="2"></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td colspan="2">3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td colspan="2">50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="5">Credits – 03</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="4">Unit -1:Virtual reality and Virtual Environment</td><td>Hours</td></tr>
<tr><td colspan="4">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.</td><td>08</td></tr>
<tr><td colspan="5">Unit -2 :Geometric Modelling</td></tr>
<tr><td colspan="4">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.</td><td>10</td></tr>
<tr><td colspan="5">Unit – 3:Animating the Virtual Environment</td></tr>
<tr><td colspan="4">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</td><td>10</td></tr>
<tr><td colspan="5">Unit – 4:Human Factors</td></tr>
<tr><td colspan="4">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.</td><td>10</td></tr>
<tr><td colspan="5">Unit – 5:VR Applications</td></tr>
<tr><td colspan="4">Shor’s Algorithm, Grover’s Algorithm, Deutsch’s Algorithm, Deutsch-Jozsa Algorithm, IBM Quantum Experience, Microsoft Q, Rigetti PyQuil</td><td>12</td></tr>
</table>

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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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.	**08**
Unit – 4:NONLINEAR DATA STRUCTURE	
Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Binary search trees, Conversionof General Trees To Binary Trees, Applications of Trees.	**10**
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.	**12**

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

<table>
<tr><th colspan="5">DESIGNING DATABASE MANAGEMENT SYSTEMS</th></tr>
<tr><td>Subject Code</td><td></td><td colspan="2">IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td colspan="2">Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td colspan="2">Exam Hours</td><td>03</td></tr>
<tr><td colspan="5">Credits – 03</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="3">Unit -1: Database system architecture</td><td colspan="2">Hours</td></tr>
<tr><td colspan="3">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.</td><td colspan="2">10</td></tr>
<tr><td colspan="5">Unit -2 : E-R Models</td></tr>
<tr><td colspan="3">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.</td><td colspan="2">10</td></tr>
<tr><td colspan="5">Unit - 3: Relational Algebra</td></tr>
<tr><td colspan="3">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.</td><td colspan="2">10</td></tr>
<tr><td colspan="5">Unit - 4: Normalization</td></tr>
<tr><td colspan="3">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).</td><td colspan="2">08</td></tr>
<tr><td colspan="5">Unit - 5: Transaction Management</td></tr>
<tr><td colspan="3">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.</td><td colspan="2">12</td></tr>
</table>

Text(T) / Reference(R) Books:	
T1	IntroductiontoDatabaseSystems, CJDate,Pearson.
T2	DatabaseManagement Systems,3rdEdition,Raghurama Krishnan,JohannesGehrke,TATAMcGrawHill.
T3	DatabaseSystems-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&Carlo sCoronel
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.

<table>
<tr><td colspan="4">OPERATING SYSTEMS CONCEPTS</td></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>

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.	**10**
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	**10**
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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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**.**	**08**
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	**12**

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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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	**08**
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 Structure**s** 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. Module**s**: 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.	**12**

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

<table>
<tr><th colspan="4">JAVA PROGRAMMING</th></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>

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.	**08**
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.	**10**
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.	**10**
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.	**12**

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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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.	**08**
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.	**12**

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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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.	**10**
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.	**08**
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.	**12**
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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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.	**08**
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 & Logic Concepts	
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.	**12**

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 IT to other Departments

S. No.	Subject Code	Subject
1.	18XXITOXXXA	Block Chain
2.	18XXITOXXXB	Data Structures
3.	18XXITOXXXC	Designing Database Management Systems
4.	18XXITOXXXD	Operating Systems
5.	18XXITOXXXE	R Programming
6.	18XXITOXXXF	Python Programming
7.	18XXITOXXXG	Java Programming
8.	18XXITOXXXH	Web Technologies
9.	18XXITOXXXI	Artificial Intelligence
10.	18XXITOXXXJ	Computer Graphics

BLOCK CHAIN			
Subject Code	18XXITOXXXA	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

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.	**08**
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 use cases, 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.	**10**
Unit – 5:Block chain application development	
Hyper ledger fabric- architecture, identities and policies, membership and access control, channels, transaction validation, writing smart contract using Hyper ledger fabric, writing smart contract using Ethereum, overview of Ripple and Corda.	**12**

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.

