ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS
(Choice Based Credit System)

R19

Mechanical Engineering

For

B.TECH. FOUR YEAR DEGREE COURSE

(Applicable for batches admitted from 2019-2020)

SWARNANDHRA
COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)

SEETHARAMAPURAM, NARSAPUR-534 280, W.G.DT., A.P.

INSTITUTION VISION AND MISSION

VISION

To produce global competent, ethical and dynamic professionals by creating Centre of Excellence in Technical Education for societal empowerment.

MISSION

M1: To provide quality education with knowledge and skills for rural and urban students.

M2: To collaborate the industries with academia for empowering the students to meet global standards.

M3: To induce highly ethical entrepreneurship in young minds with good leadership quality for the society.

M4: To enhance the institution in Research and Development by human intellectual capability.

DEPARTMENT VISION AND MISSION

VISION

To educate and enrich effective and responsible Mechanical Engineers to fulfil the needs of industry and society.

MISSION

M1 - To lay a strong foundation of technical knowledge by concentrating on fundamental concepts of Mechanical engineering.

M2 - To develop creative thinking and innovative methods for solving complex engineering problems.

M3 - To develop team spirit, leadership and professional qualities.

M4 - To strengthen research abilities in collaboration with industry.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1 – Graduates acquire solid foundation in Engineering, Science and Technology for a successful career in Mechanical Engineering.

PEO2 – Graduates become effective collaborators and innovators to address technical and engineering challenges.

PEO3 – Graduates shall get employed in industries, pursue higher studies, handle research assignments and become entrepreneurs.

PEO4 – Graduates attain communication and leadership skills, and possess professional and ethical values.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5.Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Design, model, simulate and analyze various mechanical systems or processes.

PSO2: Obtain additional skills and knowledge to develop and implement thermal engineering systems.

ACADEMIC REGULATIONS

1. INTRODUCTION

Swarnandhra College of Engineering & Technology (**Subsequently referred to as SCET**) will be followed the norms of Jawaharlal Nehru Technological University Kakinada and Govt. of Andhra Pradesh.

All Academic Programme rules and regulations are approved by the Academic Council, which is the highest Academic body of the Institute. It is applicable for all Bachelor of Technology (B. Tech) degree programme from academic year 2019-20 admission onwards.

2. ADMISSIONS

2.1 Regular Admission

(Join in first year B. Tech Programme)

Admissions in the Institution are classified into **CATEGORY – A,** through convener, EAMCET and **CATEGORY- B** filled by the college management.

2.2 Lateral Entry Admission

(Join in the Second year/third semester of B. Tech Programme)

Eligibility: B.Sc. Graduate & Diploma holders.

Based on the rank secured by the candidate at Engineering Common Entrance Test (ECET) conducted by the convener ,ECET, and Central counseling by Higher Education, Government of Andhra Pradesh.

2.3 Advance standing Admission

(Transfer from other Colleges/ Re-admission due to dis-continuation)

These may arise in the following cases:

a) When a student seeks transfer from other colleges to SCET and desirous to pursue the study at SCET in an eligible branch of study.
b) When students of SCET get transferred from one regulation to another regulation or from previous syllabus to revised syllabus.

In all such cases for admission, when needed, permissions from the statutory bodies are to be obtained and the Programme of study at SCET will be governed by the transitory regulations.

3. UNDER GRADUATE PROGRAMMES OFFERED

Presently, the College is offering Under Graduate Programmes in the following disciplines:

- Computer Science and Engineering (CSE)
- Electronics and communication Engineering (ECE)
- Electrical and Electronics Engineering (EEE)
- Information Technology (IT)
- Mechanical Engineering (ME)
- Civil Engineering (CE)

3.1 Structure of the Programme:

i) **Preamble:**

It is emphasized in UGC Guidelines on Choice Based Credit System (CBCS), that the important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. It is adopted grading system in place of conventional system of marks and percentages.

Our CBCS provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The students can register any courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach through open electives.

Key words CBCS, such as Course, credit, credit point, CGPA, SGPA, Grade Point, Letter Grades, Foundation Courses (FC), Programme Core Course (PCC) and Elective Courses (EC) as given in the UGC guidelines are used the same definitions.

Each Programme of a Discipline or branch will consist of:

i). Foundation courses in Basic Sciences, Engineering Sciences and Humanities.
ii). Programme core courses to impart broad based knowledge needed in the concerned branch.
iii). Elective courses from the discipline or interdisciplinary areas / industry related opted by the student based on their interest in specialization.
iv). Open Elective courses from the interdisciplinary areas opted by the students based on their interest in specialization.

Each Programme designed to have 35-40 theory courses and 20-25 laboratory courses. The categories of courses are indicated in the following table.

TABLE-1 CATEGORY OF COURSES

Course Category
Foundation Courses – Basic Sciences & Humanities
Foundation Courses – Engineering Sciences
Programme Core Courses in the branch of study
Elective Courses
Open Elective

Note: All components prescribed in the curriculum will be conducted and evaluated.

ii) **Contact hours:** Depending on the complexity and volume of the course the number of contact hours per week will be determined.

iii) **Credits:**

TABLE-2 CREDITS BASED ON CONTACT HOURS

Course type	No. of Contact Hours	No. of Credits
Theory	1	1
Laboratory	2	1

TABLE-3 CREDITS FOR DIFFERENT COURSES

Course type	Lecture method			Credits
	L	T	P	C
Theory /Elective	3	1	0	4
	2	1	0	3
	3	0	0	3
	2	0	2	3
	2	0	0	2
Laboratory	0	0	2	1
	0	0	3	1.5
	0	0	4	2

3.2 Curriculum for each Programme:

- The Four year curriculum of any B. Tech Programme of study in any branch of Engineering is formulated based on the guidelines mentioned in 3.1 and will be recommended by the concerned Board of Studies and is approved by the Academic Council.
- In case of students admitted under lateral entry, the respective regular curriculum contents from 3rd semester onwards are to be pursued by them.
- In case of students admitted under advanced standing, the equivalence will be prepared by the concerned Board of Studies and the Academic Council has to approve the same..

4. DURATION OF THE PROGRAMME:

The duration of the B. Tech. Programme is four academic years consisting of eight semesters. Students, who fail to fulfill all the academic requirements for the award of the degree within the prescribed duration as per article 4.1, will forfeit their admission in B. Tech course**.**

4.1 Maximum duration of study.

Maximum duration permitted for any student to successfully complete the four year B. Tech. Programme of study will be:

Regular Admission: Eight academic years in sequence from the year of admission for a student admitted into first year of any Programme.
Lateral Entry Admission: Six academic years in sequence from the year of admission for a student admitted into second year of any Programme.
Advanced standing Admission: The maximum time for completion of Programme of study, will be twice the period in terms of academic years in sequence, stipulated in the Programme curriculum defined at the time of admission.

4.2 Cancellation of Admission :

In case, any student fails to meet the above applicable/eligible conditions for the award of degree, his/her admission stands cancelled.

TABLE- 4 MAXIMUM DURATION OF STUDY

Admitted year of study	Maximum duration
First year	8 academic years in sequence
Second year (Lateral entry)	6 academic years in sequence
Advanced standing	Twice the period in terms of academic years in sequence

5. MEDIUM OF INSTRUCTION :
The medium of instruction and examinations are in English.

6. MINIMUM INSTRUCTION DAYS: Each semester will consist of 22 weeks duration with minimum of 110 working days which includes instruction days, internal tests and End examinations.

7. TRANSITORY REGULATIONS:

For those who admitted under advance standing, these transitory regulations will provide the modus of operandi. At the time of such admission, based on the Programme pursued (case by case)

- Equivalent courses completed by the student are established by the BOS of concerned discipline.
- Marks/Credits are transferred for all such equivalent courses and treated as successfully completed in the Programme of study prescribed by SCET.
- A Programme chart of residual courses not completed will be derived and a Programme of study with duration specified will be prescribed for pursuit at SCET.
- Marks obtained in the previous system, as the case maybe, shall be converted to equivalent grades and CGPA.

All other modalities and regulations governing shall be the same as those applicable to the stream of students with whom; such a candidate is merged with current regulations.

8. DISTRIBUTION AND WEIGHTAGE OF MARKS:

Each semester consists of 4/5/6 theory courses and 2/3/4 Laboratories. However, in the 8th semester there will be only 2 theory courses in addition to the project work.

(a). **Theory Courses:**

- Each course consists of five units.
- All courses will be evaluated with a maximum of 100 marks.
- Marks distribution will be 30 marks for internal evaluation and 70 marks for the end semester examination.
- The internal evaluation of 30 marks consists of two cycles. Each cycle consists of descriptive test (internal test) for 20 marks and two class tests for 10 marks.
- Mid Examination: Each mid examination will be conducted for 20 marks with the duration of 75 Minutes. Internal test paper consists of three questions (8M+8M+4M) from two and half units and all are to be answered.
- Class tests for 10 marks calculation: There will be two class tests conducted in each cycle unit wise. **Best of two** will be considered.
- **Weighted average of two Cycles** performance will be considered, weightage of 80% for the best Cycle performance and 20% for second.
- The **end semester** examination will be conducted for 70 marks which covers full syllabus. In end examination pattern, **Part – A** consists of five short questions from all units (Brainstorming/Thought provoking/Case study) for 10 marks. **Part – B** has **5 questions** with internal choice from each unit and valued for 60 marks.

(b). **Practical Courses:**

- All courses will be evaluated with a maximum of 100 marks.
- Marks distribution will be 30 marks for internal evaluation and 70 marks for the end semester examination.
- End practical examination will be conducted by the internal and external examiner appointed by COE.
- Internal evaluation will be a continuous assessment during the semester for 30 marks with 15 marks for day-to-day work, including record valuation and 15 marks for internal test.

(c). **Design or Engineering Drawing Marks Distribution:**

For the courses of design or drawing such as Engineering Graphics, etc., the distribution will be 30 marks for internal evaluation with 10 marks for day-to-day work, and 20 marks from two internal tests (80% of first best + 20% of second best). End examination will be conducted for 70 marks.

(d) **Internship:** It can be carried out with a minimum of two weeks and maximum of four weeks, any time after completion of 4^{th} semester till end of 7^{th} semester. It will be evaluated internally by an internal evaluation committee comprising of Head of the Department and two faculty of the department. A minimum of 50% of maximum marks shall be obtained to earn the corresponding credits

(e) **Mini Project:** The $6^{th}/7^{th}$ Semester Mini Project work will be evaluated for 100 marks.

The project work is evaluated for internal assessment for 30 and external examination for 70.

i) Internal Assessment: Internal Assessment will be monitored by Project Review Committee consisting of 1) Head of the Department 2) Supervisor and 3) Senior faculty member on the basis of two seminars and the internal marks will be awarded by Project Supervisor with recommendation of PRC.

ii) External Examination: External Examination will be conducted through presentation / viva - voice by the student by Project external examination committee consisting of 1) Head of the Department 2) Supervisor and 3) External examiner appointed by COE.

(g) Project Work: The 8th Semester main Project Work will be evaluated for 200 marks. The project work is evaluated for internal assessment of 60 and external examination for 140.

i) Internal Assessment: Internal Assessment will be monitored by Project Review Committee consisting of 1) Head of the Department 2) Supervisor and 3) Senior faculty member on the basis of two seminars and the internal marks will be awarded by Project Supervisor with recommendation of PRC.

ii) External Examination: External Examination will be conducted through presentation / viva - voice by the student by Project external examination committee consisting of 1) Head of the Department 2) Supervisor and 3) External examiner appointed by COE.

TABLE- 5 MARKS ALLOCATION

Course type	Marks Allocation			
	Internal		End Semester	Total
	Internal test	Class Test/ Day to day work		
Theory course	20	10	70	100
Laboratory course	15	15	70	100
Design or Drawing course	20	10	70	100

(h) Mandatory Courses: These courses are compulsory with zero credits. They shall be no external examination. However attendance in the mandatory course of minimum attendance (75%) in that particular course.

(i) Open Electives: Students are to choose Open Elective – I during 5th Semester, Open Elective–II during 6th Semester and Open Elective – III and IV during 7th Semester from the list of Open Electives given in the Course Structure. However, students cannot opt for an Open Elective Subject offered by their own (parent) Department, if it is already listed under any category of the courses offered by the parent Department in any Semester.

9. ATTENDANCE REGULATIONS

(i) A student will be eligible to appear for end semester examinations, if he/she acquired a minimum of 75% of attendance in aggregate of all the courses.

(ii) Condonation of shortage of attendance in aggregate up to 10% on medical grounds (Above 65% and below 75%) in any semester may be granted by the College Academic Committee.

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

(iv) Students with less than 65% of attendance in any semester are not eligible to take up their end examination of that particular semester and their registration for examination shall be allowed.

(v) Attendance may also be condoned for those who participate in Intercollegiate/university sports, co- and extracurricular activities provided their attendance is in the minimum prescribed range for the purpose (>65%) and recommended by the concerned authority. He/ She shall pay the prescribed condonation fee.

(vi) Prescribed Condonation fee shall be payable by the student to appear for the end examination.

(vii) A Student will not be promoted to the next semester unless he/she satisfies the attendance requirement of the present semester as applicable. They may seek re-admission for that semester as and when offered consecutively by the Department.

(viii) A student will be condoned only four times for regular student and three times for lateral entry students during entire course of study.

TABLE-7 ATTENDANCE REQUIREMENT

Attendance Percentage	Condonation fee	Appear End Exams
Above 75 %	Nil	Eligible
65 % -75%	Yes (on medical grounds)	Eligible
Below 65 %	Nil	Not Eligible (Seek re-admission to that semester when offered)

10. MINIMUM ACADEMIC REQUIREMENTS:

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in **S.No.9.**

(i) A student will be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory or practical or design or drawing subject or project if he/she secures not less than a minimum of 35% of marks exclusively in the end semester examinations in each of the courses, for which the candidate had appeared. However, the candidate should have secured a minimum of 40% marks in both external and internal components put together to declare eligible for pass in the subject.

(ii) A student will be promoted from first semester to second semester, second semester to third and third to fourth semester, if he/she satisfies the minimum attendance requirement.

(iii) A student will be promoted from 4^{th} Semester to 5^{th} Semester, if he/she fulfills the academic requirements of 40% of the credits up to 4^{th} Semester from all the examinations (Regular and supplementary) whether or not the candidate takes the examinations.

(iv) A student will be promoted from 6^{th} to 7^{th} Semester, only if he/she fulfills the academic requirements of 40% of the credits up to 6^{th} Semester from, all the examinations (regular and supply) whether or not the candidate takes the examinations.

(v) There will be supplementary examinations along with the regular semester examinations enabling the students to give a fair chance to appear in the subject if any failed.

TABLE-8 PROMOTION IN TO NEXT HIGHER CLASS

Promotion From	Promotion to	Promotion Criteria
1^{ST} Semester	2^{nd} Semester	Minimum Attendance requirement
2^{nd} Semester	3^{rd} Semester	
3^{rd} Semester	4^{th} Semester	
4^{th} Semester	5^{th} Semester	Minimum Attendance requirement & 40% of credits up to 4^{th} semester for all exams
5^{th} Semester	6^{th} Semester	Minimum Attendance requirement
6^{th} Semester	7^{th} Semester	Minimum Attendance requirement & 40% of credits up to 6^{th} semester for all exams
7^{th} Semester	8^{th} Semester	Minimum Attendance requirement

11. GAP YEAR CONCEPT

Students who wish to pursue entrepreneurship full time can take break of one year study, after the 4th Semester with the due recommendations of the GAP committee and approved by the principal. This may be extended to two years at the most and these two years would not be counted for the time for the maximum time for graduation

12. ELIGIBILITY FOR AWARD OF DEGREE:

A student shall be eligible for award of the B.Tech. Degree if he/she fulfills all the following conditions:

(i) Pursue the programme of study for a stipulated period of four years and not more than eight years.

(ii) Register for 160 credits and secure the same.

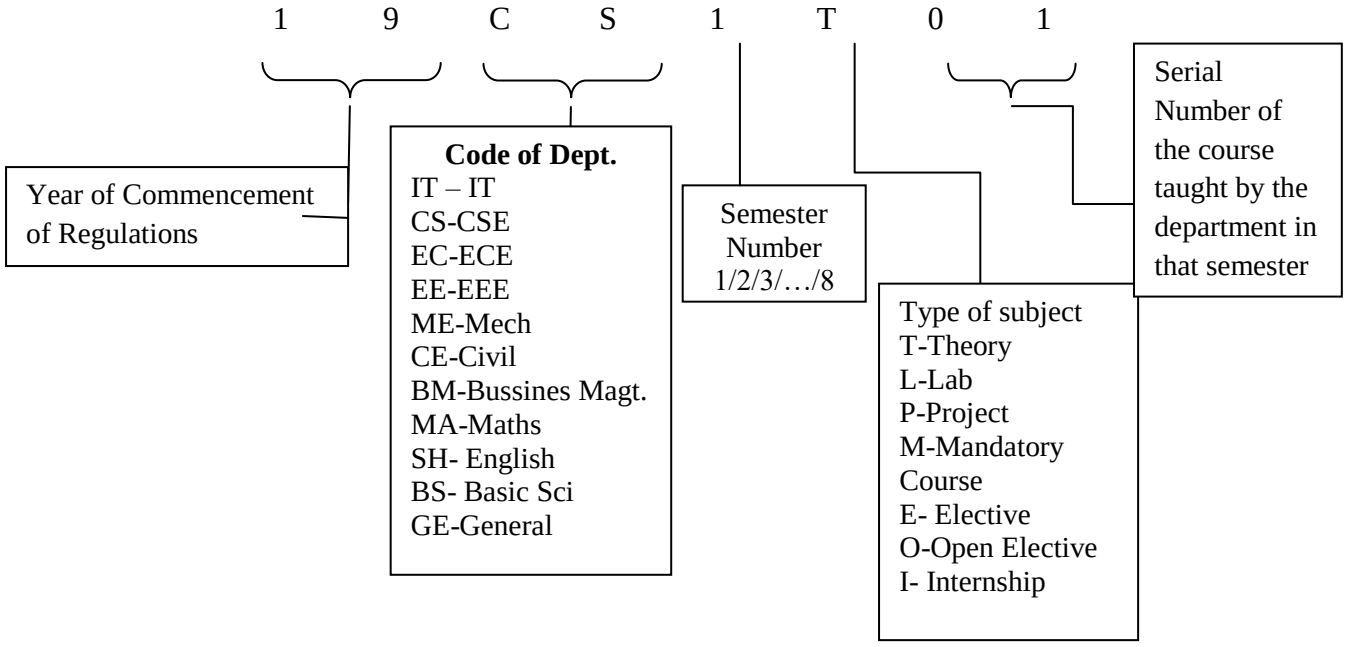
(iii) Registered and successfully completed all the components prescribed in the programme of study in which he/she is admitted.

(iv) All mandatory courses must be completed with satisfactory.

(v) Obtained CGPA greater than or equal to 4.75 (minimum requirements for pass).

13. COURSE CODE & COURSE NUMBERING SCHEME:

The subject codes will be given by the department teaching the subject. Each subject code contains 8 characters. The 8 characters for each subject will be filled as per the following guidelines.



14. GRADING SYSTEM:

14.1 Award of Grade:

(i) Grade Point Average (GPA):

a) The Grade Point Average (GPA) will be calculated according to the formula

$$GPA = \frac{\sum C_i G_i}{\sum C_i}$$

Where C_i = number of credits for the subject i

G_i = grade points obtained by the student in the subject.

b) To arrive at Cumulative Grade Point Average (CGPA), the formula is used considering the student's performance in all the courses taken in all the semesters completed up to the particular point of time.

$$CGPA = \frac{\sum C_i G_i}{\sum C_i}$$

Where C_i = number of credits for the subject i

G_i = grade points obtained by the student in the subject.

c) Equivalent percentage = (CGPA-0.75) x 10

(ii) After a student satisfy the requirements prescribed for the award of UG/PG Programme he/she shall be placed in one of the following four grades. The award of the degree is based on CGPA on a grade point scale of 10 and given in Table 9.

Table -9

CGPA	Award of Division
≥7.75*	First Class with Distinction
≥6.75	First Class
≥5.75	Second Class
≥4.75	Pass Class
<4.75	Unsatisfactory

* In addition to the required CGPA of 7.75, the student must have necessarily passed all the courses of every semester in the minimum stipulated period for the programme.

14.2 Award of Grade in Each Semester:

(i) Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester for each subject. The letter grades and the corresponding grade points are as given in the Table 10.

Table -10

Percentage of Marks Scored	Letter Grade	Level	Grade points
>=90	O	Outstanding	10
80 - 89	S	Excellent	9
70-79	A	Very Good	8
60-69	B	Good	7
50-59	C	Fair	6
40-49	D	Satisfactory	5
<40	F	Fail	0
		Absent	0

(ii) A student earns a minimum of 5 grade points (D grade) in a subject is declared to have successfully completed the subject, and is deemed to have earned the credits assigned to that subject. However, it should be noted that a pass in any subject/term paper/seminar/project/mini project shall be governed by the rules mentioned in **S.No. 8**.

(iii) Grade Sheet: A grade sheet (memorandum) will be issued to each student indicating his/her performance in all courses taken in that semester and also indicating the grades.

(iv) Transcripts: After successful completion of the programme of study, a Transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued up to any point of study to the student on request and by paying stipulated fee in force.

(v) Candidates shall be permitted to apply for revaluation within the stipulated period with payment of prescribed fee.

(vi) The Academic Council has to approve and recommend to the JNTUK, Kakinada for the award of a degree to any student.

14. SUPPLEMENTARY EXAMINATIONS:

In addition to the Regular Final Examinations held at the end of each semester, a Supplementary Examination will be conducted. A student can appear for any number courses of supplementary examinations till he/she clears the courses. However the maximum stipulated period of programme cannot be relaxed under any circumstance.

15. ADVANCED SUPPLEMENTARY EXAMINATIONS:

Candidate who fails the courses in 7^{th} and 8^{th} Semester can appear for Advanced Supplementary Examinations.

16. ACADEMIC REGULATIONS FOR B.TECH (LATERAL ENTRY SCHEME):

i. The students have to acquire 120 credits from 3^{rd} Semester to 8^{th} Semester of B. Tech Programmefor the award of the degree.
ii. All mandatory courses must be completed with satisfactory for award of degree.
iii. Obtained CGPA greater than or equal to 4.75 (minimum requirements for pass).
iv. The same attendance regulations are to be adopted as per the rules mentioned in item No.10.
v. **Rules for Promotion from 6^{th} Semester to 7^{th} Semester**: A student shall be promoted from 6^{th} Semester to 7^{th} Semester only if he/she fulfills the academic requirements of 40% credits up to 6^{th} Semester.
vi. Students, who fail to fulfill the requirement for the award of the degree in six consecutive academic years from the year of admission, shall forfeit their seat.

17. CONDUCT AND DISCIPLINE:

Students admitted in SCET are to be followed the conduct and discipline of the college and which will be updated from time to time.

18. MALPRACTICES:

If any malpractices held in internal assessment tests or Semester-End Examinations, Principal constitute a Malpractice Enquiry Committee to enquire the case. The principal shall take necessary action based on the recommendations of the committee as per stipulated norms.

19. WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the institution or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

20. ACADEMIC FLEXIBILITY:

Students can study two elective courses of 8^{th} Semester in advance, one in 6^{th} and the other in 7^{th} semester, those who cleared all the courses with CGPA 8.50 up to 5^{th} semester. If a student fails in any course of the 6^{th}/ 7^{th}semester, the flexibility will be cancelled. 8^{th} Semester elective courses can study in advance from the MOOC/NPTEL/SWAYAM/etc., courses.