DATA STRUCTURES			
Subject Code	18XXITOXXXB	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Unit -1: INTRODUCTION TO DATA STRUCTURE	**Hours**
Data 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. Array: Representation of arrays, Applications of arrays, sparse matrix and its representation	**10**
Unit -2 :Stack and Queue	
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, 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.	**08**
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.	**10**
Unit – 5: Sorting and Searching:	
Sorting – Bubble Sort, Selection Sort, Quick Sort, Merge Sort Searching –Sequential Search and Binary Search	**12**

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	Analyze algorithms' time and space complexity and justify the correctness.
CO2	Implement Stack and Queue ADT.
CO3	Implement Linked List ADT.
CO4	Implement Binary Tree ADT and traversal algorithms.
CO5	Implement Searching and sorting algorithms.

DESIGNING DATABASE MANAGEMENT SYSTEMS			
Subject Code	18XXITOXXXC	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

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, The Relational Model, Introduction to Database Design, Database Design 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).	**08**
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.	**12**

Text(T) / Reference(R) Books:	
T1	Introduction to Database Systems, CJDate ,Pearson.
T2	Database Management Systems,3rd Edition , Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill.
T3	Database Systems-The Complete Book, H GMolina,J DUllman,J WidomPearson.
T4	Database Management Systems,6/e Ramez Elmasri, Shamkant B. Navathe, PEA
R1	DatabaseSystemsdesign,Implementation,andManagement,7thEdition,PeterRob& Carlos Coronel
R2	tabase 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	Recognize the basic elements of a relational database management system.
CO2	Design entity relationship and convert entity relationship diagrams into RDBMS.
CO3	Design relational algebra and calculus to create, maintain, and manipulate a relational database using SQL.
CO4	Implement normalization techniques for logical schema models.
CO5	Estimate concurrent issues and problems through locking mechanism.

OPERATING SYSTEMS			
Subject Code	18XXITOXXXD	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

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.	**10**
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	**10**
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 the evolution of 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	18XXITOXXXE	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

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**.**	**08**
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	**12**

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	Identify the data types in R Programming Language.
CO2	Implement the control and functions with recursion and without recursion.
CO3	Implement the statistical and probabilistic functions to review, manipulate and summarize data-sets in R
CO4	Perform appropriate statistical tests using R Create and edit visualizations
CO5	Interpret data-sets to create testable hypotheses and identify appropriate statistical tests

PYTHON PROGRAMMING			
Subject Code	18XXITOXXXF	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

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	**08**
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 Structure**s** 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. Module**s**: 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	**12**

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	Describe the basic elements of Python Programming Language
CO2	Apply various operators and Control statements to solve the real world problems
CO3	Implement modularity and reusability by using functions
CO4	Employ Various OOPS Concepts for real world applications
CO5	Use Standard Libraries to develop applications

JAVA PROGRAMMING			
Subject Code	18XXITOXXXG	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

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.	**08**
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.	**10**
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, user defined 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.	**10**
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.	**12**

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	Describe OOP principles, and basic structure of a Java program
CO2	Implement reference data type like class and arrays
CO3	Demonstrate inheritance, user defined packages and exception handling.
CO4	Design the applications with Interprocess Communication using multithreading.
CO5	Demonstrate the applications using GUI elements and event handling.

WEB TECHNOLOGIES

Subject Code	18XXITOXXXH	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Unit-1: HTML	**Hours**
HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Images, Hypertext, Links, Lists, Tables, Forms, HTML5 **CSS:** Levels of Style Sheets, Style Specification Formats, Selector Forms, The Box Model, Conflict Resolution	**10**
Unit -2: Java Script	
Javascript: Introduction, Where to, Variables, Operators, Screen Output and Keyboard Input, Control Statements, Objects, Events, Arrays, Functions, Object Creation and Modification, Constructors, Pattern Matching using Regular Expressions	**10**
Unit -3 Bootstrap	
Gird basics, Bootstrap Text/Typography, Tables, Images, Jumbotron, Wells, Alerts, Button groups, Glyphicons, Progress Bars, List Groups, Panels, Dropdowns, Tabs and Pills, Navigation Bar, Forms, input sizing, Media Objects, Carousel Plugin, Popover Plugin, Scrollspy Plugin.	**10**
Unit –4: XML	
Working with XML: Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX.	**08**
Unit -5: 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.	**12**