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 Principal is final and which is to be ratified by the Chairman of the Governing Body.
d) The college 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 college.

SEMESTER-I

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	19MA1T01	Calculus and Linear Algebra	3	1	-	4.0	30	70	100
2	19BS1T01	Engineering Physics	3	-	-	3.0	30	70	100
3	19EE1T01	Basic Electrical Engineering	3	-	-	3.0	30	70	100
4	19ME1T01	Engineering Graphics	2	-	2	3.0	30	70	100
5	19CS1L02	IT Workshop	-	-	3	1.5	30	70	100
6	19BS1L01	Engineering Physics Lab	-	-	3	1.5	30	70	100
7	19EE1L01	Basic Electrical Engineering Lab	-	-	3	1.5	30	70	100
8	19HS1L01	English Proficiency Lab	-	-	3	1.5	30	70	100
Total			**11**	**1**	**14**	**19**	**240**	**560**	**800**

SEMESTER-II

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	19MA2T02	Differential Equations and Vector Calculus	3	-	-	3.0	30	70	100
2	19BS2T02	Engineering Chemistry	3	-	-	3.0	30	70	100
3	19CS2T01	Problem Solving and Programming Using C	3	-	-	3.0	30	70	100
4	19HS2T01	English	3	-	-	3.0	30	70	100
5	19ME2T03	Computer Aided Engineering Drawing	2	-	2	3.0	30	70	100
6	19ME2L01	Engineering Workshop	-	-	3	1.5	30	70	100
7	19BS2L02	Engineering Chemistry Lab	-	-	3	1.5	30	70	100
8	19CS2L01	C Programming Lab	-	-	3	1.5	30	70	100
9	19HS2L02	English Communication Skills Lab	-	-	3	1.5	30	70	100
		Total	**14**	**-**	**14**	**21**	**270**	**630**	**900**

L-LECTURE HOURS, **T**- TUTORIAL HOURS, **P**-PRACTICAL HOURS, **C**-CREDITS.
IM-INTERNAL MARKS, **EM**- EXTERNAL MARKS, **TM**- TOTAL MARKS

SEMESTER-III

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	19BM3T01	Managerial Economics and Financial Analysis	3	-	-	3.0	30	70	100
2	19CS3T04	Internet of Things	3	-	-	3.0	30	70	100
3	19ME3T01	Engineering Mechanics	3	1	-	4.0	30	70	100
4	19MA3T05	Probability and Statistics	3	-	-	3.0	30	70	100
5	19ME3T02	Fluid Mechanics and Hydraulic Machinery	3	-	-	3.0	30	70	100
6	19ME3T03	Production Technology	3	-	-	3.0	30	70	100
7	19ME3L01	Fluid Mechanics and Hydraulic Machinery Lab	-	-	3	1.5	30	70	100
8	19ME3L02	Production Technology Lab	-	-	3	1.5	30	70	100
9	19CS3L04	Internet of Things Lab	-	-	2	1.0	30	70	100
10	19BM0M04	Essence of Indian Traditional Knowledge	2	-	-	-	-	-	-
		Total	**20**	**1**	**8**	**23**	**270**	**630**	**900**

SEMESTER-IV

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	19ME4T01	Thermodynamics	3	1	-	4.0	30	70	100
2	19ME4T02	Theory of Machines	3	1	-	4.0	30	70	100
3	19ME4T03	Strength of Materials	3	1	-	4.0	30	70	100
4	19ME4T04	Metallurgy and Material Science	3	-	-	3.0	30	70	100
5	19CS4T06	Python Programming	2	-	-	2.0	30	70	100
6	19ME4L01	Theory of Machines Lab	-	-	3	1.5	30	70	100
7	19ME4L02	Strength of Materials and Metallurgy Lab	-	-	3	1.5	30	70	100
8	19CS4L04	Python Programming Lab	-	-	2	1.0	30	70	100
9	19BM0M03	Indian Constitution	2	-	-	-	-	-	-
		Total	**16**	**3**	**8**	**21**	**240**	**560**	**800**

L-LECTURE HOURS, **T**- TUTORIAL HOURS, **P**-PRACTICAL HOURS, **C**-CREDITS.
IM-INTERNAL MARKS, **EM**- EXTERNAL MARKS, **TM**- TOTAL MARKS

SEMESTER – V

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	19ME5T01	Design of Machine Elements	3	-	-	3.0	30	70	100
2	19ME5T02	Machine tools	3	-	-	3.0	30	70	100
3	19ME5T03	Thermal Engineering	3	-	-	3.0	30	70	100
4	19ME5T04	Machine Drawing	1	-	2	2.0	30	70	100
5		**Elective -I**	3	-	-	3.0	30	70	100
6		**Open Elective-I**	3	-	-	3.0	30	70	100
7	19ME5L01	Machine Tools Lab	-	-	3	1.5	30	70	100
8	19ME5L02	Thermal Engineering Lab	-	-	3	1.5	30	70	100
9	19CE0M01	Environmental Science	2	-	-	-	-	-	-
		Total	**18**	**-**	**8**	**20**	**240**	**560**	**800**

SEMESTER – VI

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	19ME6T01	Design of Mechanical Transmission Systems	3	-	-	3.0	30	70	100
2	19ME6T02	Heat Transfer	3	-	-	3.0	30	70	100
3	19ME6T03	Metrology and Instrumentation	3	-	-	3.0	30	70	100
4		**Elective-II**	3	-	-	3.0	30	70	100
5		**Elective -III**	3	-	-	3.0	30	70	100
6		**Open Elective-II**	3	-	-	3.0	30	70	100
7	19ME6L01	Heat Transfer Lab	-	-	3	1.5	30	70	100
8	19ME6L02	Metrology and Instrumentation Lab	-	-	3	1.5	30	70	100
9	19HS6L03	Advanced English Communication Skills Lab	-	-	2	1.0	30	70	100
10	19BM0M01	Professional Ethics and Intellectual Property Rights	2	-	-	-	-	-	-
		Total	**20**	**0**	**8**	**22**	**270**	**630**	**900**

L-LECTURE HOURS, **T**- TUTORIAL HOURS, **P**-PRACTICAL HOURS, **C**-CREDITS.
IM-INTERNAL MARKS, **EM**- EXTERNAL MARKS, **TM**- TOTAL MARKS

SEMESTER – VII

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	19ME7T01	3D Printing and Design	3	-	-	3	30	70	100
2		**Elective-IV**	3	-	-	3	30	70	100
3		**Open elective-III**	3	-	-	3	30	70	100
4		**Open elective-IV**	3	-	-	3	30	70	100
5	19ME7L01	Automation and Robotics Lab	-	-	3	1.5	30	70	100
6	19ME7L02	CAD Lab	-	-	3	1.5	30	70	100
7	19ME7P01	Mini Project	-	-	6	3.0	30	70	100
8	19ME7I01	Internship	-	-	2	1.0	50	-	50
		Total	**12**	**-**	**14**	**19**	**260**	**490**	**750**

SEMESTER – VIII

S.No	Course Code	Course Title	L	T	P	C	IM	EM	TM
1		**Elective-V**	3	-	-	3	30	70	100
2		**Elective-VI**	3	-	-	3	30	70	100
3	19ME8P01	Major Project	-	-	18	9	60	140	200
		Total	**6**	**-**	**18**	**15**	**120**	**280**	**400**

L-LECTURE HOURS, **T**- TUTORIAL HOURS, **P**-PRACTICAL HOURS, **C**-CREDITS.
IM-INTERNAL MARKS, **EM**- EXTERNAL MARKS, **TM**- TOTAL MARKS

ELCTIVE-I (SEM-5)									
S.NO	**COURSE CODE**	**COURSE NAME**	**L**	**T**	**P**	**C**	**IM**	**EM**	**TM**
1	**19ME5E01**	Finite Element Analysis	3	-	-	3	30	70	100
2	**19ME5E02**	Hydrogen and Fuel Cells	3	-	-	3	30	70	100
3	**19ME5E03**	Tool Design	3	-	-	3	30	70	100
4	**19ME5E04**	Production Planning and Control	3	-	-	3	30	70	100
5	**19CS5E19**	Operating Systems Concepts	3	-	-	3	30	70	100
ELCTIVE-II (SEM-6)									
6	**19ME6E05**	Mechanical Vibrations	3	-	-	3	30	70	100
7	**19ME6E06**	Automobile Engineering	3	-	-	3	30	70	100
8	**19ME6E07**	Un Conventional Machining Processes	3	-	-	3	30	70	100
9	**19ME6E08**	Industrial Engineering Management	3	-	-	3	30	70	100
10	**19CS6E22**	Interactive Computer Graphics	3	-	-	3	30	70	100
ELCTIVE-III (SEM-6)									
11	**19ME6E09**	Vehicle Dynamics and Control	3	-	-	3	30	70	100
12	**19ME6E10**	Steam and Gas Power Systems	3	-	-	3	30	70	100
13	**19ME6E11**	Automation in Manufacturing	3	-	-	3	30	70	100
14	**19ME6E12**	Total Quality Management	3	-	-	3	30	70	100
15	**19CS6E23**	Object Oriented Programming Through Java	3	-	-	3	30	70	100
ELCTIVE-IV (SEM-7)									
16	**19ME7E13**	Industrial Robotics	3	-	-	3	30	70	100
17	**19ME7E14**	Refrigeration and Air Conditioning	3	-	-	3	30	70	100
18	**19ME7E15**	Lean Manufacturing	3	-	-	3	30	70	100
19	**19ME7E16**	Supply Chain Management	3	-	-	3	30	70	100
20	**19CS7E26**	Principles of Software Engineering	3	-	-	3	30	70	100

ELCTIVE-V (SEM-8)									
21	**19ME8E17**	Designing for the Human Body	3	-	-	3	30	70	100
22	**19ME8E18**	Power plant Engineering	3	-	-	3	30	70	100
23	**19ME8E19**	MEMS	3	-	-	3	30	70	100
24	**19ME8E20**	Optimization Techniques	3	-	-	3	30	70	100
25	**19CS8E28**	Artificial Intelligence	3	-	-	3	30	70	100
ELCTIVE-VI (SEM-8)									
26	**19ME8E21**	Advanced Mechanics of Solids	3	-	-	3	30	70	100
27	**19ME8E22**	Computational Fluid Dynamics	3	-	-	3	30	70	100
28	**19ME8E23**	Flexible Manufacturing Systems	3	-	-	3	30	70	100
29	**19ME8E24**	Statistical Quality Control	3	-	-	3	30	70	100
30	**19CS8E29**	Virtual Reality	3	-	-	3	30	70	100

LIST OF OPEN ELECTIVES

S. No.	COURSE CODE	COURSE TITLE	L	T	P	C	IM	EM	TM
1	19EEXO01	Electrical Safety Management	3	-	-	3	30	70	100
2	19EEXO02	Non-conventional Energy sources	3	-	-	3	30	70	100
3	19EEXO03	Electrical Vehicle	3	-	-	3	30	70	100
4	19EEXO04	Electrical Energy Conservation and Auditing	3	-	-	3	30	70	100
5	19CEXO01	Disaster Management	3	-	-	3	30	70	100
6	19CEXO02	Environmental Pollution and Control	3	-	-	3	30	70	100
7	19CEXO03	Solid Waste Management	3	-	-	3	30	70	100
8	19CEXO04	Building Planning and Drawing	3	-	-	3	30	70	100
9	19MEXO01	3D Printing	3	-	-	3	30	70	100
10	19MEXO02	Farm Machinery	3	-	-	3	30	70	100
11	19MEXO03	Bio-Mechanical Engineering	3	-	-	3	30	70	100
12	19MEXO04	Waste to Energy Conversion	3	-	-	3	30	70	100
13	19CSXO01	Internet of Things and Applications	3	-	-	3	30	70	100
14	19CSXO02	Foundation to Data Analytics	3	-	-	3	30	70	100
15	19CSXO03	Data Engineering	3	-	-	3	30	70	100
16	19CSXO04	Machine Learning	3	-	-	3	30	70	100
17	19ECXO01	Nanotechnology and Applications	3	-	-	3	30	70	100
18	19ECXO02	Global Positioning and Navigation Satellite Systems	3	-	-	3	30	70	100
19	19ECXO03	Remote Sensing	3	-	-	3	30	70	100
20	19ECXO04	Mobile Communication and Applications	3	-	-	3	30	70	100
21	19ITXO01	Software Engineering Principles	3	-	-	3	30	70	100
22	19ITXO02	Cloud Computing Principles	3	-	-	3	30	70	100
23	19ITXO03	E-Commerce	3	-	-	3	30	70	100
24	19ITXO04	Web Technology Principles	3	-	-	3	30	70	100
25	19BMXO01	Innovations and Entrepreneurship	3	-	-	3	30	70	100
26	19BMXO02	Industrial Sociology and Psychology	3	-	-	3	30	70	100
27	19BMXO03	Digital Marketing	3	-	-	3	30	70	100
28	19BMXO04	Business Environment	3	-	-	3	30	70	100
29	19MAXO01	Operations Research	3	-	-	3	30	70	100
30	19MAXO02	Optimization Models	3	-	-	3	30	70	100
31	19BSXO01	Quantum Computing	3	-	-	3	30	70	100
32	19BSXO02	Optoelectronics	3	-	-	3	30	70	100

I SEMESTER	L	T	P	C
	3	1	-	4
19MA1T01 - CALCULUS AND LINEAR ALGEBRA				

Course Objectives:

- This course will illuminate the students in the concepts of calculus and linear algebra.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various realworld problems and their applications.

Bridge Course: Limits, continuity, Types of matrices

CO No	Co Statement	Knowledge Level
1	Develop the use of matrix algebra techniques that is needed by engineers for practical applications	K3
2	Apply the functions of several variables which is useful in optimization	K3
3	Acquire important tools of calculus in higher dimensions and will become familiar with double integral	K3
4	Solve the multiple integrals and are apply for special functions.	K4

Unit I: Matrix Operations and Solving Systems of Linear Equations

Rank of a matrix by echelon form, Normal form - solving system of homogeneous and non- homogeneous linear equations- Gauss Elimination, Jacobi and Gauss Seidel methods - Eigen values and Eigen vectors and their properties (without proof).

Learning Outcomes:

At the end of this unit, the student will be able to
solve systems of linear equations, determine the rank, Eigen values and eigenvectors(K2).

Unit II: Cayley-Hamilton theorem and Quadratic forms

Cayley-Hamilton theorem (without proof), Finding inverse and power of a matrix by Cayley-Hamilton theorem - Reduction to diagonal form - Quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical form by orthogonal transformation.

Learning Outcomes:

At the end of this unit, the student will be able to

- reduce to diagonal form and identify special properties of a matrix, such as positive definite, etc.,and use this information to facilitate the calculation of matrix characteristics; (K3)

Unit III: Multivariable calculus

Expansions of functions: Taylor's and Maclaurin's series - Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Learning Outcomes:

At the end of this unit, the student will be able to

- Expand the given function as series of Taylor's and Maclaurin's (K3)
- Find partial derivatives numerically and symbolically and use them to analyze and interpret theway a function varies. (K3)
- Acquire the Knowledge in maxima and minima of functions of several variables (K1)
- Utilize Jacobian of a coordinate transformation to deal with the problems in change of variables(K3)

Unit IV: Multiple Integrals

Double Integrals: change of order of integration, double integrals in polar coordinates, areas enclosedby plane curves.

Triple Integral: Evaluation of triple integrals, change of variables

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate double integrals of functions of several variables in two dimensions using Cartesian andpolar coordinates (K3)
- apply double integration techniques in evaluating areas bounded by a region (K4)

Unit V: Special Functions

Beta and Gamma functions and their properties, relation between beta and gamma functions.

Learning Outcomes:

At the end of this unit, the student will be able to

- Conclude the use of special functions in multiple integrals (K3)

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42/e, 2012.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 9/e, 2013.
2. B.V. RAMANA, Higher Engineering Mathematics, Tata McGraw Hill, 2007.

Course Outcomes:

At the end of the course, the student will be able to

1. develop the use of matrix algebra techniques that is needed by engineers for practicalapplications (K3)
2. familiarize with functions of several variables which is useful in optimization (K3)
3. learn important tools of calculus in higher dimensions. Students will become familiar withdouble integral(K3)
4. familiarize with triple integral and also learn the utilization of special functions

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	2	2	-	-	-	-	2	-	-	2	3	2
3	3	2	2	-	-	-	-	2	-	-	2	3	2
3	3	2	2	-	-	-	-	2	-	-	2	3	2
3	3	2	2	-	-	-	-	2	-	-	2	3	2
3	**3**	**2**	**2**					**2**			**2**	**3**	**2**

I SEMESTER	L	T	P	C
	3	-	-	3
19BS1T01 – ENGINEERING PHYSICS				

COURSE OUTCOMES

CO No	Co Statement	Knowledge Level
1	Acquire the knowledge of basic crystal systems and determination of crystal structures.	K2
2	Summarize the Magnetic and Dielectric Materials properties	K2
3	Illustrate the concept of Magnetic Induction and Super Conducting properties.	K2
4	Interpret Pure & Doped Semiconductor materials for better utility	K2
5	Acquire the knowledge on Optical fibers and Optical properties of materials and their applications	K2

UNIT –I: CRYSTAL STRUCTURE AND X-RAY

DIFFRACTIONCRYSTAL STRUCTURE:

Introduction – Space lattice – Basis – Unit Cell – Lattice parameters – Bravais lattices – Crystal systems
– Structures and packing fractions of SC, BCC and FCC.

X-RAY DIFFRACTION:
Directions in crystals- planes in crystals- Miller indices and procedure to find Miller indices- Various planes in crystals- Separation between successive (h k l) planes-Bragg's law-Bragg's Spectrometer.

Learning Outcomes: At the end of this unit, the students will be able to

- **Explain** the seven crystal systems
- **Interpret** the crystal structure based on Bragg's law

UNIT – II: MAGNETIC AND DIELECTRIC PROPERTIES

MAGNETIC PROPERTIES: Introduction-Magnetic permeability – Magnetization – Relation between three magnetic vectors - Origin of magnetic moment – Classification of Magnetic materials- Dia, Para, Ferro, Anti-Ferro and Ferri-magnetism – Hysteresis- soft and Hard Magnetic materials.

DIELECTRIC PROPERTIES: Introduction-Dielectric constant- Relation between three electric vectors-Electronic and ionic polarizations (Quantitative) - orientation polarizations (Qualitative) - Internal fields in solids- Clausius - Mossotti equation.

Learning Outcomes: At the end of this unit, the students will be able to

- **Classify** the magnetic materials into dia, para, ferro, anti ferro and ferri
- **Explain** the importance of hysteresis
- **Explain** the concept of polarization in dielectric materials.
- **Summarize** various types of polarization of dielectrics .
- **Interpret** Lorentz field and Claussius- Mosotti relation in dielectrics.

UNIT-III: ELECTROMAGNETIC WAVES AND SUPERCONDUCTIVITY

ELECTROMAGNETIC WAVES: Introduction-Electric flux –magnetic flux- Gauss law in electrostatics- Gauss law in magnetostatics- Ampere's law - Biot-Savart's law-Magnetic Induction due to current carrying circular loop- Faraday's law - Maxwell's equations.

SUPERCONDUCTIVITY: General and Thermal properties –Meissner effect – Type-I and Type-II superconductors – Flux quantization – BCS Theory of Superconductivity - Josephson effects – Applications of Superconductors.

Learning Outcomes: At the end of this unit, the students will be able to

- **Illustrate** the concept of electro magnetism based on fundamental laws of electro magnetism
- **Explain** Maxwell's equations
- **Summarize** various properties and applications of superconductors

UNIT-IV: PHYSICS OF SEMICONDUCTORS:

Classification of solids based on band theory - Intrinsic semiconductors- density of charge carriers- Equation for conductivity – Extrinsic semiconductors- P-type and N-type- density of charge carriers- Drift and diffusion – Einstein's equation – Hall Effect- Hall coefficient – Applications of Hall effect– direct & indirect band gap semiconductors.

Learning Outcomes: At the end of this unit, the students will be able to

- **Summarize** various types of solids based on band theory.
- **Outline** the properties of n-type and p-type semiconductors.
- **Identify** the type of semiconductor using Hall effect

UNIT-V: LASERS AND OPTICAL FIBERS

LASERS: Introduction– Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion - Three level and four level laser pumping schemes - Rubylaser – Helium-Neon laser- Applications of Laser.

FIBER OPTICS: Introduction to Optical fibers- Critical angle of propagation- Total internal reflection- Acceptance angle and acceptance cone- Numerical aperture- Classification of optical fibers based on refractive index profile-Classification of optical fibers based on modes- Applications of optical fibers.

Learning Outcomes: At the end of this unit, the students will be able to

- **Design** various types of lasers
- **Explain** the principle and propagation of light through Optical fibers
- **Discuss** the application of lasers and Optical fibers

TEXT BOOK:

M. N. Avadhanulu, P.G. Kshirasagar & TVS Arun Murthy , A text book of "EngineeringPhysics", S Chand publications, 11th Edition 2019.

REFERENCE BOOKS:

1. Shatendra Sharma and Jyotsna Sharma , Engineering Physics, Pearson Education, 2018.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	**-**	**-**	**-**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**1**	**-**	**-**
3	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**
3	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**
2	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**
2	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**
2.6				3			1.2				1		

I SEMESTER	L	T	P	C
	3	-	-	3
19EE1T01 – BASIC ELECTRICAL ENGINEERING				

COURSE OUTCOMES: after successful completion of this course, students should be able to:

CO No	Co Statement	Knowledge Level
1	Analyze different electrical networks using KVL, KCL and Theorems.	K4
2	Acquire the basic concepts of single-phase system for simple AC circuit..	K2
3	Compare the construction, working and operating characteristics of AC & DC machines.	K2
4	Interpret the construction details, operation and characteristics of various semiconductor devices, digital and logic operations.	K3

SYLLABUS

UNIT-I : DC CIRCUIT ANALYSIS

Electrical Circuit Elements (R, L and C), Voltage and Current Sources, Ohms Laws, Kirchoff's Laws and Star/Delta Conversion, Network Reduction Techniques-Series-Parallel- Series and Parallel (Only Resistor), Problems in Simple Circuits with DC Excitation, Superposition, Thevenin's and Norton's Theorems.

UNIT-II : AC CIRCUIT ANALYSIS

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 and RLC Combinations (Series and Parallel), Resonance, Three Phase Circuits- Voltage and Current Relations in Star and Delta Connections.

UNIT-III : DC MACHINES & TRANFORMERS

DC MACHINES: Introduction-Construction Details - Principle of Operation - EMF Equation – Classification Based on Excitation - Torque Equation- Characteristics-OCC of Generator-Load Characteristics of DC Shunt Motor, Type of Starters – Speed Control Methods of DC Motors – Swinburne's Test - Applications -Simple Problems.

TRANFORMERS: Introduction-Constructional Details - Principle of Operation - EMF Equation – OC and SC Test – Equivalent Circuit, Load Test-Voltage Regulation, Losses and Efficiency, Auto Transformer and Three Phase Transformer Connections.

UNIT-IV : AC MACHINES

INDUCTION MOTOR: Introduction-Construction Details - Principle Operation of a Three Phase Induction Motor - Generation of Rotating Magnetic Fields, Torque-Slip Characteristic. Losses and Efficiency, Speed Control of Induction Motor

ALTERNATOR: Introduction-Construction Details - Principle of Operation - Winding Factors-E.M. F Equation - Determination of Voltage Regulation by E.M.F and M.M.F Methods.

SINGLE PHASE INDUCTION MOTOR: Introduction-Construction Details - Theory of Operation - Methods of Starting.