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.
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

Course Outcomes: On completion of this course, students can

CO1	Design static webpages using HTML and CSS elements.
CO2	Design interactive webpages using Java Script
CO3	Design web responsive webpages suitable for multiple device user friendly view
CO4	Develop a webpages by the use of XML
CO5	Develop web applications using PHP

ARTIFICIAL INTELLIGENCE			
Subject Code	18XXITOXXXI	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

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.	**08**
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.	**12**

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	Describe the evolution of of AI and its working principles.
CO2	Estimate different kinds of heuristic search algorithms and get feasible solution for AI problems.
CO3	Classify optimized concepts of using various problem reduction techniques.
CO4	Express various Knowledge Representation (KR) techniques
CO5	Implement different kinds of Expert Systems.

Computer Graphics			
Subject Code	18XXITOXXXJ	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Unit -1:	Hours
INTRODUCTION: Application areas of computer graphics, overview of graphic system, video display devices, raster scan systems, random scan systems, graphics monitors and work stations, input devices.	10
Unit -2 :	
OUTPUT PRIMITIVES: Points and lines, line drawing algorithms, mid-point circle algorithm. [TB1: **FILLED AREA PRIMITIVES:** scan-line polygon fill algorithm, boundary fill and flood fill algorithm.	10
Unit – 3:	
2-D GEOMETRICAL TRANSFORMATIONS: Translation, scaling, rotation, reflection and shear, transformation matrix representations and homogeneous co-ordinates, composite transformations, transformations between coordinates. **2-D VIEWING:** The viewing pipe-line, viewing coordinate reference frame, window to view-port co-ordinate transformations, viewing function, Cohen-Sutherland and Cyrus-beck line clipping algorithms.	12
Unit – 4:	
3-D GEOMETRIC TRANSFORMATIONS: Translation, rotation, scaling, reflection and shear transformation and composite transformations. **VISIBLE SURFACE DETECTION METHODS:** Classification, back-face detection, depth-buffer, scan-line, depth sorting.	10
Unit – 5:	
COMPUTER ANIMATION: Introduction to animation, Color models, Design of animation sequence, general computer animation functions, raster animation, computer animation language, key frame system, motion specification methods.	8

Text(T) / Reference(R) Books:

T1	. Computer Graphics *C* version, Donald Hearn, M.Pauline Baker, Pearson
T2	Computer Graphics with Virtual Reality Systems, Rajesh K Maurya, Wiley
T3	Introduction to Computer Graphics, Using Java 2D and 3D, Frank Klawonn, Springer
T4	Computer Graphics, Steven Harrington, TMH
T5	Computer Graphics, Amarendra N Sinha, ArunUdai, TMH
R1	Computer Graphics Principles & practice, 2/e, Foley, VanDam, Feiner, Hughes, Pearson
R2	Computer Graphics, Peter, Shirley, CENGAGE
R3	Principles of Interactive Computer Graphics, Neuman , Sproul, TMH
R4	The Computer Graphics manual, Vol 2, David, Soloman, Springer
W2	Procedural elements for Computer Graphics, David F Rogers, 2/e, TMH

Course Outcomes: On completion of this course, students can

CO1	Recognize the basic elements and applications of computer graphics.
CO2	Discuss various algorithms for basic output primitives
CO3	Use of geometric transformations on graphics objects.
CO4	Describe 3-D transformations and Visible Surface Detection techniques.
CO5	Interpret the layout of the animation steps and color models

Open Elective
Courses Offered by CSE to other Departments

<table>
<tr><td colspan="4">INTERNET OF THINGS</td></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="3">Unit -1: The Internet of Things</td><td>Hours</td></tr>
<tr><td colspan="3">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</td><td>08</td></tr>
<tr><td colspan="4">Unit -2 :Business Models</td></tr>
<tr><td colspan="3">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</td><td>10</td></tr>
<tr><td colspan="4">Unit – 3:Design Principles for the Web Connectivity</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 4:Internet Connectivity Principles</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5:Data Collection</td></tr>
<tr><td colspan="3">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.</td><td>12</td></tr>
</table>

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			
Subject Code		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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.	**08**
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.	**10**
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.	**12**

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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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.	**08**
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	**10**
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.