UNIT-V : ELECTRICAL INSTALLATIONS

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Type of Batteries, Important Characteristics for Batteries. Elementary Calculations for Energy Consumption, Power Factor Improvement and Battery Backup.

TEXT BOOKS:

1. D.P. Kothari and I.J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 3rd edition,2010.
2. P. V. Prasad, S. Sivanagaraju, K. R. Varmah, and Chikku Abraham, Basic ElectricalEngineering, Cengage, 2019.

REFERENCE BOOKS:

1. D.C. Kulshreshtha, Basic Electrical Engineering, Tata McGraw Hill, 2009.
2. L.S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011
3. E. Hughes, Electrical and Electronics Technology, Pearson, 10th Edition, 2010.
4. Vincent Deltoro, Electrical Engineering Fundamentals, Prentice Hall India,Second Edition, 1989.
5. V K Mehta & Rohit Mehta, Principles of Electrical Engineering and Electronics", S ChandPublishers, 2019 edition.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	3	1	2	-	-	-	-	-	2	2	-	-
3	3	3	1	2	-	-	-	-	-	2	2	-	-
2	2	2	0	1	-	-	-	-	-	1	1	-	-
2	1	1	1	2	-	-	-	-	-	1	2	-	-
2.5	2.25	2.25	0.75	1.75	-	-	-	-	-	1.5	1.75	-	-

I SEMESTER	L	T	P	C
	2	-	2	3
19ME1T01 - ENGINEERING GRAPHICS				

COURSE OBJECTIVE

Engineering drawing is the principle method of communication for engineers; the objective is to introduce the students, the techniques of constructing the various types of polygons, curves. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

COURSE OUTCOMES: Students are able to

CO No	Co Statement	Knowledge Level
1	Construct polygons, conics, cycloids, involutes.	K3
2	Draw the orthographic projections of points, lines in different positions.	K2
3	Draw the orthographic projections of plane surfaces in different positions	K3
4	Draw the orthographic projections of solids like prisms, cylinder, pyramids and cone.	K2
5	Convert Isometric views to orthographic views and vice-versa and also visualize 2D & 3D objects using Auto CAD	K3

UNIT I

Polygons: Constructing regular polygons by general methods, describing polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by Eccentricity method, Cycloid, Epi-cycloid and Hypo-cycloid and Involutes.

UNIT II

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane. Projections of straight lines inclined to both the planes, determination of true lengths, and angle of inclination.

UNIT III

Projections of Planes: regular planes perpendicular and parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT IV

Projections of Solids: Prisms, Pyramids, Cone and Cylinder, Simple positions of solids and Axis of the Solid parallel to one plane and inclined to other plane.

UNIT V

Isometric Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

CAD: Fundamentals of AutoCAD - For Polygons, Creating 2d And 3d Drawings.

Using Auto CAD: Computer Aided Design, Drawing practice using Auto CAD simple figures like polygons, creating 2D&3D drawings of objects using Auto CAD.

Note: In the End Examination there will be no question from CAD.

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications 2016
2. Engineering Drawing + AutoCAD by K. Venugopal, V. Prabhu Raja, New Age 2010

REFERENCE BOOKS:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers 2016
2. Engineering Graphics for Degree by K.C. John, PHI Publishers 2009
3. Engineering Graphics by PI Varghese, McGrawHill Publishers 2013

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	-	3	-	-	1	-	-	2	-	-	2	3	-
3	-	3	-	1	1	-	-	2	-	-	2	3	-
2	-	3	-	2	1	-	-	2	-	-	2	3	-
3	-	2	-	3	1	-	-	2	-	-	3	3	-
1	-	2	-	2	1	-	-		-	-	3	2	-
2.4		2.6		2	1			2			2.4	2.8	

I SEMESTER	L	T	P	C
	-	-	3	1.5
19CS1L02 - IT WORKSHOP				

Course Objectives:

1. Understand the components of personal computer system.
2. To Demonstrate the Use of Office Took
3. To know purpose of internet and how to use it.
4. To Introduce Programming Through Visual Programming Tool — Scratch.

Course Outcome: On completion of the course students will be able to

CO No	Co Statement	Knowledge Level
1	Identify the components of a personal computer system and know how it works	K1
2	Demonstrate how to organize files and documents	K2
3	Demonstrate window and menu commands and how they are used	K2
4	Create, format and edit a word, excel documents and prepare PPTs.	K3
5	Send and receive email messages (with or without attachments) and navigate and search through the Internet	K3

LIST OF EXPERIMENTS:

Week l:

Inside a Computer Cabinet:

1. Demonstration of Hardware Components of a Computer.

Week 2:

Demonstration of Operating System:

2. Working with Different Operating Systems (Windows 7/10, Ubuntu).
3. Managing Files and Directories.

Week 3:

4. Working with Different MS-DOS and Unix command
5. Managing Files and Directories.

Week 4:

Text Editing (MS-Word)

6. Creating Bio-Data.
7. Sample Time Table creation.

Week 5:

Presentations (Ms-PowerPoint)

8. Simple presentation about your family and village.
9. Creating a Digital Story with Animations.

Week 6:

Spreadsheets (Ms-Excel)

10. Student Result data creation and Analysis.
11. Representation of student data using different charts.

Week 7:

Building Animations (Scratch)

12. Create an animation for the fall of Humpty Dumpty.

Week 8:

Using Internet

13. Communicating with e-mail.

Week 9:

Cloud based collaboration tools:

14. Event registrations, create quizzes, and analyze responses using Google Forms

Week 10:

15. Simple Static web page creation

Week 11:

16. Simple Static web page creation

References:

1. Anita Goal, Computer Fundamentals, Pearson Education, 1 e, 2010
2. https://scratch.mit.cdu/ideas
3. https://appinventormitedu/exploreki2/tutorials

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	-	-	2	-	-	2	-	-	-	-	-	-
3	3	-	-	2	-	-	2	-	-	-	-	-	-
3	2	-	-	2	-	-	2	-	-	-	-	-	-
3	2	-	-	3	-	-	3	-	-	-	-	-	-
3	2	-	-	3	-	-	3	-	-	-	-	-	-
3	2.4			2.4			2.4						

I SEMESTER	L	T	P	C
	-	-	3	1.5
19BS1L01 - ENGINEERING PHYSICS LAB				

STUDENT HAS TO DO ANY TEN OF THE FOLLOWING

CO No	Co Statement	Knowledge Level
1	Apply the basic knowledge to know the frequency of a vibrator, hall coefficient.	K3
2	Attain knowledge to verify some of the properties of physical optics	K4
3	Develop skills to plot various characteristic curves and to calculate the physical properties of given materials	K3
4	Estimate some the properties of semiconducting materials.	K3

1. Determination of wavelength of Laser using diffraction grating.
2. Determination of Numerical Aperture and Acceptance angle of an Optical Fiber.
3. Determination of the charge carrier density by using Hall Effect.
4. Determination of the Band Gap of a Semiconductor using a p-n junction diode.
5. Study of Characteristic curves (l/V) of a Zener diode to determine its Breakdown voltage.
6. Determination of Temperature coefficient of resistance of a Thermistor by using its Characteristiccurve.
7. Study the variation of intensity of magnetic field along the axis of a circular current carrying coil byusing Stewart and Gee's experiment.
8. Study of Characteristic curves (l/V) of a P-N diode.
9. Determine Frequency of given electrically driven tuning fork in Transverse and Longitudinalmodes by using Melde's apparatus
10. Determine frequency of A.C. supply by using Sonometer.
11. Determination of the Time Constant for a C-R Circuit
12. Determination of the Planck's constant by using Photo-Cell
13. Determination of dielectric constant of a given material

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	-	-	-	-	-	-	1	-	-	-	-	-	-
3	-	-	-	-	-	-	1	-	-	-	-	-	-
3	-	-	-	-	-	-	1	-	-	-	-	-	-
2	-	-	-	-	-	-	1	-	-	-	-	-	-
2.75							1						

I SEMESTER	L	T	P	C
	-	-	3	1.5
19EE1L01 - BASIC ELECTRICAL ENGINEERING LAB				

COURSE OUTCOMES: ***After successful completion of this course, students should be able to:***

CO No	Co Statement	Knowledge Level
1	Acquire knowledge on electrical networks by using KVL,KCL.	K2
2	Analyze the performance characteristics and to determine efficiency of DC machines	K4
3	Identify the characteristics of AC machines.	K3
4	Apply knowledge on PN junction diode , transistor and Rectifiers	K3

LIST OF EXPERIMENTS

1. Practice on Measuring Instruments – Voltmeter, Ammeter, Multimeter, Oscilloscope.
2. Verification of KCL and KVL.
3. Verification of Thevenin Theorem.
4. Verification Norton's Theorem.
5. Verification Superposition Theorem.
6. Resonance in R-L-C Circuits.
7. Three Phase Star and Delta Connections
8. Measurement of Three-Phase Power in Balanced Circuits.
9. Open Circuit Characteristics of DC Shunt Generator.
10. Load Characteristics of DC Shunt Generator.
11. Speed-Torque Characteristic of DC Motor.
12. Load Test on a Single Phase Transformer
13. Open Circuit and Short Circuit Test on a Single Phase Transformers.
14. Load Test on a Single-Phase Induction Motor.
15. Load Test on Three Phase Induction Motor.
16. Regulation of Alternator Using EMF Method.

Note: Any Ten Experiments will conduct from the above experimentsREFERENCE:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
2	3	3	1	2	-	-	-	-	-	2	2	-	-
2	3	3	1	2	-	-	-	-	-	1	2	-	-
2	2	1	0	1	-	-	-	-	-	1	1	-	-
2	2	1	1	1	-	-	-	-	-	1	1	-	-
2	2.5	2	0.75	1.5						1.25	1.5		

I SEMESTER	L	T	P	C
	-	-	3	1.5
19HS1L01 - ENGLISH PROFICIENCY LAB				

COURSE OBJECTIVES

- To improve the language proficiency of technical under graduates in English with emphasis onLSRW Skills.
- To provide learning environment to practice Listening, Speaking, Reading and Writing Skills withinand beyond the classroom environment.
- To assist students to carry on the tasks and activities through guided instructions and materials.
- To effectively integrate English language learning with employability skills and training.
- To design the main course material and exercises with authentic materials drawn from everyday useto cater to everyday needs.
- To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

COURSE OUTCOMES

CO No	Co Statement	Knowledge Level
1	Understand the sounds of words for correct pronunciation.	K2
2	Identify and learn accent of words for mastering language proficiency.	K2
3	Distinguish the word pronunciation relating to accent and accuracy of English language.	K4
4	Practice the words for ensuring the ability for correct pronunciation	K2
5	Understand the influence of mother tongue on target language.	K2

a) Reading Skills.
- Addressing explicit and implicit meaning of a text.
- Understanding the context.
- Learning new words and phrases.
- Using words and phrases in different contexts.

b) Writing Skills:
- Using the basic structure of a sentence.
- Applying relevant writing formats to create paragraphs, essays, letters, E-Mails, reports andpresentations.
- Retaining a logical flow while writing.
- Planning and executing an assignment creatively.

c) Interactive skills:
- Analyzing a topic of discussion and relating to it.
- Participating in discussions and influencing them.
- Communicating ideas effectively.
- Presenting ideas coherently within a stipulated time.

d) Life Skills and Core Skills:
- Examining self-attributes and identifying areas that require improvement self-diagnosis, self-motivation.
- Adopting to a given situation and developing a functional approach to find solutions-adaptability, problem-solving.

- Understanding the importance of helping others-community service, enthusiasm.

COURSE DESCRIPTION

Communicating in a language is also a skill. So a student has to look for an opportunity to practice English language in order to acquire proficiency in English. 'Enrich your interactive Skills: Part - A' is designed to provide opportunities for engineering students to revise and consolidate the basic skills in listening, speaking, reading and writing in addition to giving ample practice in various communicative functions and Life skills.

PRE REQUISITES

The student is expected to have basic knowledge in English language and must be able to write in English. He is also expected to possess fundamental knowledge of general English grammar and vocabulary.

Unit	TOPIC
1	Vowels, Consonants, Pronunciation, Phonetic transcripts
2	Word stress and syllables
3	Rhythm and Intonation
4	Contrastive Stress –Homographs
5	Word Stress : Weak and Strong forms , Stress in compound words

Text Book:

"Infotech" by Maruthi Publications (2019)

Reference Books:

1. J. D. O'Connor, Better English Pronunciation, Cambridge, 2 e, 1980
2. Peter Roach ,Phonetics and Phonology, Cambridge University Press, 2009

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
							2	2	3		1		

II SEMESTER	L	T	P	C
	3	-	-	3
19MA2T02 - DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS				

Course Objectives:

1. To enlighten the learners in the concept of differential equations and vector calculus.
2. To furnish the learners with basic concepts and techniques at plus two level to lead them intoadvanced level by handling various real world applications.

CO No	Co Statement	Knowledge Level
1	Solve the differential equations related to various engineering fields	K3
2	Identify solution methods of partial differential equations that model physical processes	K3
3	Evaluate the approximate roots of polynomial and transcendental equations by different algorithms	K3
4	Solve integrate and ordinary differential equations by various numerical techniques.	K3

Unit I: Ordinary Differential equations of first order and first degree:

Linear differential equations – Bernoulli's equations – Exact equations and equations reducible to exactform.
Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal trajectories

Learning Outcomes:

At the end of this unit, the student will be able to

- solve first order differential equations by appropriate method (K3)
- apply to geometrical and real world problems (K3)

Unit II: Linear differential equations of higher order:

Solutions of Non-homogeneous equations of higher order with constant coefficients – with non- homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, e^{ax} V(x) and x^nV(x) – Method ofVariation of parameters. Applications: LCR circuit

Learning Outcomes:

At the end of this unit, the student will be able to

- identify the essential characteristics of linear differential equations with constant coefficients(K3)
- solve the linear differential equations with constant coefficients by appropriate method (K3)

Unit –III: Partial Differential Equations of First Order:

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply a range of techniques to find solutions of standard PDEs (K3)
- outline the basic properties of standard PDEs (K2)

Unit IV: Vector differentiation

Scalar and vector point functions, vector operator del, del applied to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, physical interpretation of Gradient Div F and Curl F, Del applied twice to point functions Del applied to products of point functions.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply del to Scalar and vector point functions (K3)
- illustrate the physical interpretation of Gradient, Divergence and Curl (K3)

Unit V: Vector integration

Integration of Vectors Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof).

Learning Outcomes:

At the end of this unit, the student will be able to

- find the work done in moving a particle along the path over a force field (k3)
- evaluate the rate of fluid flow along and across curves (K3)
- apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals (K3)

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna publishers, 42/e, 2012.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 9/e, 2013.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,2008

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	3	2	-	-	-	-	2	-	-	2	2	2
3	3	3	2	-	-	-	-	2	-	-	2	2	2
3	3	3	2	-	-	-	-	2	-	-	2	2	2
3	3	3	2	-	-	-	-	2	-	-	2	2	2
3	3	3	2					2			2	2	2

II SEMESTER	L	T	P	C
	3	-	-	3
19BS2T02 - **ENGINEERING CHEMISTRY**				

COURSE OUTCOMES

At the end of semester, the students will be able to

CO No	Co Statement	Knowledge Level
1	Summarize the impurities present in raw water, problems associated and how to avoid them.	K2
2	List out the advantages of Polymers in daily life	K2
3	Illustrate the theory of construction of battery and fuel cells and theories of corrosion and prevention methods.	K2
4	Compare conventional and non-conventional energy sources and their advantages and disadvantages.	K2
5	Interpret the usage of advanced materials in day to day life	K2

UNIT I: WATER TECHNOLOGY

Hardness of water-types of hardness-disadvantages of hard water-determination of hardness by EDTA complexometric method. Portable water and its specifications-steps involved in purification of water-chlorination, break point of chlorination. Boiler troubles: Scale and sludge-priming and foaming-boiler corrosion-caustic embrittlement.

Industrial Water Treatment: Softening methods: zeolite process-ion exchange process. Brackish water treatment (desalination methods): Reverse osmosis - electro dialysis.

Learning Outcomes: At the end of this unit, the students will be able to explain

The impurities present in raw water, problems associated with them and how to avoid them

UNIT-II: POLYMERS AND COMPOSITE MATERIALS

Polymers-Introduction-Types of polymers-degree of polymerization-functionality-preparation propertiesand applications of individual polymers-Bakelite-PVC-Poly styrene.

Plastics: Types (thermosetting and thermoplastic)-compounding of plastics-moulding Process (Any Four) - recycling of e-waste.

Rubbers and elastomers: Introduction-natural rubber-vulcanization of rubber-synthetic rubbers-Buna-N, Buna-S.

Composite materials: Fiber reinforced plastics-biodegradable polymers-biomedical polymers-conducting polymers

Learning Outcomes: At the end of this unit, the students will be able to

- **Outline** the properties of polymers and various additives added and different methods of forming plastic materials.
- **Explain** the preparation, properties and applications of some plastic materials.
- **Discuss** natural and synthetic rubbers and their applications.

UNIT III: ELECTRO CHEMICAL CELLS AND CORROSION

Electrochemical Cells

Introduction-single electrode potential-electrochemical cell-electrochemical series and applications. Reference electrodes-standard hydrogen electrode and calomel electrode-construction of glass electrode.

Batteries: Construction, working and cell reaction of primary (dry cell) and Secondary (Pb acid, Ni-Cd,Zinc-Air and Li-ion) battery. Fuel cells (H_2-O_2, Methanol-Air cells).

Corrosion

Definition-theories of corrosion (Chemical and Electrochemical corrosion)-types of corrosion (Galvanic,Differential aeration (waterline and pitting corrosion), stress Corrosion). Factors influencing rate of corrosion-nature of metal-nature of corrosive atmosphere.

Corrosion Prevention methods: Cathodic protection-Sacrificial anodic method-Impressed voltage method. Metallic coatings: Galvanization-Tinning-Electro plating-Electro less plating.

Learning Outcomes: At the end of this unit, the students will be able to

- **Explain** the theory of construction of battery and fuel cells.
- **Categorize** the reasons for corrosion and study some methods of corrosion control.

UNIT IV: CONVENTIONAL AND NONCONVENTIONAL ENERGY RESOURCES

Conventional energy sources

Introduction to fuels-classification and characteristics of fuels-solid, Liquid and gaseous fuels advantages and disadvantages-calorific value-higher and lower calorific values-construction and working of bomb calorimeter-analysis of coal-proximate and ultimate analysis-numerical problemsrelated to bomb calorimeter, Dulong's formula and coal analysis-petroleum refining-cracking-petrol and diesel knocking-octane number and cetane number-gaseous fuels-Natural gas-CNG-LPG

Non-conventional energy sources

Solar energy: Advantages-disadvantages of solar cells-construction and working of photo voltaic cell- Introduction to hydro power-geo thermal power-tidal and wave power.

Learning Outcomes: At the end of this unit, the students will be able to

- **Differentiate** conventional and non conventional energy sources and their advantages anddisadvantages.
- **Explains** energy production by different natural sources

UNIT V: CHEMISTRY OF MATERIALS

Nano materials: Introduction-sol-gel method-characterization by BET, SEM and TEM methods-carbonnano tubes and fullerenes: Types, preparation and applications

Semiconductors: Preparation (Distillation, Zone refining, Czochralski crystal pulling epitaxy, diffusion, ion implantation)-semiconductor devices (P-N junction diode as rectifier, junction transistor)

Cement: Constituents of cement-setting and Hardening of cement, Decay of Cement.

Refractories: Definition of refractory-classification and properties of refractoriness-applications ofrefractories.

Learning Outcomes: At the end of this unit, the students will be able to

- **Outline** the awareness of materials like nanomaterials and fullerenes and their uses.
- **Explain** the techniques that detect and measure the surface properties of materials.
- **Illustrate** the commonly used industrial materials.

Text Books:

T1. N. Y. S. Murthy, V. Anuradha & K. Ramana Rao, A Text Book of Engineering Chemistry,Maruthi Publications. (2018)

T2. K. Sesha Maheswaramma, Mridula Chugh, A Text Book of Engineering Chemistry,Pearson Publications (2018).

Reference Books:

R1. Jain & Jain, Engineering Chemistry –Dhanpat Rai Publishing Company (2017)

R2. Shashi Chawla, Text Book of Engineering Chemistry - Dhanpat Rai & Co. (P) Limited (2017)

R3. Prasanta Rath, Subhendu Chakroborthy, Chemistry – Cengage publications (2018)

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	-	-	-	-	-	2	-	-	-	-	-	-	-
3	-	-	-	-	-	2	-	-	-	-	-	-	-
3	-	-	-	-	-	2	-	-	-	-	-	-	-
3	-	-	-	-	-	2	-	-	-	-	-	-	-
3	-	-	-	-	-	2	-	-	-	-	-	-	-
3						2							

II SEMESTER	L	T	P	C
	3	-	-	3
19CS2T01 - PROBLEM SOLVING AND PROGRAMMING USING C				

Course Objectives:

- To impart adequate knowledge on the need of programming languages and problem solving techniques and develop programming skills.
- To enable effective usage of Control Structures and Implement different operations on arrays.
- To demonstrate the use of Strings and Functions.
- To impart the knowledge of pointers and understand the principles of dynamic memory allocation.
- To understand structures and unions and illustrate the file concepts and its operations.
- To impart the Knowledge Searching and Sorting Techniques.

CO No	Co Statement	Knowledge Level
1	Develop an algorithm/flowchart to find a solution for computational problem	K2
2	Develop C programs with branching and looping statements, which uses Arithmetic, Logical, Relational or bitwise operators	K3
3	Develop a C program using arrays to divide a given computational problem into a number of modules	K3
4	Apply pointers for array processing and parameter passing	K3
5	Develop C programs with structure or union and files for storing the data to be processed.	K3

UNIT-I

Introduction to Computer Problem Solving: Programs and Algorithms, Computer Problem Solving Requirements, Phases of Problem Solving, Problem Solving Strategies, Top-Down Approach, Algorithm Designing, Program Verification, Improving Efficiency, Algorithm Analysis and Notations.

UNIT-II

Introduction to C Programming: Introduction, Structure of a C Program, Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements, Operators, Type Conversion.

Control Flow, Relational Expressions: Conditional Branching Statements: if, if-else, if-else–if, switch.Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, goto statement.

UNIT-III

Arrays: Introduction, Operations on Arrays, Arrays as Function Arguments, Two dimensional Arrays, Multi-dimensional arrays.

Pointers: Concept of a Pointer, Declaring and Initializing Pointer Variables, Pointer Expressions and Address Arithmetic, Null Pointers, Generic Pointers, Pointers as Function Arguments, Pointers and Arrays, Pointer to Pointer, Dynamic Memory Allocation, Dangling Pointer, Command Line Arguments.

UNIT-IV

Functions: Introduction, Function Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes, Recursion.

Strings: String Fundamentals, String Processing with and without Library Functions, Pointers and Strings.

UNIT-V

Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type –enum variables, Using Typedef keyword, Bit Fields.

Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Course Outcomes:

At the end of the Course, Student will be able to:

- Illustrate the Fundamental concepts of Computers and basics of computer programming.
- Use Control Structures and Arrays in solving complex problems.
- Develop modular program aspects and Strings fundamentals.
- Demonstrate the ideas of pointers usage.
- Solve real world problems using the concept of Structures, Unions and File operations.

Text Books:

1. Reema Thareja, Computer Programming, Oxford University Press.2016.
2. R. G. Dromey , How to solve it by Computer, Pearson Education, 2011.

Reference Books:

1. Yaswanth Kanetkar, Let us C, BPB Publication, 16th Edition, 2019.
2. Ajay Mittal, Programming In C A-Practial Approach, Pearson. 2010

Web Links:

1. http://www.c4learn.com/
2. http://www.geeksforgeeks.org/c/
3. http://nptel.ac.in/courses/122104019/
4. http://www.learn-c.org/
5. https://www.tutorialspoint.com/cprogramming/

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	3	3	2	-	-	-	2	-	-	2	-	-
3	3	3	3	2	-	-	-	2	-	-	2	-	-
3	3	2	3	2	-	-	-	2	-	-	2	-	-
3	2	2	2	2	-	-	-	2	-	-	2	-	-
3	2	2	2	2	-	-	-	2	-	-	2	-	-
3	2.6	2.4	2.6	2				2			2		

II SEMESTER	L	T	P	C
	3	-	-	3
19HS2T01 - ENGLISH				

COURSE OBJECTIVES

1. To improve the language proficiency of technical under graduates in English with emphasis onLSRW Skills.
2. To provide learning environment to practice Listening, Speaking, Reading and Writing Skillswithin and beyond the classroom environment.
3. To assist students to carry on the tasks and activities through guided instructions and materials.
4. To effectively integrate English language learning with employability skills and training.
5. To design the main course material and exercises with authentic materials drawn from everydayuse to cater to everyday needs.
6. To provide hands-on experience through case –studies, mini –projects, group and individualpresentations.

COURSE OUTCOMES

CO No	Co Statement	Knowledge Level
1	Identify the importance of correct usage of grammar	K2
2	Illustrate ideas effectively on various topics	K3
3	Prepare the reports and essays by using appropriate sentences	K2
4	Identify the importance of correct usage of grammar	K3
5	Illustrate ideas effectively on various topics	K3

A) Reading Skills

- Addressing explicit and implicit meaning of a text.
- Understanding the context.
- Learning new words and phrases.
- Using words and phrases in different contexts.

B) Writing Skills

- Using the basic structure of a sentence.
- Applying relevant writing formats to create paragraphs, essays, letters, e-mails, reports andpresentations.
- Retaining a logical flow while writing.
- Planning and executing an assignment creatively.

C) Interactive skills

- Analyzing a topic of discussion and relating to it.
- Participating in discussions and influencing them.
- Communicating ideas effectively.
- Presenting ideas coherently within a stipulated time.

D) Grammar in context

- Enable the skills of grammar using in a situation
- Identifying the needs of apt grammar in life related situation
- Promoting discourse with grammar effectively

Syllabus :

S No	Content
UNIT –I	**Vocabulary Building** **1.1** Video Lesson 1.2.1 Word formation 1.2.2. Root words 1.2.3. Prefixes and Suffixes 1.2.4. Synonyms and Antonyms **1.3 Parts of Speech** **1.4 Note- making, Note-taking**
UNIT - II	**Basic Writing Skills** **2.1** Video Lesson 2.2.1 Basic sentence structure 2.2.2. Clauses and Phrases 2.2.3 Punctuations 2.2.4 Creating coherence 2.2.5 Organizing principles of paragraph documents 2.2.6 Techniques for writing precisely **2.3 Tenses** **2.4 Letter Writing**
UNIT- III	**Identifying Common Errors in Writing** **3.1** Video Lesson 3.2.1 Sub + verb agreement 3.2.2 Noun pronoun agreement 3.2.3 Articles 3.2.4 Preposition 3.2.5 Redundancies 3.2.6 Clichés **3.3.1 Active - Passive Voice** **3.3.2 Reported Speech** **3.4 Resume Writing**
UNIT- IV	**Nature and Style of sensible Writing** **4.1** Video Lesson 4.2.1 Describing 4.2.2 Classifying 4.2.3 Writing Introduction and conclusion **4.3.1 Conditional Sentences** **4.3.2 Degrees of Comparison** **4.4 Email writing**
UNIT-V	**Writing Practice** **5.1** Video Lesson 5.2.1 Comprehension 5.2.2 Precise writing 5.2.3 Essay Writing **5.3 Simple Compound and Complex Sentences** **5.4 Report Writing**

TEXT BOOK: Building Effective Communication Skills

By Maruti Publications (2019)

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
-	-	-	-	-	-	-	2	2	3	-	1	-	-
-	-	-	-	-	-	-	2	2	3	-	1	-	-
-	-	-	-	-	-	-	2	2	3	-	1	-	-
-	-	-	-	-	-	-	2	2	3	-	1	-	-
-	-	-	-	-	-	-	2	2	3	-	1	-	-
							2	2	3		1		

II SEMESTER	L	T	P	C
	2	-	2	3
19ME2T03 - COMPUTER AIDED ENGINEERING DRAWING				

COURSE OBJECTIVE:

To enhance the student's knowledge and skills in engineering drawing and to introduce drafting packages and commands for computer aided drawing and modeling.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Draw and communicate the objects with definite shape and dimensions	K1
2	Recognize and draw the shape and size of projections through different views	K2
3	understand and Generte points, lines, curves, polygons and its dimensions using CAD software	K2
4	understand and and locate various View Points and View Ports using CAD software	K2
5	Identify the interdisciplinary engineering components or systems through its graphical representation	K2

UNIT – I

Projections of Solids: Projection of regular solids inclined to both the planes using auxiliary views and sectional views of regular solids.

Development of Surfaces of Right Regular Solids: Prisms, Cylinders, Pyramids and Cone.

UNIT –II

Isometric Projections and Orthographic Projections: Compound solids, isometric projections of objects having non-isometric lines and spherical parts.

Perspective Projections: perspective view of points, lines, plane figures and simple solids- vanishing point method (General method only)

UNIT-III

Introduction to Computer Aided Drafting: Generation of points, lines, curves, polygons, dimensioning. Object selection commands, edit, zoom, crosshatching, pattern filling, utility commands, 2D wire frame modeling, 3D wire frame modeling

UNIT-IV

View Points and View Ports: View point coordinates and views displayed, examples to exercise different options like save, restore, delete, joint, single option.

UNIT-V

Computer Aided Solid Modeling: Modeling of simple solids and modeling of different Machines and Machine parts

TEXT BOOKS:

1. Engineering Drawing by N.D.Bhatt , Charotar publications 2016
2. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age2010

REFERENCE BOOKS:

1. Engineering Drawing - K.L.Narayana, P.Kannaiah, and K.Venkata Reddy, New Age International Publishers. 2016
2. Text book of Engineering Drawing with AutoCAD - K.Venkata reddy, B.S.Publications 2017
3. Engineering Drawing - R.K. Dhawan,S.Chand 2012

The syllabus in respect of the subject "Computer Aided Engineering Drawing Practice" consists of two major portions

1. Unit I to II - conventional drawing pattern.
2. Unit III to V - computer lab pattern using any drafting package.

Max Marks – 100.

Internal Marks: 30 & External Marks: 70

The examination in respect of the above may conducted on par with lab with the following pattern:

Mid Exam:

I Mid Exam from first Two Units- Conventional Drawing

II Mid Exam from Last three Units - Computer Lab

END SEMESTER EXAM:

Part - A - Conventional Drawing test in Drawing Hall from first Two Units - 2 hrs duration.

Part - B - Exam in Computer Lab using any drafting package - 2 hrs duration.

End Exam duration - 4 hrs

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	2	-	-	1	-	-	1	1	-	2	1	-
1	-	2	-	-	1	-	-	1	1	-	2	1	-
1	-	2	-	1	1	2	-	2	-	2	2	2	-
2	-	2	-	1	1	1	-	2	-	2	2	1	-
1	-	2	-	2	-	-	-	2	2	-	2	2	-
1.2		2		1.33	1	1.5		1.6	1.33	2	2	1.4	

II SEMESTER	L	T	P	C
	-	-	3	1.5
19ME2L01 - ENGINEERING WORKSHOP				

COURSE OBJECTIVE: To impart hands–on practice on basic Engineering trades and skills.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Model and Develop various basic prototypes in Carpentry trade.	K3
2	Model and Develop various basic prototypes in Fitting trade.	K3
3	Perform Various Forging Operations.	K3
4	Perform various House Wiring Techniques.	K3
5	Develop various basic prototypes in the trade of Sheet metal.	K3

TRADE:

I. CARPENTRY:

1. CROSS LAP JOINT 2. DOVETAIL JOINT 3. MORTISE and TENNON JOINT

II. FITTING:

1. SQUARE FIT 2. V-FIT 3. HALF ROUND FIT

III. FORGING:

1. ROUND ROD TO SQUARE
2. S-HOOK
3. ROUND ROD TO SQUARE HEADED BOLT

IV. HOUSE WIRING:

1. PARALLEL/SERIES CONNECTION OF THREE BULBS
2. STAIRCASE WIRING
3. FLOURESCENT LAMP FITTING

V. SHEET METAL:

1. SQUARE TRAY 2. HOLLOW CYLINDER 3. OPEN SCOOP

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
2	-	1	-	-	1	-	-	3	-	-	1	2	-
2	-	1	-	-	1	-	-	3	-	-	1	2	-
2	-	1	-	-	1	-	-	3	-	-	1	2	-
2	-	-	-	-	1	-	-	3	-	-	1	1	-
2	-	1	-	-	-	-	-	3	-	-	1	2	-
2		1			1			3			1	1.8	

II SEMESTER	L	T	P	C
	-	-	3	1.5
19BS2L02 - ENGINEERING CHEMISTRY LAB				

Outcomes:

The experiments introduce volumetric analysis: Acid-Base, complexometric, Redox, Conductometric and potentiometric titrations. Then they are exposed to a few instrumental methods of chemical analysis.

CO No	Co Statement	Knowledge Level
1	Identify the concentration of given solution by different methods of chemical analysis	K3
2	Analyze the water purity by checking hardness, DO and Acidity.	K4
3	Estimate the Cu+2, Fe+3, Ca+2, Mg+2 ions and Ascorbic acid present in given solution.	K4
4	Identify the pour and cloud point of lubricants.	K3
5	Classify the principles of conductometric and potentiometric titrations.	K2

Syllabus:

1. Estimation of HCl using standard Na_2CO_3 through acid-base titration.
2. Estimate the total hardness of water using standardized EDTA solution through complexometrictitration.
3. Estimation of $KMnO_4$ using standard $H_2C_2O_4$ through redox titration method.
4. Estimation of Dissolved Oxygen in given water sample by Wrinkler's Method
5. Determination of ferric (Fe^{+3}) ions using standard KCr_2O_7 solution
6. Determination of copper (II) using standard hypo solution.
7. Estimation of strong acid by using strong base through conductometric titration method.
8. Estimation of strong acid by using strong base through potentiometric titration method.
9. Preparation of polymer (Demo).
10. Determination of Vitamin 'C'.
11. Determination of Pour and Cloud Point of lubricating oils

Reference Books

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
-	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
-	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3		2		3									

II SEMESTER	L	T	P	C
	-	-	3	1.5
19CS2L01 - C PROGRAMMING LAB				

Course Objectives:

- To impart knowledge on various Editors, Raptor.
- To make the students understand the concepts of C programming.
- To nurture the students on Control Structures and develop different operations on arrays.
- To make use of String fundamentals and modular programming constructs.
- To implement programs using dynamic memory allocation.
- To explain the concepts of Structure, Unions and files for solving various problems.

CO No	Co Statement	Knowledge Level
1	Develop basic programs in C and design flowcharts in Raptor.	K3
2	Apply Conditional and Iterative statements to solve the real time scenarios in C.	K3
3	Implement the concept of Arrays and Modularity and Strings.	K3
4	Apply the Dynamic Memory Allocation functions using pointers.	K3
5	Develop programs using structures and Files.	K3

List of Experiments:

1. Introduction to Algorithms and Flowcharts

1. Implement Algorithm Development for Exchange the values of Two numbers.
2. Given a set of n student's examination marks (in the range 0-100) make a count of the number ofstudents that passed the examination. A Pass is awarded for all of 50 and above.
3. Given a set of n numbers design an algorithm that adds these numbers and returns the resultantsum. Assume N is greater than or equal to zero.

2. Introduction to C Programming

1. Exposure to Turbo C, Code Blocks IDE, Dev C++, Falcon C++.
2. Writing simple programs using printf(), scanf() .

3. Raptor

1. Introduction to Raptor.
2. Draw a flow chart to find the Sum of 2 numbers.
3. Draw a flow chart to find Simple interest.

4. Basic Math

1. Write a C Program to convert Celsius to Fahrenheit and vice versa.
2. Write a C Program to find largest of three numbers using ternary operator.
3. Write a C Program to Calculate area of a Triangle using Heron's formula.

5. Control Flow- I

1. Write a C Program to Find Whether the Given Year is a Leap Year or not.
2. Write a C program to find the roots of a Quadratic Equation.
3. Write a C Program to make a simple Calculator to Add, Subtract, Multiply or

Divide UsingSwitch…case.

6. Control Flow- II

1. Write a C Program to Find Whether the Given Number is Prime number or not.
2. Write a C Program to Find Whether the Given Number is Armstrong Number or not.
3. Write a C program to print Floyd Triangle.

7. Control Flow- III

1. Write a C program to find the sum of individual digits of a positive integer.
2. Write a C program to check whether given number is palindrome or not.
3. Write a C program to read two numbers, x and n, and then compute the sum of the geometricprogression $1+x+x^2+x^3+\ldots+x^n$.

Practice Programs:

Write a C program to print all natural numbers from 1 to n. - using while loop
Write a C program to print all natural numbers in reverse (from n to 1). - using while loop
Write a C program to print all alphabets from a to z. - using while loop
Write a C program to print all even numbers between 1 to 100. - using while loop
Write a C program to print sum of all even numbers between 1 to n.
Write a C program to print sum of all odd numbers between 1 to n.
Write a C program to print table of any number.
Write a C program to find first and last digit of any number.
Write a C program to count number of digits in any number.
Write a C program to calculate sum of digits of any number.
Write a C program to calculate product of digits of any number.
Write a C program to swap first and last digits of any number.
Write a C program to enter any number and print its reverse.
Write a C program to enter any number and check whether the number is palindrome or not.
Write a C program to find frequency of each digit in a given integer.
Write a C program to enter any number and print it in words.
Write a C program to print all ASCII character with their values.
Write a C program to enter any number and print all factors of the number.
Write a C program to enter any number and calculate its factorial.
Write a C program to find HCF (GCD) of two numbers.
Write a C program to find LCM of two numbers.
Write a C program to check whether a number is Prime number or not.
Write a C program to check whether a number is Armstrong number or not.
Write a C program to check whether a number is Perfect number or not.
Write a C program to check whether a number is Strong number or not.
Write a C program to print Fibonacci series up to n terms.

8. Arrays

1. Write a C program to search an element in the given array (Linear Search).
2. Write a C program to perform matrix addition.
3. Write a C program to perform matrix multiplication.

Practice Programs:

Write a C program to read and print elements of array.
Write a C program to find sum of all array elements. - using recursion.
Write a C program to find maximum and minimum element in an array. - using recursion.
Write a C program to find second largest element in an array.

Write a C program to copy all elements from an array to another array.
Write a C program to insert an element in an array.
Write a C program to delete an element from an array at specified position.
Write a C program to print all unique elements in the array.
Write a C program to print all negative elements in an array.
Write a C program to count total number of even and odd elements in an array.
Write a C program to count total number of negative elements in an array.
Write a C program to count total number of duplicate elements in an array.
Write a C program to delete all duplicate elements from an array.
Write a C program to count frequency of each element in an array.
Write a C program to merge two array to third array.
Write a C program to find reverse of an array.
Write a C program to convert lowercase string to uppercase.
Write a C program to convert uppercase string to lowercase.
Write a C program to toggle case of each character of a string.
Write a C program to find total number of alphabets, digits or special character in a string.

9. Pointers

1. Write a C Program to Perform Addition, Subtraction, Multiplication and Division of twonumbers using Command line arguments.
2. Write a C program to find sum of n elements entered by user. To perform this program,allocate memory dynamically using malloc () function.
3. Write a C program to find sum of n elements entered by user. To perform this program,allocate memory dynamically using calloc () function.

10. Functions, Array & Pointers

1. Write a C Program to demonstrate parameter passing in Functions.
2. Write a C Program to find Fibonacci, Factorial of a number with Recursion and withoutrecursion.
3. Write a C Program to find the sum of given numbers with arrays and pointers.

Practice Programs:

Program to change the value of constant integer using pointers.
Program to print a string using pointer.
Program to count vowels and consonants in a string using pointer.
Program to read array elements and print with addresses.

11. Strings

1. Implementation of string manipulation operations with library function:
   a) copy
   b) concatenate
   c) length
   d) compare
2. Implementation of string manipulation operations without library function:
   a) copy
   b) concatenate
   c) length
   d) compare
3. Verify whether the given string is a palindrome or not.

12. Structures

1. Write a C Program to Store Information of a book Using Structure.
2. Write a C Program to Add Two Complex Numbers by Passing Structure to a Function.

13. Files

1. Write a C program to open a file and to print the contents of the file on screen.
2. Write a C program to copy content of one file to another file.
3. Write a C program to merge two files and store content in another file.

14. Application

Creating structures to capture the student's details save them in file in proper record format, searchand prints the student details requested by the user.

Note: Draw the flowcharts using Raptor from Experiment 3 to Experiment 6.

Course Outcomes:

- Implement basic programs in C and design flowcharts in Raptor.
- Use Conditional and Iterative statements to solve real time scenarios in C.
- Implement the concept of Arrays and Modularity and Strings.
- Apply the Dynamic Memory Allocation functions using pointers.
- Develop programs using structures, and Files.

Reference Books:

1. Yashwanth Kanetkar, Let Us C, 16th edition, BPB Publications, 2019,
2. Ajay Mittal, Programming In C A-Practical Approach, Pearson. 2010

Web Links:

1. https://www.hackerrank.com/
2. https://www.codechef.com/
3. https://www.topcoder.com/
4. https://code-cracker.github.io/
5. https://raptor.martincarlisle.com/
6. https://nptel.ac.in/courses/106105085/2

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	3	-	-	-	-	-	2	-	-	2	-	
3	3	2	-	-	-	-	-	2	-	-	2	-	
3	2	2	-	-	-	-	-	2	-	-	2	-	
3	2	2	-	-	-	-	-	2	-	-	2	-	
3	2	2	-	-	-	-	-	2	-	-	2	-	
3	2.4	2.2						2			2		

II SEMESTER	L	T	P	C
	-	-	3	1.5
19HS2L02- ENGLISH COMMUNICATION SKILLS LAB				

COURSE OBJECTIVES

- To improve the language proficiency of technical under graduates in English with emphasison LSRW Skills.
- To provide learning environment to practice Listening, Speaking, Reading and Writing Skillswithin and beyond the classroom environment.
- To assist students to carry on the tasks and activities through guided instructions andmaterials.
- To effectively integrate English language learning with employability skills and training.
- To design the main course material and exercises with authentic materials drawn fromeveryday use to cater to everyday needs.
- To provide hands-on experience through case-studies, mini-projects, group and individualpresentations.

COURSE OUTCOMES:

CO No	Co Statement	Knowledge Level
1	Identify the difference between impromptu and extempore.	K3
2	Express hypothetical situations in different ways.	K2
3	Outline the etiquettes of telephonic conversation and interviews.	K2
4	Identify the need of the presentation skills to participate in various oral activities.	K5
5	Apply preparatory techniques for Job interviews.	K2

a) Reading Skills.

- Addressing explicit and implicit meaning of a text.
- Understanding the context.
- Learning new words and phrases.
- Using words and phrases in different contexts.

b) Writing Skills:

- Using the basic structure of a sentence.
- Applying relevant writing formats to create paragraphs, essays, letters, E-Mails, reports andpresentations.
- Retaining a logical flow while writing.
- Planning and executing an assignment creatively.

c) Interactive skills:

- Analyzing a topic of discussion and relating to it.
- Participating in discussions and influencing them.
- Communicating ideas effectively.
- Presenting ideas coherently within a stipulated time.

d) Life Skills and Core Skills:

- Examining self-attributes and identifying areas that require improvement self-diagnosis, self-motivation.
- Adopting to a given situation and developing a functional approach to find solutions-adaptability,problem-solving.

- Understanding the importance of helping others-community service, enthusiasm.

COURSE DESCRIPTION

Communicating in a language is also a skill. So a student has to look for an opportunity to practice the language he is learning in order to acquire communication skills. 'Enrich your interactive Skills: Part
- B' is designed to provide opportunities for engineering students to revise and consolidate communication skills in different contexts formal and informal. It prepares the student for facingInterviews, participating in group discussions and making presentations.

PRE REQUISITES

The student is expected to have basic knowledge in English language and must be able to write inEnglish. He is also expected to possess fundamental knowledge of general English grammar and vocabulary.

Syllabus

UNIT	TOPIC
1	Oral Activity : JAM, Hypothetical situations, self / peer profile, Common errors in pronunciation, Neutralizing Accent
2	Oral Activity : Telephonic Etiquette, Role plays, Poster presentations and e-mail Writing
3	Oral Activity : Oral Presentation Skills, Public Speaking Data Interpretation
4	Oral Activity : Group Discussion: Do's and Don'ts –Types, Modalities
5	Oral Activity : Interview Skills: Preparatory Techniques, FAQ, Mock Interviews Pronunciation : Connected speech (pausing, tempo, tone, fluency etc.,)

Text Book:

"Infotech" by Maruthi Publications (2019)

Reference Books:

1. Clive Fletchers, How to Face Interviews
2. Stephen Covey , The 7 Habits of Highly Effective People.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
-	-	-	-	-	-	-	**2**	**2**	**3**	-	**1**	-	-
							2	2	3		1		

III SEMESTER	L	T	P	C
	3	-	-	3
19BM3T01- MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS				

COURSE OBJECTIVES:

1. To acquire knowledge of economics to facilitate the process of economic Decision making
2. To analyze production function and its laws of variable proportions and cost concepts
3. To differentiate and distinguish price and output decisions in different market structures
4. To compare and contrast the difference between private and public sector in their functioning
5. To develop the skills to analyze financial statements.

COURSE OUTCOMES

CO No	Co Statement	Knowledge Level
1	Describe the importance of managerial economics and its utility in decision making	K2
2	Generalize the meaning and usefulness of the production function and cost function in analyzing the firm's production activity	K3
3	Comprehend the concept of Market structure, different types of Markets and pricing policies	K4
4	Identify different forms of business organization and analyze their merits and demerits	K2
5	Evaluate the investment proposals through techniques of capital budgeting and financial performance of the company through Financial Statements	K5

UNIT–I Managerial Economics &Demand Analysis: Definition – Nature and Scope - Relation with other disciplines - Concept of Demand-Types-Determinants - Law of Demand – Exceptions - Elasticity of Demand - Types and Measurement-Demand forecasting and its Methods.

UNIT–II Production and Cost Analysis: Production function - Law of Variable proportions - Isoquants and Isocosts -Law of returns Economies of Scale - Cost Concepts - Fixed, Variable Costs, Explicit Costs, Implicit Costs & Opportunity cost - Cost Volume Profit Analysis - Break Even Point (Simple Problems)

UNIT-III Market Structures & Pricing Policies: Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly – Features – Price & Output Determination - Pricing Methods

UNIT-IV Forms of Organizations & Business Cycles: Business Organization- Sole Trader – Partnership - Joint Stock Company - State/Public Enterprises and their forms - Business Cycles: Meaning and Features - Phases of Business Cycle.

UNIT–V Capital Budgeting and Accounting: Concept and sources-Techniques of capital budgeting- Traditional and Modern Methods (Simple problems)

Introduction to accounting: Branches-Systems of Accounting-Single Entry-Double Entry System-Journal-Ledger-Trail Balance-Final Accounts(Simple problems)

TEXTBOOKS:

1. Aryasri: Managerial Economics and Financial Analysis, 2/e, TMH, 2005.
2. T.V.Ramana & B. Kuberudu: Managerial Economics and Financial Analysis, Himalaya PublishingHouse,Mumbai
3. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2003.