<table>
<tr><th colspan="4">VIRTUAL REALITY</th></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td colspan="3">Unit -1:Virtual reality and Virtual Environment</td><td>Hours</td></tr>
<tr><td colspan="3">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.</td><td>08</td></tr>
<tr><td colspan="4">Unit -2 :Geometric Modelling</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 3:Animating the Virtual Environment</td></tr>
<tr><td colspan="3">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</td><td>10</td></tr>
<tr><td colspan="4">Unit – 4:Human Factors</td></tr>
<tr><td colspan="3">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.</td><td>10</td></tr>
<tr><td colspan="4">Unit – 5:VR Applications</td></tr>
<tr><td colspan="3">Shor’s Algorithm, Grover’s Algorithm, Deutsch’s Algorithm, Deutsch-Jozsa Algorithm, IBM Quantum Experience, Microsoft Q, Rigetti PyQuil</td><td>12</td></tr>
</table>

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, 2^{nd} 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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

6. Operations on linear data structures and their applications.
7. The various operations on linked lists.
8. The basic concepts of Trees, Traversal methods and operations.
9. Concepts of implementing graphs and its relevant algorithms.
10. 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.	**08**
Unit – 4:NONLINEAR DATA STRUCTURE	
Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Binary search trees, Conversionof General Trees To Binary Trees, Applications of Trees.	**10**
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.	**12**

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

<table>
<tr><td colspan="4" align="center">DESIGNING DATABASE MANAGEMENT SYSTEMS</td></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>

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).	**08**
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.	**12**

Text(T) / Reference(R) Books:	
T1	IntroductiontoDatabaseSystems, CJDate,Pearson.
T2	DatabaseManagement Systems,3rdEdition,Raghuram Krishnan,JohannesGehrke, TATAMcGrawHill.
T3	DatabaseSystems-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.

<table>
<tr><th colspan="4">OPERATING SYSTEMS CONCEPTS</th></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits – 03</td></tr>
</table>

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.	**10**
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	**10**
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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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**.**	**08**
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	**12**

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

<table>
<tr><td colspan="5">PYTHON PROGRAMMING</td></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td colspan="2">30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td colspan="2">70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td colspan="2">03</td></tr>
<tr><td colspan="5">Credits – 03</td></tr>
<tr><td colspan="5">Course Objectives:
The learning objectives of this course are:
1. Introduction to Scripting Language.
2. Exposure to various problems solving approaches of computer science.</td></tr>
<tr><td colspan="4">Unit -1: Introduction</td><td>Hours</td></tr>
<tr><td colspan="4">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</td><td>08</td></tr>
<tr><td colspan="5">Unit -2 : Types, Operators and Expressions</td></tr>
<tr><td colspan="4">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.</td><td>10</td></tr>
<tr><td colspan="5">Unit – 3: Functions</td></tr>
<tr><td colspan="4">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</td><td>10</td></tr>
<tr><td colspan="5">Unit – 4: Object Oriented Programming in Python</td></tr>
<tr><td colspan="4">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</td><td>10</td></tr>
<tr><td colspan="5">Unit – 5: Brief Tour of the Standard Library</td></tr>
<tr><td colspan="4">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.</td><td>12</td></tr>
</table>

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

<table>
<tr><td colspan="4" align="center">JAVA PROGRAMMING</td></tr>
<tr><td>Subject Code</td><td></td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>3</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4" align="center">Credits – 03</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>

<table>
<tr><td>Unit -1: Introduction to OOP</td><td>Hours</td></tr>
<tr><td>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.</td><td>08</td></tr>
<tr><td colspan="2">Unit -2 :Classes and objects</td></tr>
<tr><td>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.</td><td>10</td></tr>
<tr><td colspan="2">Unit – 3:Inheritance</td></tr>
<tr><td>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</td><td>10</td></tr>
<tr><td colspan="2">Unit – 4:Multithreading</td></tr>
<tr><td>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.</td><td>10</td></tr>
<tr><td colspan="2">Unit – 5:Applet</td></tr>
<tr><td>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.</td><td>12</td></tr>
</table>

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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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.	**08**
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.	**12**

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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objectives:
The learning objectives of this course are:
1. 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.	**10**
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.	**08**
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.	**12**
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		IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	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.	**08**
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 & Logic Concepts	
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.	**12**

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.