REFERENCE BOOKS:

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, PHI, 4th Ed.
3. Suma Damodaran, Managerial Economics, Oxford University Press.
4. Lipsey & Chrystel, Economics, Oxford University Press.
5. S. A. Siddiqui & A. S. Siddiqui, Managerial Economics & Financial Analysis, New age InternationalSpace Publications.
6. Domnick Salvatore: Managerial Economics in a Global Economy, 4th Edition, Thomson.
7. Narayanaswamy: Financial Accounting A Managerial Perspective, PHI.
8. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech.
9. S.N.Maheswari & S.K. Maheswari, Financial Accounting, Vikas.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
-	3	-	-	-	1	-	-	-	-	2	1	-	1
-	3	-	-	-	2	-	-	-	-	1	2	-	2
-	2	-	-	-	2	-	-	-	-	2	2	-	1
-	2	-	-	-	2	-	-	-	-	2	2	-	1
-	2	-	-	-	2	-	-	-	-	2	2	-	1
	2.4				1.8					1.8	1.8		1.2

III SEMESTER	L	T	P	C
	3	-	-	3
19CS3T04 - INTERNET OF THINGS				

COURSE OBJECTIVE

- Discuss the fundamentals relating to IoT, Things in IoT, Communication Models and APIs
- Explain the difference between M2M and IoT, and familiarize the concepts of SDN and Network Virtualization.
- Expose various hardware used for IoT Applications
- Demonstrate the use of IoT through various case studies
- Familiarize IIoT and Industry 4.0.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Summarize the basic principles, Physical and logical design, functional blocks, Communication systems and API of IoT systems.	K2
2	Differentiate between IoT and M2M technologies; Explain the concepts of Software Defined Networks (SDN) and Network Virtualization.	K2
3	Describe hardware components used for computing, communicating, sensing, Actuation, I/O interfaces in IoT.	K2
4	Summarize the applications of IoT through various case studies.	K2
5	Explain the concepts of IIoT and Industry 4.0, their requirements and benefits.	K3

UNIT – I

Introduction to IoT: Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

UNIT – II

IOT & M2M: Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Software defined networks (SDN), Network Virtualization

UNIT -III

ELEMENTS OF IOT: Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.

UNIT – IV

IOT CASE STUDIES: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

UNIT – V

IIOT: Key IIOT Technologies, Catalysts and Precursors of the IIoT, Innovation and the IIoT, Intelligent Devices, Key Opportunities and benefits, **INDUSTRY 4.0:** Definition, four main

characteristics of Industry 4.0, Industry 4.0 design principles, Building blocks of Industry 4.0, Smart Manufacturing.

TEXT BOOKS:

1. Internet of Things: A Hands-On Approach Paperback by Arsheep Bahga, Vijay Madisetti, 1st Edition, Orient Blackswan Private Limited (2015)
2. Internet of Things Paperback by Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Wiley (2019)
3. Industry 4.0: The Industrial Internet of Things Paperback by Alasdair Gilchrist, 1st edition, Apress (2017)

REFERENCE BOOKS:

1. Internet of Things: Principles and Paradigms by Rajkumar Buyya, Amir Vahid Dastjerdi, 1st Edition, Morgan Kaufmann (2016)
2. Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies by Dimitrios Serpanos, Marilyn Wolf, 1st Edition, Springer(2018)
3. Internet of Things with Arduino Cookbook by Marco Schwartz, Packt Publishing Limited (2016)
4. Architecting the Internet of Things by Dieter Uckelmann, Mark Harrison, Florian Michahelles, Springer (2011)

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	3	3	3	2	2	-				1		
3	3	3	3	3	2	2	-				1		
3	3	3	3	3	2	2	-				1		
3	3	3	3	3	2	2	-	2			1		
3	3	3	3	3	2	2	-	2			1		
3	**3**	**3**	**3**	**3**	**2**	**2**		**2**			**1**		

III SEMESTER	L	T	P	C
	3	1	-	4
19ME3T01- ENGINEERING MECHANICS				

COURSE OBJECTIVES:

- To impart knowledge on the concept of forces and its resolution in different planes, resultant of force system and moment of forces.
- To develop capacity to forecast the effect of force and its motion.
- To make the students compute the centre of gravity and moment of inertia.
- To educate the students about dynamic forces in rigid body.

COURSE OUTCOMES: Student will be able to

CO No	Co Statement	Knowledge Level
1	Illustrate the various types of forces and moments.	K2
2	Analyze the rigid body in equilibrium and determine the effects by the laws of friction.	K3
3	Evaluate the centroid, moment of inertia of surfaces and center of gravity, mass moment of inertia of solids.	K3
4	Calculate the kinetics and kinematics force exerted in a rigid body.	K3
5	Perceive the concept of the work-energy principle and virtual work and its application.	K3

UNIT-I

Introduction to Engineering Mechanics: System of Forces, Coplanar Concurrent Forces, Components in plane - Resultant- Moment of Forces and its Application; Couples - General case of parallel forces in a plane. Equilibrium of Rigid Bodies in two dimensions - Free body diagram.

UNIT-II

Spatial Systems: Components of force in space – Resultant- Moment of Forces and its Application.

Friction: Introduction, Types of friction, Laws of Friction, Limiting friction, Angle of repose, Angle of friction, Cone of friction. Equilibrium analysis of simple systems with sliding friction, Wedge friction, Screw friction.

UNIT-III

Centroid & Centre Of Gravity: Centroid- Simple and Composite figures. Centre of gravity - Simple and Composite bodies, Theorems of Pappus.

Moment Of Inertia: Moment of Inertia, Product of Inertia and Principal moment of inertia for planes. Mass moment of inertia for solids.

UNIT-IV

Kinetics: Analysis as a Particle and analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

Kinematics: Rectilinear and Curvilinear Motion – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion.

UNIT-V

Work Energy Method: Work-Energy principle and its Application in plane motion of connected bodies. Impulse-Momentum method.

Virtual Work: Virtual displacements, Principle of virtual work for particle and Ideal system of rigid bodies. Application of virtual work principle.

TEXT BOOKS:

1. Engineering Mechanics - S. Timoshenko & D.H. Young, McGraw Hill education, 5th edition, 2017.
2. A Text Book of Engineering Mechanics - Bansal R.K.by Laxmi Publications, 6th edition, 2013.
3. Engineering Mechanics - R.S. Khurmi & N.Khurmi, by S. Chand publications, 22nd edition, 2019.
4. Engineering Mechanics, D.S. Bedi and MP Poonia, Khanna Book Publishing Co. (P) Ltd, 2nd edition, 2019.
5. Engineering Mechanics, DP Sharma, Pearson Education, 1st edition, 2011.

REFERENCE BOOKS:

1. Engineering Mechanics - S. S. Bhavikatti, New Age International Publishers, 6th edition, 2018.
2. Engineering Mechanics - A.K.TAYAL – UMESH Publications, 14th edition, 2010.
3. Engineering Mechanics – Statics & Dynamics - Reddy Vijay Kumar K. and J. Suresh Kumar, BSP Books Pvt.Ltd, 3rd edition,2010.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	2	-	-	-	-	-	-	-	-	-	-	2	-
2	1	-	-	-	-	-	-	-	-	-	-	1	-
2	1	-	-	-	-	-	-	-	-	-	-	1	-
3	2	-	-	-	-	-	-	-	-	-	-	-	1
3	2	-	-	-	-	-	-	-	-	-	-	-	1
2.6	**1.6**											**1.33**	**1**

III SEMESTER	L	T	P	C
	3	-	-	3
19MA3T05- PROBABILITY AND STATISTICS				

Course Objectives:

1. To familiarize the students with the foundations of probability and statistical methods
2. To impart probability concepts and statistical methods in various applications of Engineering
3. To introduce the correlation and regression and method of least squares

CO No	Co Statement	Knowledge Level
1	Make use of the concepts of probability and their applications	K3
2	Apply discrete and continuous probability distributions	K3
3	Use the components of a classical hypotheses test	K3
4	Examine significance tests based on small and large sampling tests	K3
5	Use correlation methods and principle of least squares, regression lines	K3

Unit-1 Probability:

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions,properties, mathematical expectation.

Learning Outcomes:

At the end of this unit, the student will be able to

- define the terms trial, events, sample space ,probability, and laws of probability (K_1)
- make use of probabilities of events in finite sample space from experiments (K_3)
- apply Baye's theorem to real time problems(K_3)
- explain the notion of random variable, distribution functions and expected value(K_2)

Unit-2 Probability distributions:

Probability distribution-Binomial, Poisson approximation to the binomial distribution and normaldistribution –their properties.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply Binomial and Poisson distributions for real data to compute probabilities, theoreticalfrequencies (K_3)
- interpret the properties of normal distribution and its applications (K_2)

Unit-3 Sampling distribution and Testing of hypothesis, large sample tests:

Basic terminology in sampling, sample techniques (with and without replacement), sampling distributionof means for large and small samples (with known and unknown variance).

Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level ofsignificance, two types of errors.

Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the concept of sampling distribution for large and small samples (K_2)
- apply the concept of hypothesis testing for large samples (K_4)

Unit-4 Small sample tests:

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variance(F- test), Chi-square test for goodness of fit and independence of attributes.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply the concept of testing of hypothesis for small samples to draw the inferences (K_3)
- estimate the goodness of fit (K_4)

Unit-5 Curve Fitting and Correlation:

Curve Fitting : Method of least squares -Fitting a straight line, Second degree parabola - exponentialcurve-power curves

Correlation: Simple correlation, correlation coefficient (for ungrouped data), rank correlation. Linearregression, regression lines, regression coefficients.

Learning Outcomes:

At the end of this unit, the student will be able to

- Adopt correlation methods and principle of least squares, regression lines (K_4)

Course Outcomes:

At the end of this unit, the student will be able to

1. make use of the concepts of probability and their applications (k3)
2. apply discrete and continuous probability distributions(K3)
3. design the components of a classical hypotheses test(K6)
4. infer the statistical inferential methods based on small and large sampling tests(K6)
5. adopt correlation methods and principle of least squares, regression lines (K_4)

Books:

1. Dr. B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 42nd Edition, 2012.
2. Dr. K. Murugesan & P.Gurusamy, Probability and Statistics, Anuradha Publications, 2011.

Reference:

1. Miller & Freund, Probability and statistics for engineers, Prentice Hall,8th Edition, 2011.
2. Ramana B.V., Higher Engineering Mathematics, Tata Mc Graw Hill New Delhi 11th Reprint2010

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	2	2	2	-	-	-	-	-	2	2	3	2
3	3	2	2	2	-	-	-	-	-	2	2	3	2
3	3	2	2	2	-	-	-	-	-	2	2	3	2
3	3	2	2	2	-	-	-	-	-	2	2	3	2
3	3	2	2	2	-	-	-	-	-	2	2	3	2
3	**3**	**2**	**2**	**2**						**2**	**2**	**3**	**2**

III SEMESTER	L	T	P	C
	3	-	-	3
19ME3T02- FLUID MECHANICS AND HYDRAULIC MACHINERY				

COURSE OBJECTIVES:

- To understand the conservation laws of fluid flow, the dimensional analysis applied to fluid flow and hydraulic machines.
- To understand the behavior of fluids at various conditions

CO No	Co Statement	Knowledge Level
1	Describe the fundamental properties of fluids and apply the concepts of fluid statics.	K2
2	Apply the principles of fluid kinematics and boundary layer concepts for fluid flow problems.	K3
3	Analyze the fluid flow through pipes.	K4
4	Illustrate working principles of hydraulic turbines.	K3
5	Illustrate working principles of hydraulic pumps.	K3

UNIT I

Basic Concepts and Properties: Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids: density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillarity and surface tension. Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

UNIT II

Fluid Kinematics and Boundary Layer Concepts: Fluid Kinematics: Flow visualization, lines of flow, types of flow, continuity equation (one dimensional flow) - Fluid dynamics: equations of motion, Euler's equation along a streamline, Bernoulli's equation, applications, Venturimeter, Orifice meter, Pitot tube - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

UNIT III

Flow Through Pipes and Dimensional Analysis: Flow through pipes: Darcy -Weisbach equation, pipe roughness, friction factor, minor losses. Flow through pipes in series and in parallel, power transmission - Dimensional analysis, Buckingham's π theorem, applications, similarity laws and models. Introduction to CFD: Necessity, limitations, philosophy behind CFD, applications.

UNIT IV

Hydraulic Turbines: Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies - performance curves of turbines.

UNIT V

HYDRAULIC PUMPS:

Pumps- classifications - Centrifugal pump- classifications, working principles, priming, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump- classification, working principles, slip, performance curves and work saved by air vessels - cavitations in pumps.

TEXT BOOKS:

1. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2011.

2. Rajput.R.K., A Textbook of Hydraulic Machines in SI Units (Fluid Mechanics and Hydraulic Machines Part –II), Reprint 2012, Laxmi publications (P) Ltd., New Delhi, 2012.

REFERENCE BOOKS:

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (9th edition), Laxmi publications (P) Ltd., New Delhi, 2010.
2. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 2011.
3. Som, S.K., Biswas, G., "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 4th Edition, 2011.
4. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi (7th edition), 2011.
5. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 2011.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	0	-	2	-	-	-	-	-	-	1	1	-
1	3	2	-	1	-	1	-	-	-	-	1	2	-
3	3	2	-	2	-	1	-	-	-	-	1	2	-
-	3	2	-	1	-	1	-	-	-	-	1	2	-
3	2	1	-	1	-	1	-	-	-	-	1	2	-
2.5	**2.8**	**1.4**		**1.4**		**1**					**1**	**1.8**	

III SEMESTER	L	T	P	C
	3	-	-	3
19ME3T03- PRODUCTION TECHNOLOGY				

COURSE OBJECTIVES:

- To impart the students to understand the fundamentals of casting and their application.
- To make the knowledge of solidification of metals and melting furnace working principle.
- To perceive the students various types of welding processes and welding defects.
- To enable the students to acquire Hot and Cold working processes concept.
- To introduce the fundamentals of plastic processing techniques and Rapid Prototyping.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Describe various metal casting processes.	K2
2	Illustrate melting furnace working principle and solidification processes.	K2
3	Describe various welding techniques, soldering and brazing.	K2
4	Summarize various hot working and cold working methods of metals.	K2
5	Describe plastics processes and Rapid Prototyping.	K2

UNIT I

Casting Processes: Basic casting process and its characteristics, Patterns and Pattern making, Pattern allowances and their application, Principles and design of Gating systems, Special moulding methods and processes- CO_2 & Shell moulding processes and machine moulding. Centrifugal, Cold & Hot chamber Die Casting, Investment Casting processes.

UNIT II

Melting and Solidification: Crucible melting and cupola operation, steel making processes, Solidification of casting, Solidification of pure metal and alloys, short & long freezing range alloys, Principles and design of Rising system.

UNIT III

Welding Processes: Classification of welding processes, Types of welded joints and their characteristics, Welding processes: Gas welding and cutting, Arc welding, Resistance welding, Thermit welding and Plasma welding processes and their characteristics. Friction welding, Induction welding, Explosive welding, Laser welding, Soldering & Brazing. Heat affected zones in Welding, Welding defects.

UNIT IV

Mechanical Working of Metals - Extrusion of Metals:

Hot and cold working processes, characteristics, recovery, recrystallization and grain growth analysis, Theory of rolling, Fundamentals, types of Rolling mills and products. Analysis of rolling process and estimation of power requirement.

Introduction of extrusion process and its characteristics, Press working operations and their characteristics, Extrusion of metals**,** Drawing processes and its force analysis, Hot and Cold spinning.

UNIT V

Plastic Process & Rapid Prototyping: Plastics processing methods & Equipment (blow & injection moulding), Introduction to powder metallurgy. Fundamentals of Rapid Prototyping Technologies, Stereolithography, Selective Laser Sintering, Laminated Object Manufacturing, Fused Deposition Modeling, 3D Printing.

TEXTBOOKS

1. S Kalpakjian, S R. Schmid, Manufacturing- Engineering and Technology, Pearson publications, 7th Edition, 2014.
2. P.C Sharma, Production Technology, S.Chand and Co. Ltd., 2014.
3. Gerardus Blokdyk, Rapid Prototyping, Emereo Pty Limited, 3rd Edition, 2018.

REFERENCES

1. R. K. Jain, Production Technology, Khanna publishers, 16th Edition, 2014.
2. G.Thirupati Reddy, Production Technology, Scitech Publications, 2013.
3. P.N. Rao, Manufacturing Technology - Foundry, Forming and Welding, 4th Edition, TMH-2013.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	-	2	-	-	1	-	-	-	-	-	1	2	-
-	-	-	-	3	1	-	-	-	-	-	1	1	-
3	-	-	-	-	1	-	-	-	-	-	1	-	2
3	-	-	-	3	2	-	-	-	-	-	1	-	1
3	-	-	-	3	1	-	-	-	-	-	2	-	1
3		**2**		**3**	**1.2**						**1.2**	**1.5**	**1.33**

III SEMESTER	L	T	P	C
	-	-	3	1.5
19ME3L01- FLUID MECHANICS AND HYDRAULIC MACHINERY LAB				

COURSE OBJECTIVE

To impart practical exposure on the performance evaluation methods of various flow measuring equipments, hydraulic turbines and pumps.

CO No	Co Statement	Knowledge Level
1	Predict major and minor losses in various piping system.	K3
2	Predict performance characteristics of various Turbines and Pumps.	K3
3	Calibrate Venturi meter and Orifice meter.	K3
4	Apply the impulse momentum concepts on jets.	K3

LIST OF EXPERIMENTS:

1. Impact of jet on flat plate.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturi meter.
9. Calibration of Orifice meter.
10. Determination of friction factor of a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Determination of loss of head due to sudden enlargement in a pipeline.
13. Bernoulli's apparatus.**NOTE**: Any 10 of the above 13 experiments are to be conducte

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	-	0	2		1	1				1	1		2
3	3	0	2		1	1				1	1		2
3	3	0	2		1	1				1	1		2
3	3	0	2		1	1				1	1		2
3	**3**	**0**	**2**		**1**	**1**				**1**	**1**		**2**

III SEMESTER	L	T	P	C
	-	-	3	1.5

19ME3L02 - PRODUCTION TECHNOLOGY LAB

COURSE OBJECTIVES

To make the students familiarize with

- Design and manufacture of simple patterns.
- Sand testing.
- Arc welding, gas welding and resistance welding equipment for the fabrication of welded joints.
- Injection and blow moulding processes.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Describe effects of the properties of green sand of grain size, moisture content, compressive strength, shear strength and permeability number	K1
2	Perform Arc Welding and Spot Welding.	K3
3	Perform the metal casting and Press working operations.	K3
4	Perform the Pattern making.	K3

I. METAL CASTING LAB:

1. Pattern Design and making - for one casting drawing.
2. Sand properties testing - Exercise -for strengths, and Permeability.
3. Moulding Melting and Casting.

II WELDING LAB:

1. ARC Welding Lap & Butt Joint.
2. Spot Welding.

III METAL FORMING:

1. Blanking & Piercing operations, study of simple, compound and progressive dies.

2. Deep Drawing and Extrusion operations.

IV PROCESSING OF PLASTICS:

1. Injection Moulding.

Blow Moulding.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	-	-	-	2	1	1	-	-	-	1	1	3	-
3	-	-	-	1	2	2	1	-	-	2	1	3	-
3	-	-	-	2	2	2	-	-	-	2	2	3	-
2	-	1	-	1	2	1	1	-	-	1	1	3	-
2.75		**1**		**1.5**	**1.75**	**1.5**	**1**			**1.5**	**1.25**	**3**	

III SEMESTER	L	T	P	C
	-	-	2	1
19CS3L04 - INTERNET OF THINGS LAB				

COURSE OBJECTIVE

- Familiarize students with the use of Arduino for sensing and actuation purposes.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Measure temperature and humidity using various sensors	K3
2	Use IR sensor/push button to on/off LED	K3
3	Interface Bluetooth module with Arduino and Use the same	K3
4	Interface Actuating elements with Arduino and control the same	K3
5	Design and Develop Mobile Application which can interact with Sensors and Actuators.	K3

Expt 1: Familiarization with Arduino and perform necessary software installation.
Expt 2: To interface LED/Buzzer with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds.
Expt 3: To interface Push button/Digital sensor (IR/LDR) with Arduino and write a program to turn ON LED when push button is pressed or at sensor detection.
Expt 4: To interface DHT11 sensor with Arduino and write a program to print temperature and humidity readings.
Expt 5: To interface motor using relay with Arduino and write a program to turn ON motor when push button is pressed.
Expt 6: To interface OLED with Arduino and write a program to print temperature and humidity readings on it.
Expt 7: To interface Bluetooth with Arduino and write a program to send sensor data to smart phone using Bluetooth.
Expt 8: To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smart phone using Bluetooth.
Expt 9: To interface Servo motor with Arduino and write a program to control the same
Expt 10: To interface Stepper motor with Arduino and write a program to control the same using potentiometer
Expt 11: To interface thermistor with Arduino for temperature measurement
Expt 12: To measure temperature using thermocouple by interfacing it with Arduino
Expt 13: Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
Expt 14: Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

NOTE: Any 10 of the above 14 experiments are to be conducted

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	3	3	3	2	2	-				1		
3	3	3	3	3	2	2	-				1		
3	3	3	3	3	2	2	-				1		
3	3	3	3	3	2	2	-	2			1		
3	3	3	3	3	2	2	-	2			1		
3	**3**	**3**	**3**	**3**	**2**	**2**		**2**			**1**		

III SEMESTER (MANDATORY COURSE)	L	T	P	C
	2	-	-	-
19BM0M04 - ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE				

UNIT-I:
Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT-2:
Protection of traditional knowledge:The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT-3:
Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT-4:
Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT-5:
Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Text books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

Web Links:
1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

IV SEMESTER	L	T	P	C
	3	1	-	4
19ME4T01 - THERMODYNAMICS				

COURSE OBJECTIVES:

To impart the knowledge of the thermodynamic laws and principles so as to enable the student to prepare an energy audit of any mechanical system that exchange heat and work with the surroundings

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Apply basic principles and Zeroth law of thermodynamics to solve problems.	K4
2	Apply the first law of thermodynamics to different thermodynamic systems.	K4
3	Apply the second law of thermodynamics and general thermodynamic property relations to solve problems.	K4
4	Describe the thermodynamic concepts of pure substances and identify their properties using standards.	K2
5	Analyze various power cycles, vapour power cycles, and Refrigeration cycles.	K4

UNIT – I

Introduction: Basic Concepts : System, Surroundings, Boundary, Universe, Types of Systems, Control volume, Macroscopic and Microscopic view points, Thermodynamic Equilibrium, Property, State, Process, Cycle , Quasi - static Process, Irreversible Process, Causes of Irreversibility , Energy in State and in Transition- Types- Work and Heat, Point function and Path function, Zeroth Law of Thermodynamics , Concept of Temperature, Principles of Thermometry – Reference Points – Constant Volume gas, electrical resistance thermometers and thermocouple, Ideal Gas Scale.

UNIT II

First Law of Thermodynamics: Perfect Gas Laws – Equation of State, specific heat at constant volume, specific heat at constant pressure and Universal Gas constant, Joule's Experiment – First law for a closed system undergoing a cycle and a change of state – PMM I , First law applied to a Process, various Non-flow processes- properties-end states-Heat transfer-Work Transfer-change in Internal Energy, Throttling and Free Expansion Processes, First law applied to a flow system – Steady Flow Energy Equation –Applications.

UNIT – III

Second Law of Thermodynamics: Limitations of the First Law, Thermal Reservoir, Heat Engine, Refrigerator and Heat pump, Parameters of performance, Second Law of Thermodynamics – Kelvin-Planck and Clausius Statements and their Equivalence – PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT IV

Properties of Pure Substances: Pure Substances – Phase Transformation–P-V diagram – P-T diagram– T-S diagram and h-s diagram or Mollier Chart– P-V-T- surface –Triple point at critical point, Dryness Fraction – Steam Calorimetry, Property tables, Various Thermodynamic processes and energy Transfer.

UNIT - V

Power Cycles: Otto, Diesel, Dual Combustion cycles – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

Vapour Power & Refrigeration Cycles: Brayton cycle and Rankine cycle – thermal efficiency, Bell-Coleman cycle and Vapour compression refrigeration cycle - Coefficient of performance – simple problems on ideal cycles.

TEXT BOOKS:

1. Engineering Thermodynamics - P.K. Nag, 6th Edition, Tata McGraw Hill Education Private Limited, New Delhi. 2017
2. Thermodynamics – An Engineering Approach – Yunus Cengel & M.A.Boles, Tata McGraw Hill Publishing Company Limited, New Delhi. 2017

REFERENCE BOOKS:

1. Fundamentals of Thermodynamics by Claus Borgnakke, Richard E. Sonntag, 8th Edition, John Wiley & Sons (2013)
2. A Text Book of Engineering Thermodynamics- R.K. Rajput, Tenth Edition– Lakshmi Publications, New Delhi. 2017
3. Engineering Thermodynamics - K. Ramakrishna, 2nd edition, Anuradha Publishers, India.2011
4. An Introduction to Thermodynamics- Y. V. C. Rao, Revised Edition, Universities Press, Hyderabad, India.2003

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	2	1	-	-	-	-	-	-	-	-	-	1	-
3	1	1	-	-	-	-	-	-	-	-	-	1	-
3	1	1	-	-	-	-	-	-	-	-	-	1	-
2	1	-	-	-	-	1	-	-	-	-	-	-	-
2	1	-	-	-	-	-	-	-	-	-	-	1	-
2.6	**1.2**	**1**				**1**						**1**	

IV SEMESTER	L	T	P	C
	3	1	-	4
19ME4T02 - THEORY OF MACHINES				

COURSE OBJECTIVES

Machines are those mechanical systems which achieve their task through mobility. The first step in designing machines is synthesizing and performing rigid body dynamic analysis so as to estimate the velocities, accelerations and forces on various members. The current course aims at imparting knowledge as how to analyze various mechanisms for designing a machine. The objectives of the course are as follows:

1. To impart knowledge on various terminologies, criteria and analysis methods related to mechanisms, various mechanisms with lower pairs and their applications.
2. To impart skills to analyze the position, velocity and acceleration of mechanisms.
3. To familiarize higher pairs like cams and gears.
4. To impart mathematical methods for estimating rotary and reciprocating unbalance in mechanisms and machines.
5. To familiarize The Governors.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Analyze and Explain the terminology and criteria of mechanisms as well as working of mechanisms with lower pairs.	K3
2	Analyze the velocity of various links in mechanisms using velocity diagrams or instantaneous center method as well as determine the acceleration of links using acceleration diagrams.	K3
3	Describe the terminology of Gears as well as Analyze Gears and Gear Trains kinematically.	K2
4	Design and Analyze Cams for specified motion and follower.	K4
5	Estimate unbalances force in rotating members and reciprocating mechanisms and Solve problems of Governors.	K3

UNIT-I: SIMPLE MECHANISMS

Basics of Mechanisms And Machines: Types of links, Degrees of freedom, Kinematic pairs – lower pairs and higher pairs, Kinematic chains, mechanisms, Machines, Mobility (Chebychev–Grübler–Kutzbach criterion), inversions - Grashof's conditions for 4-bar chain, inversions of slider crank chain and double slider crank chain with their applications

Mechanisms with Lower Pair: Pantograph, Exact Straight-Line Mechanisms – Peaucellier, Hart and Scott Russell mechanisms, Approximate Straight-Line Mechanisms – Grasshopper, Watt, Tchebicheff and Robert Mechanisms, Modified Scott Russell mechanism, Hooke's Joint.

UNIT-II: VELOCITY & ACEELERATION DIAGRAMS

Velocity and Acceleration Analysis of Mechanisms: Velocity and acceleration – Motion of link in machine – Determination of Velocity Acceleration diagram for a given mechanism, Klein's construction, Coriolis acceleration, determination of Coriolis component of acceleration.

Plane motion of body: Instantaneous center of rotation, centrodes and axodes – relative motion between two bodies – Three centers in line theorem – Graphical determination of instantaneous center, diagrams for Simple mechanisms and determination of angular velocity of points and links.

UNIT-III: GEARS & GEAR TRAINS

Gears & Gear Trains: Gear – Types and profile – nomenclature of spur & helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains.

UNIT – IV: CAMS

Cams: Cam – Types of cams and followers – Cam design for different follower motions (SHM, Uniform Velocity, Uniform Acceleration, Cycloidal profiles), circular and tangent cams – pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

UNIT-V: BALANCING OF MASSES AND GOVERNORS

Balancing of Rotating Masses: Static and dynamic balancing, balancing of single rotating mass by balancing masses in same plane and in different planes.

Balancing of Reciprocating Masses: Inertia effect of crank and connecting rod, unbalance in slider crank mechanism

Governors: Introduction, Centrifugal governor, Watt, Porter and Proell governors, spring loaded governors, Hartnell and Hartung with auxiliary springs

TEXT BOOKS:

1. S.S Rattan, Theory of Machines, 5th Edition, Tata McGrawHill, 2017
2. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2009.

REFERENCE BOOKS:

2. R. K. Bansal, Theory of Machines, 5th Edition, Laxmi Publications (P)Ltd., 2016
3. John J. Uicker, Gordon R. Pennock, Joseph E. Shigley, Theory of Machines And Mechanisms, 4th Edition, Oxford University Press, 2014
4. Cleghorn W.L., Nikolai Dechev, Mechanics of Machines, Oxford University Press, 2015.
5. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, 3rd Edition, Affiliated East-West Pvt. Ltd, New Delhi, 2008.
6. Robert L. Norton, Kinematics and Dynamics of Machinery, SIE, Tata McGrawHill, 2017.
7. R S Khurmi, Theory of Machines, 14th Edition, S. Chand, 2017.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	1	1	-	-	2	-	-	-	-	-	1	3	-
3	2	1	-	-	2	-	-	-	-	-	1	3	-
3	3	2	2	-	1	-	-	-	-	-	1	3	-
3	3	2	2	-	1	-	-	-	-	-	1	3	-
3	3	2	2	-	1	-	-	-	-	-	1	3	-
3	**2.4**	**1.6**	**2**		**1.4**						**1**	**3**	

IV SEMESTER	L	T	P	C
	3	1	-	4
19ME4T03 - STRENGTH OF MATERIALS				

COURSE OBJECTIVES:

1. The student will acquire the fundamental concepts of deformable bodies.
2. The student will be able to draw the shear force and bending moment diagrams for various beams with different loads.
3. The student will acquire the knowledge to sketch both stress distribution curves for bending and shear loads for different sections.
4. The student will compute beam deflections under transverse loads using various methods.
5. The student will compute stress in thin cylinder thick cylinder and spheres due to external and internal pressure.

CO No	Co Statement	Knowledge Level
1	Calculate stresses and strains in structural members subjected to various types of loadings.	K3
2	Sketch the Shear force and Bending moment diagrams of beams subject to combination of loads.	K3
3	Determine and Sketch the stress distribution in section of the beam subjected to Bending and Shear loads.	K3
4	Determine the Shear stresses and Modulus of rigidity, Slope and Deflection in shafts.	K3
5	Evaluate stresses in thin and thick cylinders.	K4

UNIT – I

Simple Stresses and Strains: Introduction, Stress, Strain, Types of Stresses, Elasticity and Elastic Limit, Hooke's Law and Elastic Moduli, Modulus of Elasticity, Factor of Safety, Constitutive Relationship between Stress and Strain.

Elastic Constants: Introduction, Longitudinal Strain, Lateral Strain, Poisson's Ratio, Volumetric Strain, Volumetric Strain of a Cylindrical Rod, Sphere and Rectangular block Bulk Modulus, Expression for Young's Modulus in Terms of Bulk Modulus.

Principal Stresses and Strains

Introduction, Principal Planes and Principal Stresses, Methods of Determining Stresses on Oblique Section, Analytical Method for Determining Stresses on Oblique Section, Graphical Method for Determining Stresses on Oblique Section, Mohr's Circle.

UNIT – II

Shear Force and Bending Moment: Introduction, Types of Beams, Types of Loads, Sign Conventions for Shear Force and Bending Moment, Shear Force and Bending Moment Diagrams for a Cantilever, simply supported and over hanging beams with different loads and combination of loads- Point loads, UDL,UVL and couple. Relation between Load, Shear Force and Bending Moment.

UNIT – III

Flexural Stresses: Introduction, Pure Bending or Simple Bending, Theory of Simple Bending with Assumptions Made, Expression for Bending Stress, Neutral Axis and Moment of resistance, Bending Stresses in Symmetrical Sections, Section Modulus, Section Modulus for Various Shapes of Beam Sections, and Bending Stress in Unsymmetrical Sections

Shear Stresses: Introduction, Shear Stress at a Section, Shear Stress Distribution for Different Sections like Rectangular, Circular, Triangular, I, T and Angle sections.

UNIT – IV

Deflection of Beams: Introduction, Deflection and Slope of a Beam Subjected to Uniform Bending Moment, Relation between Slope, Deflection and Radius of Curvature, Deflection of a Simply Supported, cantilever Beams Carrying point load and UDL using Macaulay's Method and Moment Area Method.

Torsion:

Introduction, Derivation of Shear Stress Produced in a Circular Shaft Subjected to Torsion, Maximum Torque Transmitted by a Circular Solid Shaft and Hollow Circular Shafts, Power Transmitted by Shafts, Expression for Torque in Terms of Polar Moment of Inertia, Polar Modulus, Strength of a Shaft of Varying Sections, Combined Bending and Torsion.

UNIT – V

Thin Cylinders and Spheres: Introduction, Stresses in a Thin Cylindrical Vessel Subjected to Internal Pressure, Expression for Circumferential Stress, Expression for Longitudinal Stress, Efficiency of a Joint, Effect of Internal Pressure on the Dimensions of a Thin Cylindrical Shell, Wire Winding of Thin Cylinders. Thin Spherical Shells, Change is Dimensions of a Thin Spherical Shell Due to an Internal Pressure.

Thick Cylinders: Introduction, Stresses in a Thick Cylindrical Shell, Stresses in Compound Thick Cylinders, Initial Difference in Radii at the Junction of a Compound Cylinder for Shrinkage.

TEXT BOOKS:

1. Solid Mechanics, by Popov E, Prentice Hall India Learning Private Limited, 2nd edition, 2002.
2. Strength of Materials by R K Rajput S. Chand Publishing, 6th Edition, 2015.

REFERENCES:

1. Strength of Materials by R. K Bansal Revised 4th Edition, Laxmi Publications, New Delhi, 2010,
2. Strength of Materials by S.S. Rattan 2nd edition, Tata Mc-Graw Hill Private Limited, New Delhi, 2012
3. Mechanics of Materials, (2nd edition), by Stephen P. Timoshenko, James M. Gere, C B S Publishers, 2011.
4. Mechanics of Materials, by Ferdinand P. Beer, E. Russell Johnston Jr. , John T. DeWolf, David F. Mazurek , 7th Edition, 2014.
5. A Textbook Of Strength Of Materials by R K Rajput, 1st Edition, S. CHAND, 2018.
6. Strength Of Materials, by Ramamrutham S, Dhanpat Rai Publishing Company (p) Ltd., 18th Edition, 2014.
7. Strength of Materials by U. C. Jindal, Pearson Education; 1st edition, 2012.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	2	1	-	-	-	-	-	-	-	1	3	-
2	2	2	1	-	2	-	-	-	-	-	1	3	-
3	2	1	2	-	2	-	-	-	-	-	1	3	-
3	1	2	1	-	-	-	-	-	-	-	1	3	-
3	1	1	1	-	1	-	-	-	-	-	1	3	-
2.8	**1.8**	**1.6**	**1.2**		**1.67**						**1**	**3**	

IV SEMESTER	L	T	P	C
	3	-	-	3
19ME4T04 - METALLURGY & MATERIAL ENGINEERING				

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COURSE OBJECTIVE

- Discuss the principles of physical metallurgy, i.e. crystallography of metals, constitution of alloys, phase diagrams and heat treatment of steels.
- Explain the methods to change the properties of materials through heat treatment processes.
- Expose commercially important metals and alloys (both ferrous and nonferrous) with engineering constraints.
- Familiarize properties and applications of ceramics, polymers and composite materials.
- Demonstrate the fundamental properties of Nano-materials and their applications.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Infer the concept and importance of material science in engineering.	K2
2	Illustrate various types of steels and cast iron, their properties and applications.	K2
3	Summarize the concept of heat treatment of steels and strengthening mechanisms.	K2
4	Asses the Importance of non-ferrous & composites metals and alloys in engineering applications.	K2
5	Describe mechanical properties and various methods to quantify their mechanical integrity	K2

UNIT – I

Structure of Metals: Crystal Structures: Unit cells, Metallic crystal structures.

Imperfection in Solids: Point, Line, interstitial and volume defects, dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Constitution of Alloys: Necessity of alloying, substitutional and interstitial solid solutions-phase diagrams: Interpretation of binary diagrams and microstructure development, eutectic, peritectic, peritectoid and monotectic reactions. Iron-Iron-carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite and cast iron.

UNIT -II

Cast Irons and Steels: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, nodular cast iron, Alloy cast irons. Classification of alloy steel, structure and properties of plain carbon steels, Low alloy steels, tool and die steels, applications of cast iron and steels.

UNIT – III

Heat Treatment: Annealing, normalizing, tempering, Hardening, spheroidizing, isothermal transformation for Fe-Fe3C system, TTT diagrams, Hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

UNIT - IV

Non-Ferrous Metals and Alloys: Micro-Structure, properties and applications of copper and its alloys, Aluminium and its alloys, Titanium and its alloy.

Composite Materials: Classification of composites, various methods of fabrication of composites, particle reinforced and fiber reinforced composites.

UNIT – V

Fracture Mechanism: Types of fracture, methods of protection against fracture.

Mechanical Properties: Elasticity and plasticity in materials, Stress-strain curve, Resolved shear stress, Tensile properties, Hardness and hardness measurement, Impact properties, Fatigue, Creep.

TEXT BOOKS:

1. Materials Science and Engineering: A First Course, 6th ed.(2015) - V. Rahghavan, PHI Publications.
2. Introduction to Physical Metallurgy, 2nd ed. (1997)- Sidney H. Avener, Tata McGraw Hill Edition.

REFERENCE BOOKS:

1. Callister's Material Science and Engineering 2nd ed. (2014), R.Balasubramaniam, wiley india.
2. Material science and metallurgy,42th ed (2018) by V.D. Kodgire, S.V.Kodgire, Everest Publishing House.
3. Engineering materials and metallurgy, Revised edition (2012) - R.K.Rajput, S.Chand & company, New Delhi.
4. Material Science & Metallurgy, 2nd edition (2014) by O.P.Khanna – Dhanpatrai publications.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	2	2	1	-	1	-	-	-	-	-	2	3	-
3	3	2	2	-	1	-	-	-	-	-	2	3	1
3	1	2	2	-	1	-	-	-	-	-	2	3	1
3	2	2	2	-	1	-	-	-	-	-	2	3	2
3	-	2	2	-	1	-	-	-	-	-	2	3	1
3	**2**	**2**	**1.8**		**1**						**2**	**3**	**1.25**

IV Semester	L	T	P	C
	2	-	-	2
19CS4T06 - PYTHON PROGRAMMING				

COURSE OUTCOMES:

At the end of the course students are able to

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CO No	Co Statement	Knowledge Level
1	Recognize core programming basics and program design with functions using Python programming language.	K2
2	Interpret the high-performance programs designed to strengthen the practical expertise.	K3
3	Develop applications for real time problems by applying python data structure concepts.	K2
4	Apply the concepts of packages, handling, multithreading and socket programming.	K2
5	Analyze the importance of object-oriented programming over structured programming.	K3

UNIT – I:

Introduction: 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.

UNIT – II:

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

UNIT – III:

Data Structures Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions.

UNIT – IV:

Functions - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions(Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

Modules: Creating modules, import statement, from. Import statement, name spacing,

Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages

UNIT – V:

Object Oriented Programming OOP 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

TEXT BOOKS

1. Mark Lutz, Learning Python, O'rielly, 5th edition, 2013
2. Vamsi Kurama, Python Programming: A Modern Approach, Pearson, 2nd edition, 2018.

REFERENCE BOOKS:

1. Kenneth A, Introduction to Python, Lambert, Cengage, 2e, 2019.
2. W.Chun, Core Python Programming, Pearson, 2e, 2006.
3. Allen Downey, Think Python, Green Tea Press

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	3	2	2	3	-	-	-	-	-	-	-	2	2
2	2	2	2	3	-	-	-	-	-	-	-	2	2
3	3	2	2	3	-	-	-		-	-		2	3
2	2	3	2	3	-	-	-	-	-	-		1	2
3	3	2	2	3	-	-	-	-	-	-		2	3
2.6	**2.6**	**2.2**	**2**	**3**								**1.8**	**2.4**

IV SEMESTER	L	T	P	C
	-	-	3	1.5
19ME4L01- THEORY OF MACHINES LAB				

COURSE OBJECTIVE:

- Expose the students practically to the concepts they studied in Theory of Machines subject.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Analyze basic mechanisms like four bar mechanism, single slider crank chain and double slider crank chain mechanisms.	K3
2	Analyze kinematically working of cams with various types of followers.	K3
3	Experimentally determine the performance characteristics of different types of governors .	K4
4	Estimate unbalance existing in mechanisms.	K4

Any 10 out of below 14are to be executed

Expt 1: A study on a combination of Four bar Mechanisms
Expt 2: A study on single slider crank chain mechanisms.
Expt 3: A study on double slider crank chain mechanisms
Expt 4: A study on cam with reciprocating follower and oscillating follower
Expt 5: A study on single face cam and face follower mechanism
Expt 6: To perform experiment on watt Governor to prepare performance characteristic Curves, and to find stability & sensitivity.
Expt 7: To perform experiment on porter Governor to prepare performance characteristic Curves, and to find stability & sensitivity.
Expt 8: To perform experiment on proell Governor to prepare performance characteristic Curves, and to find stability & sensitivity.
Expt 9: To perform experiment on Hartnell loaded Governors to prepare performance characteristic Curves, and to find stability & sensitivity.
Expt 10: To perform experiment on Hartung loaded Governors to prepare performance characteristic Curves, and to find stability & sensitivity.
Expt 11: To perform the experiment for static balancing on static balancing machine.
Expt 12: To perform the experiment for dynamic balancing on dynamic balancing machine.
Expt 13: To estimate the reciprocating unbalance in single cylinder engine.
Expt 14: To estimate the reciprocating unbalance in multi cylinder engine.

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	1	1	-	-	2	-	-	-	-	-	1	3	-
3	3	2	2	-	1	-	-	-	-	-	1	3	-
3	3	2	2	-	1	-	-	-	-	-	1	3	-
3	3	2	2	-	1	-	-	-	-	-	1	3	-
3	**2.5**	**1.75**	**2**		**1.25**						**1**	**3**	

IV SEMESTER	L	T	P	C
	-	-	3	1.5
19ME4L02 - STRENGTH OF MATERIALS LAB				

COURSE OBJECTIVE:

To impart practical exposure on the microstructures of various materials and their hardness evaluation. Also to impart practical knowledge on the evaluation of material properties through various destructive testing procedures.

COURSE OUTCOMES: Students will be able to

CO No	Co Statement	Knowledge Level
1	Illustrate the impact resistance in machine components.	K3
2	Determine the hardness of metals and rigidity modulus of spring.	K3
3	Calculate Torsional rigidity and elasticity modulus of the shaft.	K3
4	Compare microstructure of the material with standard structure.	K2
5	Observe the how the hardness is changes by Jomney end quench test.	K2

SECTION – A

MECHNICS OF SOLIDS LAB:

1. Direct tension test
2. Bending test
3. Torsion test
4. Hardness test
    a) Brinell's hardness test
    b) Rockwell hardness test
5. Test on springs.
6. Impact test

SECTION - B

METALLURGY LAB:

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. Hardenability of steels by Jomney End Quench Test.
7. To find out the hardness of various treated and untreated steels.

Note: ANY 5 EXPERIMENTS FROM EACH SECTION A AND B.

PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
3	2	2	2	1	1	1	-	-	-	-	1	3	-
2	-	2	1	1	1	1	-	-	-	-	1	2	-
3	2	2	2	1	1	1	-	-	-	-	1	3	-
3	-	-	-	1	1	1	-	-	-	-	1	1	-
3	-	-	-	1	1	1	-	-	-	-	1	1	-
2.8	**2**	**2**	**1.666666667**	**1**	**1**	**1**					**1**	**2**	

IV SEMESTER	L	T	P	C
	-	-	2	1
19CS4L04 - PYTHON PROGRAMMING LAB				

COURSE OUTCOMES:

At the end of the course students are able to

CO No	Co Statement	Knowledge Level
1	Apply core programming basics and program design with functions using Python programming language.	K3
2	Interpret the high-performance programs designed to strengthen the practical expertise.	K3
3	Develop applications for real time problems by applying python data structure concepts.	K3
4	Test and apply the concepts of packages, handling, multithreading and socket programming.	K3
5	Divide the importance of object-oriented programming over structured programming.	K4

Exercise 1 - Basics

a) Running instructions in Interactive interpreter and a Python Script
b) Write a program to purposefully raise Indentation Error and correct it

Exercise 2 - Operations

a) Write a program to compute distance between two points taking input from the user(Pythagorean Theorem)
b) Write a program add.py that takes 2 numbers as command line arguments and prints itssum.

Exercise - 3 Control Flow

a) Write a Program for checking whether the given number is an even number or not.
b) Using a "for loop", write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, . . .1/10
c) Write a program using a "for loop" that loops over a sequence. What is sequence?
d) Write a program using a "while loop" that asks the user for a number, and prints a countdown from that number to zero.

Exercise 4 - Control Flow - Continued

a) Find the sum of all the primes below two million. Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10terms will be:
1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...
b) By considering the terms in the Fibonacci sequence whose values do not exceed fourmillion, find the sum of the even-valued terms.

Exercise - 5 - DS

a) Write a program to count the numbers of characters in the string and store them in adictionary data structure
b) Write a program to use split and join methods in the string and trace a birthday with adictionary data structure.

Exercise - 6 DS - Continued

a) Write a program combine lists that combines these lists into a dictionary.
b) Write a program to count frequency of characters in a given file. Can you use character frequency to tell whether the given file is a Python program file, C program file or a text file?

Exercise - 7 Files

a) Write a program to print each line of a file in reverse order.
b) Write a program to compute the number of characters, words and lines in a file.

Exercise - 8 Functions

a) Write a function ball collides that takes two balls as parameters and computes if they arecolliding. Your function should return a Boolean representing whether or not the balls are colliding.
Hint: Represent a ball on a plane as a triple of (x, y, r), r being the radius
If (distance between two balls centers) <= (sum of their radii) then (they are colliding)
b) Find mean, median, mode for the given set of numbers in a list.

Exercise - 9 Functions - Continued

a) Write a function nearly equal to test whether two strings are nearly equal. Two strings Aand B bare nearly equal when a can be generated by a single mutation on B.
b) Write a function dups to find all duplicates in the list.
c) Write a function unique to find all the unique elements of a list.

Exercise - 10 - Functions - Problem Solving

a) Write a function cumulative product to compute cumulative product of a list of numbers.
b) Write a function reverse to reverse a list. Without using the reverse function.
c) Write function to compute GCD, LCM of two numbers. Each function shouldn't exceedone line.

Exercise 11 - Multi-D Lists

a) Write a program that defines a matrix and prints
b) Write a program to perform addition of two square matrices
c) Write a program to perform multiplication of two square matrices

Exercise - 12 - Modules

a) Install packages requests, flask and explore them using (pip)
b) Write a script that imports requests and fetch content from the page. Eg. (Wiki)
c) Write a simple script that serves a simple HTTP Response and a simple HTML Page

Exercise - 13 OOP

a) Class variables and instance variable and illustration of the self-variable
i) Robot
ii) ATM Machine

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	2	3	-	2	-	-	-	-	-	2	3		
3	3	3	-	2	-	-	-	-	-	2	3		
3	3	3	-	2	-	-	-		-	2	3		
3	2	2	-	2	-	-	-	-	-	2	3		
3	3	3	-	3	-	-	-	-	-	2	3		
3	**2.6**	**2.8**		**2.2**						**2**	**3**		

IV SEMESTER (MANDATORY COURSE)	L	T	P	C
	2	-	-	-
19BM0M03- INDIAN CONSTITUTION (MANDATORY COURSE)				

UNIT I: Introduction to Indian Constitution-Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT II: Union Government and Administration Structure of the Indian Union: Federalism, Centre State relationship, President: Role, powers and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions

UNIT III: State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

UNIT IV:.Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions of Pachayat Raj Institution: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy.

UNIT V:Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate -State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women.

TEXTBOOKS:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India Pvt. Ltd.
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics

REFERENCE BOOKS:

1. D.C. Gupta, Indian Government and Politics
2. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
3. J.C. Johari, Indian Government andPolitics Hans
4. J. Raj IndianGovernment and Politics
5. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
6. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012.

e-Resources:

1) nptel.ac.in/courses/109104074/8
2) nptel.ac.in/courses/109104045/
3) nptel.ac.in/courses/101104065/
4) www.hss.iitb.ac.in/en/lecture-details
5) www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

V SEMESTER	L	T	P	C
	3	-	-	3
19ME5T01: DESIGN OF MACHINE ELEMENTS				

COURSE OBJECTIVES:

- To familiarize the design procedures and machine components failure under various loadings.
- To develop the basic steps involved in the design of shaft, key and couplings.
- To analyse the functional and strength requirements of various mechanical joints.
- To learn the design procedure of different fasteners, joints, shafts, key, couplings and springs.

Course Outcomes:

Co No	CO Statement	Knowledge Level
1	Describe the design process, material selection, stress concentrations under various loading.	K2
2	Design the machine elements like shaft, couplings and keys.	K4
3	Design the temporary joints such as cotter joints, knuckle joints, and screw joints.	K4
4	Design the permanent joints such as riveted joints, welded joints.	K4
5	Design and analyse mechanical springs for the given loading conditions.	K4

UNIT – I

INTRODUCTION

Basic design procedure– General considerations in the design-Engineering Materials and their properties – Selection –Manufacturing consideration in design- Tolerances and fits– BIS codes.

Concept of Machine Design: Theories of failures, Design of simple machine parts – Impact and shock loading, Stress concentration – Stress concentration factors, fatigue failure, endurance limit, notch sensitivity, Fatigue design under combined stresses - Soderberg, Goodman and modified Goodman diagrams.

UNIT – II

SHAFTS, KEYS AND COUPLINGS: Design of shafts- Shafts subjected to bending, torsion, axial loading, Shafts subjected to fluctuating loads, Design of shafts based on rigidity, Keys-types, Design of keys, Couplings – design of flange and universal couplings. Muff and Split Muff Coupling

UNIT – III

DESIGN OF TEMPORARY JOINTS: Socket & Spigot cotter joint, Sleeve & Cotter joint, Gib and Cotter joint, Knuckle Joint.

Bolted joints – design of bolts with pre-stresses, Design of joints under eccentric loading.

UNIT – IV

DESIGN OF PERMANENT JOINTS: Types of riveted joints, Types of failures, Efficiency of riveted joint, Design of joints for boiler Shell, Eccentrically loaded riveted joints.
Welded joints- types, strength of parallel fillet welds, transverse fillet welds, axially loaded unsymmetrical welded joints, eccentrically loaded welded joints.

UNIT – V

MECHANICAL SPRINGS: Helical springs- classification, terminology, spring materials, spring end formation, Design of helical springs, Concentric springs- surge in spring, Helical torsion springs, Leaf springs.

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2017.
2. R.S. khurmi, J.K.Guptha, "Machine Design", 14th Edition, S Chand publications, 2020.
3. P.C. Sharma., D.K. Agarwal, "Machine Design", 8th Edition, S.K.Kataria& Sons, 2010.
4. S MD Jalaludin, "Machine Design",3rd Edition, Anuradha Publishers, 2016.
5. Joseph Edward Shigley, Mechanical Engineering Design, McGraw-Hill, 10th Edition, 2017.

REFERENCES:

1. Schaum Series, "Machine design", 1st Edition, McGraw Hill Professional publications, 2017.
2. Pandya& shah, "Machine design", 20th Edition, Charotar Publishing House Pvt. Limited, 2015.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	2	1	1	1	1	1	-	-	1	3	-
2	2	3	3	1	1	1	1	1	1	-	-	1	3	-
3	2	2	3	2	1	1	1	1	1	-	-	1	3	-
4	3	3	3	2	1	1	1	1	1	-	-	1	3	-
5	2	3	3	1	1	1	1	1	1	-	-	1	3	-
Avg	**2.2**	**2.8**	**3**	**1.6**	**1**	**1**	**1**	**1**	**1**			**1**	**3**	**5**

V SEMESTER	L	T	P	C
	3	-	-	3
19ME5T02 MACHINE TOOLS				

COURSE OBJECTIVES:

1. The course provides students with fundamental knowledge and principles in material removal processes.
2. In this course, the students apply the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, and drill presses, Computer Numerical Control etc.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Analyze mechanics of metal cutting to determine cutting forces, tool life, tool wear.	K3
2	Illustrate the various machining operations performed on lathes	K2
3	Differentiate various machining operations on shaping, slotting, planning, drilling and boring machines	K3
4	Describe the working principle of milling, methods of indexing and accessories of milling machine.	K2
5	Describe the different types of finishing process and describe the function of jigs and fixtures.	K3

UNIT – I: FUNDAMENTALS OF MACHINING:

Elementary treatment of metal cutting theory, element of cutting process, geometry of single point cutting tool, chip formation and types of chips - built up edge and its effects, chip breakers, Mechanics of orthogonal cutting , Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, Taylor's tool life equation, coolants, tool materials.

UNIT – II: LATHE MACHINES:

Engine lathe - principle of working, lathe components, lathe operations, specification of lathe, types of lathe, work holding devices, tool holding devices, turret and capstan lathes, principal features of automatic lathes - classification - single spindle and multi-spindle automatic lathes.

UNIT – III: SHAPING, SLOTTING AND PLANNING MACHINES:

Shaping, slotting and planning machines, Principles of working - principal parts, specification, operations performed, Crank and slotted link mechanism, Whitworth quick return mechanism, machining time calculations.

DRILLING & BORING MACHINES: Principles of working, specifications, types, operations performed tool holding devices, Nomenclature of twist drill ,Boring Machines - Fine boring machines , Jig boring machine, Deep hole drilling Machine.

UNIT – IV: MILLING MACHINES:

Principles of working - specifications, classification of Milling Machines -Principle features of horizontal, vertical and universal milling machine, Milling operations, types of cutters -geometry of milling cutters , methods of indexing , milling machines accessories.

UNIT –V: FINISHING PROCESSES:

Theory of grinding machines, classification of grinding machines- cylindrical and surface grinding machines, tool and cutter grinding machines,Different types of abrasives bonds specification and selection of a grinding wheel ,Lapping, Honing & Broaching operations,

JIGS & FIXTURES: Principles of jigs and fixtures and uses- classification of jigs & fixtures.

TEXT BOOKS:

1. R. K. Jain, Production Technology, Khanna Publishers, India, 1th edition 2012.
2. P.N.Rao, Manufacturing Technology:Metal Cutting and Machine Tools, 4th edition, McGraw-Hill Education, 2018.
3. Chitale, A.K., and Jain, K.C., Text book of production Engineering. PHI Learning India, 2014.

REFERENCES:

1. Milton Clayton Shaw, Metal cutting principles, Oxford University Press, United Kingdom, 2005.
2. Winston A Knight, and Geoffrey Boothroyd, Fundamentals of machining and machine tools, United Kingdom, Taylor & Francis, 2006.
3.HMT Bangalore, Production Technology, McGraw-Hill Education (India) Pvt Limited, 2001.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	1	-	1	1	-	-	-	-	2	2	-
2	1	1	1	1	2	2	1	-	1	1	-	2	2	1
3	1	1	1	1	2	2	1	-	1	1	-	2	2	1
4	1	1	1	1	2	2	1	-	1	1	-	2	2	1
5	2	-	1	-	-	1	1	-	1	1	-	2	1	2
Avg	1.6	1	1	1	2	1.6	1		1	1		2	1.8	1.25

V SEMESTER	L	T	P	C
	3	-	-	3
19ME5T03 : THERMAL ENGINEERING				

COURSE OBJECTIVES:

- To understand the different processes of Actual Cycles
- To interpret the working principle and various components of IC engine
- To analyze the combustion phenomenon of CI and SI engines and their impact on engine variables.
- To demonstrate the performance of an I.C. Engine.
- To interpret the working principles and various components of Reciprocating and Rotary Air Compressors.

Course Outcomes:

CO No	Co Statement	Knowledge Level
1	Differentiate the air standard cycles and actual cycles concerning engine performance.	K2
2	Illustrate the working of I. C. Engines and its components.	K3
3	Distinguish and discuss the effect of engine variables on combustion phenomenon in S.I. and C.I. engines.	K3
4	Evaluate the performance of I. C. Engines.	K4
5	Describe the working and analyze the performance of reciprocating and rotary air compressors.	K3

UNIT – I

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.

UNIT – II

I.C. ENGINES : Classification - Working principles, Valve and Port Timing Diagrams, Engine systems – Fuel, Carburettor, Fuel Injection, Ignition, Cooling and Lubrication, principle of Wankle engine, principles of super charging and turbo charging.

UNIT – III

COMBUSTION IN S.I. ENGINES: Stages of Combustion Flame Front Propagation, Factors Influencing the Flame Speed, Abnormal Combustion – Knocking, Knock Limited Parameters, anti knock additives, fuel rating, 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 requirements and fuel rating.

UNIT – IV

TESTING AND PERFORMANCE : Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, indicated power, determination of frictional losses and brake power, Performance test, Heat balance sheet and chart.

UNIT – V

AIR COMPRESSORS:

Classification, Reciprocating compressor - principle of operation, work required, isothermal efficiency, volumetric efficiency, effect of clearance, multi stage compression - saving of work, minimum work condition for two stage compression. Rotary compressor - working principles of roots blower, vane sealed compressor, Lysholm compressor, centrifugal compressor, axial flow compressor.

TEXT BOOKS:

1. V. Ganesan, Internal Combustion Engines, Tata McGraw Hill, 4th Edition, 2017
2. R.K.Rajput, Thermal Engineering, Lakshmi Publications, 10th Edition, 2018

REFERENCES:

1. Mahesh M Rathore. Thermal Engineering-I, Tata McGraw Hill, 4th Edition, 2018
2. Rudramoorthy, Thermal Engineering, Tata McGraw-Hill Education India, 4th Edition, 2010 Thermal Engineering,
3. R. S Khurmi and J. S. Gupta, Thermal Engineering, S. Chand Company limited, 2009.
4. **CO-PO-PSO MAAPPING:**

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	2	1	-	-	-	-	-	-	-	-	-	2	-
3	2	1	-	-	-	-	-	-	-	-	-	1	1
3	1	1	-	-	-	-	-	-	-	-	-	1	1
2	3	2	-	-	-	-	-	-	-	-	-	2	1
2	3	2	-	-	-	-	-	-	-	-	-	2	1

2.6	**2.2**	**1.4**										**1.6**	**1**

V SEMESTER	**L**	**T**	**P**	**C**
	1	**-**	**2**	**2**
19ME5T04 MACHINE DRAWING				

COURSE OBJECTIVES:

- To provide basic understanding and drawing practice of various joints, simple mechanical parts.
- To provide hands on practice on selection of views, additional views for various machine elements and parts with every drawing proportion.
- To impart the knowledge on assembly drawing from the individual part drawing.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1.	Draw different types of mechanical components.	K2
2.	Draw and represent standard dimensions of different mechanical fasteners and Couplings.	K2
3.	Draw different types of Joints.	K2
4.	Draw the assembled view and sectional view of machine components with all the dimensions.	K3

I. DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS

a) Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
b) Keys, Cotter joints and knuckle joint.
c) Riveted joints for plates.
d) Shaft coupling, spigot & socket pipe joint.
e) Journal, pivot, collar and foot step bearings.

II. ASSEMBLY DRAWINGS:

a) ENGINE PARTS: Stuffing box, Cross head, Petrol engine connecting rod, Piston assembly.
b) OTHER MACHINE PARTS: Screws jack, Machine Vice, Plummer block, Tailstock.
c) VALVES: Steam stop valve, Spring loaded safety valve, Feed check valve, Air cock.

TEXTBOOKS

1. K.L.Narayana, P.Kannaiah& K. Venkata Reddy , Machine Drawing, 3rd edition, New Age Publishers, 2019.
2. N.D Bhatt, V. M. Panchal, Machine Drawing, 20th edition, Charotar Publishing House Pvt. Ltd, 2014.

REFERENCES

1. P.S.Gill ,A Text book of Machine Drawing, 18th edition, S.K.Kataria & Sons, 2013.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	3	1	3		1				1		3	
2	1	1	2	1	1		1				1		3	
3	1	1	3	3	1		1				1		2	
4	1	1	2	2	1		1				1		3	
Avg	**1**	**1**	**2.5**	**1.8**	**1.5**		**1**				**1**		**2.75**	

V SEMESTER (ELECTIVE-I)	L	T	P	C
	3	-	-	3
19ME5E01 - FINITE ELEMENT ANALYSIS				

COURSE OBJECTIVES:

1. To learn basic principles and procedure of finite element analysis
2. To introduce the concepts of mathematical modeling of Engineering problems.
3. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses performed by others.
4. Learn to model complex geometry problems and solution techniques.

COURSE OUTCOMES: Students are able to

1	Understand the basic concept and application of FEM and compare with other method.	K2
2	Solve the displacement, stress and reactions in trusses and beams.	K4
3	Solve two dimensional problems using CST and higher order elements and apply numerical integration for higher order element problem analysis.	K3
4	Apply finite element analysis to solve steady state heat transfer problems.	K3
5	Determine the natural frequencies and mode shapes for bar and beams.	K4

UNIT – I

Introduction to FEM

Basic concept, Historical background, Application of FEM, Comparison of FEM with other methods. Basic equations of elasticity, Stress- Strain relations, Strain- Displacement relations.

One Dimensional Problem: Finite element modeling, Coordinates and shape functions for one dimensional bar element. Potential Energy approach: formulation and assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions using elimination and penalty approaches.

UNIT –II

Analysis of Trusses: Stiffness Matrix for plane truss element, Assembly consideration, calculations of displacement and reactions.

Analysis of Beams: Hermite shape functions - Element stiffness matrix for simple beam element, Load vector, Calculations of displacement and stresses.

UNIT – III

Two Dimensional Problems: CST-Stiffness matrix and load vectors, Iso-parametric element representation, Shape functions, Convergence requirements -Problems, Quadrilateral elements, Numerical integration.

UNIT – IV

Steady State Heat Transfer Analysis: One dimensional analysis of a fin, one and two dimensional analysis of conduction in plates with convective boundary conditions, Analysis of a uniform shaft subjected to torsion.

UNIT – V

Dynamic Analysis: Formulation of finite element model, Element matrices – Lumped, Consistent mass matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar and a beam, Free Vibration analysis.

TEXTBOOKS

1. S.S.Rao, The Finite Element Methods in Engineering, Elsevier, India, 6th Edition, 2019.
2. R. Tirupathi Chandrapatla, Introduction to Finite Elements in Engineering, Pearson Education, India.4th edition, 2015.

REFERENCES

1. J N Reddy, Introduction to Finite Element Method, McGraw Hill Education, India Pvt Ltd, 4th edition, 2020.
2. Daryl L Logan, A First Course in the Finite Element Method, Cengage Learning, India, 5th edition, 2012.

V SEMESTER (ELECTIVE-I)	L	T	P	C
	3	-	-	3
19ME5E02- HYDROGEN AND FUEL CELLS				

COURSE OBJECTIVE

- The student will acquire essential knowledge about hydrogen and its properties.
- Make the student to understand about Hydrogen Storage technologies.
- The student to know working of various fuel cells, applications and economics.

COURSE OUTCOMES: Students are able to

Co No	CO Statement	Knowledge Level
1	Describe the physical and chemical properties and the characteristics of the Hydrogen energy	K2
2	Describe the generation of the Hydrogen fuel by using different methods.	K2
3	Illustrate the storage methods of hydrogen and its safety management and applications.	K3
4	Classify the history, working principle, fuel generation process, comparison and performance evaluation of the fuel cells.	K3
5	Describe the method of power generation and applications of Fuel Cells.	K4

UNIT I

Hydrogen: Hydrogen as a source of energy, physical and chemical properties, salient characteristics, relevant issues and concerns.

UNIT II

Hydrogen Generation: Production of hydrogen, steam reforming, water electrolysis, gasification and woody biomass conversion, biological hydrogen production, photo dissociation, direct thermal or catalytic splitting of water.

UNIT III

Hydrogen Storage: Hydrogen storage options, compressed gas, liquid hydrogen, hydride, chemical storage, safety and management of hydrogen, applications of hydrogen.

UNIT IV

Fuel Cells: Types, brief history, principle, working, thermodynamics and kinetics of fuel cell process, types of fuel cells; AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits, performance evaluation of fuel cell, comparison of battery and fuel cell.

V UNIT

Fuel Cells -Applications and Economics: Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells.

TEXT BOOKS:

1. Bent Sorensen, Hydrogen and Fuel Cells: Emerging Technologies and Applications, 3nded. Elsevier Academic Press, 2018
2. Dmitri Bessarabov, PEM Electrolysis for Hydrogen Production: Principles and Applications, CRC press 2017
3. Andrzej Wieckowski, Jens K. Nørskov**,** Fuel Cell Science: Theory Fundamentals, and Bio catalysis, John Wiley & Sons, 2010

REFERENCES:

1. Shripad T. Revankar Pradip Majumdar, **Fuel Cells: Principles, Design, and Analysis 6thed,** Scrivener Publishing, **2014**
2. Basile A, Hydrogen Production Separation and Purification for Energy, 8th ed , Institution of Engineering & Technology, , 2017
3. Mehmet Sankir, NurdanDemirciSankir**, Hydrogen Production T**echnologies, 6thed ,Scrivener Publishing, 2019.

V SEMESTER (ELECTIVE-I)	L	T	P	C
	3	-	-	3
19ME5E03 - TOOL DESIGN				

COURSE OBJECTIVES:

1. Implement the tool design process when designing tooling for the manufacturing of a product.
2. Design, develop, and evaluate cutting tools and work holders for a manufactured product.
3. Design, develop, and evaluate appropriate systems to define limits and specifications of a work piece during the manufacturing process.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Describe the design requirements of single point and multi-point cutting tools.	K2
2	Describe the importance of cutting tools and work holding device in design.	K2
3	Illustrate the function of jigs for several operations and simple design of jigs.	K2
4	Illustrate the design principles of fixtures and describe the application of fixtures for machine tools and NC Machine.	K3
5	Describe the fundamentals of die cutting operations and design of simple progressive and sets.	K2

UNIT – I: DESIGN OF CUTTING TOOLS:

Metal cutting process, Selection of tool materials, Design of single point tool, multipoint cutting tool-form tool, drill, milling cutter, broaches and chip breaker.

UNIT – II: LOCATING AND CLAMPING METHODS:

Basic Principles of Location, Locating methods and devices, Principles of clamping - Mechanical, Pneumatic and Hydraulic actuation, Clamping force analysis – Design problems.

UNIT – III: DESIGN OF JIGS:

Types of drill jigs, General considerations in the design of drill jigs, Drill bushings -types, methods of construction ,Simple designs of Plate, Channel, Boxes, Angle plate.

UNIT – IV: DESIGN OF FIXTURES:

Design principles, Types of fixtures, Fixtures for lathe, milling, boring, broaching, Fixture design for NC Machine.

UNIT – V: DESIGN OF DIES:

Fundamentals of die cutting operations - Cutting action in punch and die operations, Die clearance, Design of simple die, progressive die.

TEXT BOOKS:

1. R.K. Jain and S.C. Gupta, Production Technology, Khanna Publishers, 16th edition, 2007
2. Cyril Donaldson ,Tool design, 5th Edition, McGraw hill Publications, 2017.
3. S Kalpak Jian S R. Schmidt, Manufacturing- Engineering and Technology, Pearson publications, 7th Edition, 2014

REFERENCES

1. Elanchezhian & M. Vijay an, ,Machine Tools, Anuradha Publications, 1st edition, 2008
2. Bhattacharya A and Sen, Principles of Machine Tools, New Central Book Agency, 1st edition, 2009.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	2	-	1	2	1	-	-	-	-	-	2	-	2
2	-	1	-	-	-	-	-	-	1	1	1	-	1	1
3	2	2	1	-	1	-	1	-	-	1	-	2	-	1
4	3	1	-	-	-	-	1	-	1	2	-	1	1	1
5	3	-	-	2	1	-	2	-	-	-	-	2	1	1
Avg	**2.67**	**1.5**	**1**	**1.5**	**1.33**	**1**	**1.33**		**1**	**1.33**	**1**	**1.75**	**1**	**1.2**

V SEMESTER (ELECTIVE-I)	L	T	P	C
	3	-	-	3
19ME5E04- PRODUCTION PLANNING AND CONTROL				

COURSE OBJECTIVES:

- To understand functions of production planning and control.
- To crack the forecasting problems.
- To solve the inventory problems using ABC, VED and EOQ models.
- To find the new facility location and layout using Algorithms and understand the recent trends
- To prepare the production schedule for different types of scheduling.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Infer the objectives and functions of production planning and control.	K2
2	Formulate and solve the various forecasting problems in production planning	K3
3	Estimate the required quantities of materials by using ABC, VED and EOQ models	K2
4	Determine the new facility location and layout problems.	K2
5	Apply scheduling techniques to solve the scheduling problems.	K3

UNIT I

Production Planning and Control: Objectives, Functions, Elements, Types of production, Organization of production planning and control department, internal organization of department.

UNIT II

Forecasting: Importance of forecasting, general principles of forecasting, Forecasting Techniques- Qualitative methods, and Quantitative methods.

UNIT III

Inventory Management: Functions of inventories, relevant inventory costs, ABC analysis, VED analysis, EOQ model, Inventory control systems, P–Systems, Q-Systems.

UNIT IV

Facility Location and Layout

Facility location, Factors influencing plant location, Location Alternatives, Facility layout-objectives, functions, layout types.

Recent Trends in PPC

Master Production Schedule, Material Requirement Planning, Introduction to Lean Manufacturing.

UNIT V

Sequencing & Scheduling

Sequencing: Priority Rules, Performance measures, Gantt chart, Scheduling: Objectives, Terminologies, Types of scheduling, Standard scheduling methods: One-machine n job problem, Two-machine n job problem, Three-machine n job problem.

TEXTBOOKS

1. Martand T Telsang, Industrial Management and Production Management, 5th Edition, S Chand Publishers, 2016.
2. S.N. Chary, Production and Operations Management, 6th Edition, McGraw Hill Education Pvt. Ltd, 2019.
3. S.K. Mukhopadhyay, Production Planning and Control, 3rd Edition, PHI Learning Pvt. Ltd, 2015.

REFERENCES

1. Samuel Ellian, Elements of Production Planning and Control, 3rd Edition, McGraw Hill Education Pvt. Ltd, 2018.

2. R.Panneerselvam, Production and Operation Management, 3rd Edition, PHI Learning Pvt. Ltd, 2012.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	1	2	1	2	2	1	-
2	2	3	-	-	1	2	-	-	-	-	2	2	1	-
3	3	3	-	-	1	1	-	-	-	1	1	1	1	-
4	3	3	-	-	-	-	-	-	-	2	1	2	1	
5	3	3	-	-	-	-	-	-	1	1	2	1	1	-
Avg	**2.8**	**2.8**			**1**	**1.5**		**1**	**1.5**	**1.25**	**1.6**	**1.6**	**1**	

V **SEMESTER (ELECTIVE-I)**	**L**	**T**	**P**	**C**
	3	**-**	**-**	**3**
19CS5E19 - PRINCIPLES OF OPERATING SYSTEMS				

COURSE OUTCOMES:

At the end of the course student are able to

CO No	CO Statement	Knowledge Level
1	Define the Basic concepts about Operating System and its functions.	K1
2	Describe Process management, CPU scheduling and Deadlocks.	K2
3	Analyze Memory management	K3
4	Describe and Implement File systems & Disk Structures	K2
5	Perform Case Study on LINUX,WINDOWS and Android OS	K4

UNIT – I

OPERATING SYSTEMS OVERVIEW

Introduction-OS Concepts – Evolution of OS, OS Structures- Kernel, Shell. Operating-System Services, System Calls, Types of System Calls, System Structure. UNIX- Introduction-Architecture, Logging In, Files and Directories, Input and Output, Programs and Processes, Error Handling, User Identification, Time Values, System Calls and Library Functions, Command-Line Arguments, UNIX File API'S.

UNIT – II

PROCESS MANAGEMENT

Process: Concept, Operations on Processes, Inter process Communication. Threads-Multithreading Models, Threading Issues, threads .

Synchronization: The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Critical Regions, Monitors, Classic Problems of Synchronization,

Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms- CPU (Uniprocessor) scheduling algorithms, Multiprocessor and Real-time scheduling algorithms.

Deadlocks: Characterization – Prevention – Avoidance - Detection and Recovery

UNIT – III

MEMORY MANAGEMENT

Basic Memory Management, Swapping, Contiguous Memory Allocation, Virtual Memory Concept, Demand Paging - Page Interrupt Fault, Page Replacement Algorithms, Segmentation – Simple, Multi-level, Segmentation with Paging, Memory Management.

UNIT – IV

INFORMATION MANAGEMENT

File system Interface: The concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection.

File System implementation: File system structure, allocation methods, free-space management

Mass-storage structure: Overview of Mass-storage structure, Disk structure, disk attachment, disk scheduling, Disk Management, Swap-Space Management, RAID Structure.

UNIT – V

CASE STUDY

The Linux System, Microsoft Windows 7, Android Software Platform**:** Android Architecture, Operating System Services, Android Runtime Application Development, Application Structure.

TEXT BOOK:

1. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 10th Edition, John Wiley and Sons Inc., 2018.
2. Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2016.
3. Operating Systems-S Halder, Alex A Aravind,Second Edition,Pearson Education,2016 .

REFERENCE BOOKS:

1."Understanding Operating Systems"Ann McIver McHoes Ida M. Flynn, Sixth Edition,Course Technology-Cengage Learning ,2011.
2. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley, 2001.
3. Operating Systems Design and Implementation, Andrew S. Tanenbaum , Albert S. Woodhull - Amherst, Third Edition Prentice Hall, 2006.
4. Advanced Programming in UNIX Environment, by W. Richard Stevens: 2nd Ed, Pearson Education,

2005.

5. UNIX System Programming Using C++,by Terrence Chan: Prentice Hall India, 1999.

6. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIScBANG/Operating%20Systems/New_index1.html

V SEMESTER	L	T	P	C
	-	-	3	1.5
19ME5L01- MACHINE TOOLS LAB				

COURSE OBJECTIVES:

1. To study the working system, important parts and functions of the machines like Lathe, Drilling, Milling, Shaping and Slotting Machine.
2. To study the material and geometry of tools used in metal cutting like single point, multi point cutting tools.
3. To impart hands on experience on lathe, drilling, shaping, milling, slotting, grinding and grinding machines.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Perform step, taper turing, thread cutting and knurling using lathe machine	K4
2	Perform Drilling, tapping and surface grinding operations.	K4
3	Perform V-block by using Shaping machine	K4
4	Generate a keyway with Slotting Machine	K4
5	Operate Milling machines for cutting various shapes	K4

COURSE CONTENT:

1. Study of general purpose machines – lathe machine, drilling machine, milling machine, shaper machine, slotting machine, and grinding machine.
2. Step turning on lathe machine.
3. Taper turning on lathe machine
4. Thread cutting on lathe machine.
5. Knurling on lathe machine.
6. Drilling and tapping.
7. Shaping operations.
8. Slotting operations.
9. Milling operations.
10. Surface grinding operations.

REFERENCE

1. Bruce Black. J, Workshop processes practices and materials. Routledge, 5th Edition 2015.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1											1	
2	2	1											1	
3	2	1												
4	2	1												
5	2	1											1	
Avg	**2**	**1**											**1**	

V SEMESTER	L	T	P	C
	-	-	3	1.5
19ME5L02 - THERMAL ENGINEERING LAB				

COURSE OBJECTIVES:

- To provide hands on experience in operating various types of internal combustion engines and understands their functioning and performance and applying for proper valve timing in IC engines.
- **Course Outcomes:**

CO No	CO Statement	Knowledge Level
1	Demonstrate the working of various types of boilers.	K3
2	Demonstrate the working of IC engines and draw valve timing diagram.	K3
3	Evaluate performance of diesel and petrol engines	K4
4	Analyze heat balance in I.C. Engine	K4
5	Evaluate the performance of reciprocating air compressor	K4

LIST OF EXPERIMENTS:

1. Study of Boilers.
2. I.C. Engine Valve timing Diagram.
3. Performance test on single cylinder four stroke Diesel Engine.
4. Performance test on single cylinder four stroke Petrol Engine
5. Morse test on multi cylinder, four stroke Petrol Engine.
6. Motoring test on single cylinder four stroke Petrolengine.
7. I.C.Engine heat balance on single cylinder four stroke Diesel Engine.
8. Performance test on Multi cylinder four stroke Petrol Engine.
9. Performance test on Reciprocating Air Compressor.
10. Disassembly / Assembly of I.C. Engine.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	1	-	1	-	1	-	3
CO2	1	-	-	1	-	-	-	-	-	1	-	1	-	3
CO3	3	2	2	1	1	1	1	1	1	1	1	1	-	3
CO4	3	2	1	1	1	1	1	1	1	1	1	1	-	3
CO5	3	2	1	1	1	1	1	1	1	1	1	1	-	3
Avg	**2.2**	**2**	**1.33**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**		**3**

V SEMESTER	L	T	P	C
	2	-	-	-
19CE0M01: ENVIRONMENTAL SCIENCE				

UNIT-I:

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:

Definition, Scope and Importance –Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects;. Role of information technology in environment and human health.

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem; - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT-II:

NATURAL 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 non-agriculture activities-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.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT-III:

BIODIVERSITY AND ITS CONSERVATION:

Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

UNIT – IV

ENVIRONMENTAL POLLUTION:

Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his wellbeing.

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

UNIT – V

SOCIAL ISSUES AND THE ENVIRONMENT:

Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental 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.

Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.
The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:

1. K. V. S. G. Murali Krishna , Environmental Studies,VGS Publishers, Vijayawada, 2010
2. R. Rajagopalan, Environmental Studies, 2nd Edition, Oxford University Press, 2011
3. P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani, Environmental Studies, 2nd Edition , Pearson Education, Chennai,2015

Reference:

1. Deeshita Dave & P. Udaya Bhaskar Text Book of Environmental Studies, Cengage Learning, 2011
2. Shaashi Chawla, A Textbook of Environmental Studies, TMH, New Delhi,2017
3. Benny Joseph, Environmental Studies, Tata McGraw Hill Co, New Delhi, 2006
4. Anubha Kaushik, C P Kaushik , Perspectives in Environment Studies, New Age International Publishers, 2014.

VI SEMESTER	L	T	P	C
	3	-	-	3
19ME6T01: DESIGN OF MECHANICAL TRANSMISSION SYSTEMS				

COURSE OBJECTIVES:

- To impart design knowledge about various machine members such as bearings, engine parts, gears, clutches and brakes.
- To solve numerical problems in design of various mechanical drives.
- To understand the design principles and procedures for various mechanical transmission drives based on standard data and catalogues.
- To learn to use the design standards and catalogues.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Design the journal bearing using different empirical relation and select the rolling contact bearing	K4
2	Design suitable power transmission system like belt drives, chain drives.	K4
3	Design of spur, helical, bevel, and worm gears based on contact and beam strength.	K4
4	Design of Engine parts like connecting rod, crank shaft, piston.	K4
5	Design of the clutches based on torque.	K4

UNIT – I

BEARINGS: Sliding contact bearings: Types, Bearing materials, Lubrication modes, Temperature effect on viscosity, Bearing modulus, McKee equations, Journal bearings design. Rolling contact bearings: Ball and Roller bearings, Static load and dynamic load capacity, Load factor, Equivalent load, Selection of suitable bearings from manufacturer's catalogue.

UNIT – II

BELT AND CHAIN DRIVES: Types, Design of Flat and V belt, Power transmission by flat and V belt drives-transmission efficiencies, Design of Chain drives and Sprockets.

UNIT – III

GEARS: Classifications, Gear materials, Design of Spur gear & helical gear based on strength and wear considerations, Gear tooth failures, Beam strength of Gear teeth, Lewis and Buckingham equations, Thermal design considerations of gears, Design of Bevel and Worm gears.

UNIT – IV

I.C ENGINE PARTS DESIGN: Design of cylinder and head, Piston, Cylinder cross-head, Cylinder liners, Connecting rod.

UNIT- V

CLUTCHES AND BRAKES: Friction clutches- torque capacity of single plate and multi plate clutch, design considerations, Centrifugal clutches. Cone clutches. Brakes: Types, Energy equations, Brake design- Band and block brake, internal expanding shoe brake, self-locking.

TEXT BOOKS:

1. R.S. Khurmi, S.Chand,A Text Book of Machine Design, 25th edition, 2020.
2. V.B.Bandari, Design of Machine Elements, McGraw Hill, 5th edition, 2020
3. Dr.P.C. Sharma., D.K. Agarwal,A Text book of Machine Design, S.K.Kataria& Sons, 2013.
4. Design Data: Data Book of Engineers- PSG College – Kalaikathir Achchaga, Coimbatore, 2012.

REFERENCES:

1. Joseph Edward Shigley, Mechanical Engineering Design, McGraw-Hill, Tenth Edition in SI units, 2017.
2. Robert L. Norton, Machine Design, Pearson Paperback, 2018.
3. Robert C. Juvinall and Kurt M. Marshek, Machine Component Design, Wiley Publishers, 2016. 4. V.B. Bhandari, Design of Machine Elements Paperback, McGraw Hill, 2017.
5. Linda C. Schmidt, George Dieter, Engineering Design, McGraw Hill, 2017.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	2	2	2	2	2	2			2	3	-
2	2	3	3	2	2	2	2	2	2			2	3	-
3	2	2	3	2	2	3	2	2	3			2	3	-
4	3	2	3	3	2	3	3	3	2			2	3	-
5	3	2	3	2	2	2	2	2	3			2	3	-
Avg	2.4	2.4	3	2.2	2.00	2.40	2.20	2.20	2.40			2.00	3.00	

VI SEMESTER	L	T	P	C
	3	0	0	3
19ME6T02- HEAT TRANSFER				

COURSE OBJECTIVES:

- To impart knowledge on various modes of heat transfer (conduction, convection & radiation).
- To get knowledge on heat transfer through extended fin and transient heat conduction.
- To get knowledge on forced and natural convection heat transfer.
- To understand various regimes of boiling and types of condensation heat transfer.
- To impart knowledge on radiation heat transfer.
- **Course Outcomes:**

CO No	CO Statement	Knowledge Level
1	Describe modes of heat transfer and solve one-dimensional heat conduction problems without and with heat generation.	K3
2	Develop heat transfer relations for different fin configurations and solve one-dimensional transient heat conduction problems.	K3
3	Apply different correlations developed for the estimation of forced and natural convection heat transfer.	K3
4	Analyze different heat exchangers and describe various regimes of boiling and types of condensation heat transfer.	K4
5	Apply laws of radiation and estimate radiation heat transfer between bodies	K3

UNIT – I

INTRODUCTION TO HEAT TRANSFER AND CONDUCTION:

Basic modes of heat transfer, laws of heat transfer, multi-mode heat transfer-simple problems, General conduction equation in Cartesian, cylindrical, spherical coordinates, Initial and boundary conditions. One dimensional conduction heat transfer with and without heat generation-Cartesian and cylindrical coordinates only, Thermal contact resistance, Overall heat transfer coefficient, Conduction shape factor.

UNIT – II

CONDUCTION AND CONVECTION SYSTEMS

Extended surface (fins) Heat Transfer –types, General fin heat transfer equation for long Fin, fin with insulated tip, Short Fin, Fin effectiveness, Fin efficiency.

ONE DIMENSIONAL TRANSIENT CONDUCTION HEAT TRANSFER: Systems with negligible internal resistance, Significance of Biot and Fourier Numbers, Chart solutions of transient conduction systems.

UNIT –III

CONVECTIVE HEAT TRANSFER: Classification of convective heat transfer, Dimensional analysis – Buckingham Pi Theorem for forced and free convection, Significance of non-dimensional numbers,

differential mass, momentum and energy equations of laminar boundary layer on a flat Plate, Reynold's and Colburn analogy, Empirical relations of laminar and turbulent flows over geometries of different shapes.

Flow through pipes: Concepts about hydrodynamic and thermal entry lengths - Use of empirical relations for horizontal pipe flow and annulus flow.

Natural convection heat transfer- Laminar Free Convection on a vertical surface, effects of turbulence, Empirical correlations -Vertical Plate, Inclined and Horizontal Plates, long Horizontal Cylinder, Spheres.

UNIT – IV

Boiling and Condensation & Heat Exchangers

Boiling– Pool boiling, different regimes of pool boiling, empirical relation for heat flux in nucleate boiling, maximum or critical heat flux and Leiden frost point.

Condensation - Film wise and drop wise condensation, Nusselt theory of film condensation, applications of boiling and condensation.

Heat Exchangers: Parallel and counter flow double pipe heat exchanger- LMTD, effectiveness- NTU method, Cross flow heat exchanger, Shell and tube heat exchanger.

UNIT – V

Radiation Heat Transfer

Plank's theory of radiation, Stefan – Boltzmann's law of radiation, Wein's displacement law, Emissivity, Absorbvity, Transmissivity, Kirchof's law, Shape factor algebra, Radiation heat transfer between infinite and finite surfaces, Radiation shields.

TEXT BOOKS:

1. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, 5th edition,New Age Internationals, 2017
2. R K Rajput, Heat and Mass Transfer, Revised 5th Edition, S Chand- 2012
3. D.S. Kumar, Heat Transfer, 8thEdition, S. K. Kataria, & Sons, 2015.
4. J. P. Holman,Heat Transfer, 9thEdition, Tata McGraw-Hill publishing Company Limited, 2008.

REFERENCES:

1. P. K. Nag, Heat and Mass Transfer,3rdEdition, Tata McGraw-Hill Education, 2011.
2. S. C Arora,S. Domkundwar and Anand V. Domkundwar, Heat and Mass Transfer, 2nd Edition, , Dhanpat Rai & co, 2007
3. S. P. Sukhatme, Heat Transfer, 4th Edition, Orient Longman Private Limited, 2005

DATA BOOK:

1. C. P. Kothandaraman, S. Subramanyam, Heat and Mass Transfer Data Book ,6th Edition, New Age International Publishers, 2009.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	1		1	1					2		3
2	3	3	2	2		1	1					2		3
3	3	3	2	2	1	1	1					2		3
4	3	3	2	2		1	1					2		3
5	3	3	2	2		1	1					2		3
Avg	3	3	1.8	1.8	1	1	1					2		3

VI SEMESTER	L	T	P	C
	3	0	0	3
19ME6T03 – METROLOGY AND INSTRUMENTATION				

COURSE OBJECTIVES:

- To provide knowledge on various Metrological equipments available to measure the dimension of the components.
- To learn the working principle and applications of various linear and angular measuring instruments
- To learn the principles and methods of form and surface metrology.
- To improve the knowledge on advances in measurements for quality control in manufacturing Industries.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Asses the basic concepts of metrology and measurements.	K3
2	Describe the principles of linear and angular measurement various methods.	K2
3	Relate the principles and working of Interferometer & CMM.	K2
4	Illustrate the working of straightness, Flatness, screw thread and gear teeth, surface finish, Roundness.	K4
5	Describe the principles of Power, pressure and flow measurement through various methods	K2

UNIT I

Basics of Metrology

Measurement – Need, process, role in quality control, Factors affecting measurement – SWIPE, Errors in Measurements – types, Measurement uncertainty – types, estimation, problems on estimation of uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, ISO standards, Introduction to Systems of limits and fits- normal size, tolerance& limits, deviations, allowance, fits and their types.

UNIT II

Linear and Angular Measurements

Linear Measuring Instruments –vernier calipers, micrometer, telescopic gauge, height gauge, and depth gauge, Gauge blocks – use and precautions, Angular measuring instruments – bevel protractor, clinometers, angle gauges, angle dekkor, sine bar, angle alignment telescope, autocollimator.

UNIT III

Advances in Metrology

Lasers in metrology - advantages of lasers, laser scan micrometers, laser interferometers, Straightness, alignment, Ball bar tests, Computer Aided Metrology, Basic concept of CMM – Types of CMM, constructional features ,probes, accessories, software, applications, multi sensor CMMs, Machine Vision - Basic concepts of Machine Vision System, Elements, Applications, On-line and in-process monitoring in production, Computed tomography, White light Scanners.

UNIT IV

Form Measurement

Principles and Methods of straightness, Flatness measurement, Thread measurement, gear measurement, surface finish measurement, Roundness measurement.

UNIT V

Measurement of Power, Displacement, Pressure and Temperature

Force, torque, power - mechanical, pneumatic, hydraulic and electrical type, Displacement – inductive, capacitance, resistance, Pressure - Bourdon pressure gauges, bellows, diaphragm gauges, Temperature - bimetallic strip, thermocouples, electrical resistance thermometer.

TEXTBOOKS

1. Jain R.K. "Engineering Metrology", 21st edition, Khanna Publishers, 2018.
2. Gupta. I.C., "Engineering Metrology", 4th edition, Dhanpatrai Publications, 2018.

REFERENCES

1. R.K.Rajput, "Mechanical Measurements and Instrumentation", 5th edition, S.K. Kataria & Sons, 2013.
2. Beckwith G and Thomas G, Mechanical Measurements, 6th Edition, Pearson Education, 2013.
3. M Mahajan, "Metrology" 2nd edition, Dhanpath Rai & Co, 2014.
4. Smith G T, Industrial Metrology, 1st Edition, Springer London, 2013.

CO-PO-PSO MAAPPING:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
2	2	2	-	-	1	-	-	-	-	-	-	1	-
2	1	-	-	-	1	-	-	-	-	-	-	-	-
2	2	1	-	2	1	-	-	-	-	-	-	1	-
2	1	-	-	1	1	-	-	-	-	-	-	-	-
2	-	-	-	1	1	-	-	-	-	-	-	-	1
2	**1.5**	**1.5**		**1.33**	**1**							**1**	**1**

VI SEMESTER (ELECTIVE-II)	L	T	P	C
	3	-	-	3
19ME6E05: MECHANICAL VIBRATIONS				

COURSE OBJECTIVES:

- To understand various levels of vibrations and remedies for each of them.
- To understand the fundamental knowledge on vibrating systems.
- To understand how to model the physical vibrating systems mathematically and the basic behavior of vibration measuring instruments and their industrial applications.

COURSE OUTCOMES: Students are able to

1	Summarize the basic concepts of vibrations and analyze simple free damped and undamped vibrations.	K4
2	Analyze the response of damped and undamped systems subjected to harmonic excitation.	K4
3	Analyze the response of systems subjected to forced vibrations with different kinds of loads	K4
4	Evaluate the vibration response of multi degrees of freedom systems	K3
5	Evaluate the vibration response of continuous systems.	K3

UNIT – I

FUNDAMENTALS OF VIBRATIONS AND FREE VIBRATIONS

Basic concepts of vibration, Classification of vibrations, Vibration analysis procedure, spring elements, Mass or inertia elements, damping elements, Harmonic analysis. Free vibration of an undamped translational system, free vibration of an undamped torsional system, Stability conditions, Raleigh's energy method, free vibration with viscous damping, coulomb damping, hysteretic damping.

UNIT – II

HARMONICALLY EXITED VIBRATIONS

Introduction, Equation of motion, Response of an undamped system under harmonic force, Response of a damped system under harmonic force, Response of a damped system under harmonic motion of the base, Response of a damped system under rotating unbalance, Forced vibration with coulomb damping, hysteresis damping.

UNIT – III

FORCED VIBRATION AND TWO DEGREES OF FREEDOM

Vibration Under General Forcing Conditions: Introduction, Response under a general periodic force, Response under a periodic force of irregular form, Response under a non-periodic force, Convolution integral. Vibration Measurement: Vibrometers, velocity meters & accelerometers

Two Degree of Freedom Systems: Introduction, Equation of motion for forced vibration, Free vibration analysis of an undamped system, Torsional system, Coordinate coupling and principal coordinates, Forced vibration analysis.

UNIT – IV

MULTI-DEGREE OF FREEDOM SYSTEMS AND NUMERICAL METHODS

Introduction, Modeling of Continuous systems as multi degree of freedom systems, Using Newton's second law to derive equations of motion, Influence coefficients, Free and Forced vibration of undamped systems, Forced vibration of viscously damped systems. Introduction to experimental model analysis.

Determination of Natural Frequencies and Mode Shapes: Introduction, Dunkerley’s formula, Rayleigh’s method, Holzer’s method, Matrix iteration method, Jacobi' s method.

UNIT – V

CONTINUOUS SYSTEMS

Exact and approximate solutions, Transverse vibration of a spring or a cable, Longitudinal vibration of bar or rod, Torsional vibration of a bar or rod, Lateral vibration of beams, critical speed of rotors. Case studies on formulation and response calculation.

TEXT BOOKS:

1. Singiresu S Rao , "Mechanical Vibrations ", 4th Edition, Pearson education , 2011.

REFERENCES:

1. G.K. Grover, "Mechanical Vibrations ", 7th Edition, Nem Chand & Bros , 2014.
2. W.T. Thomson, "Theory of Vibrations ", 5th Edition, Addison-Wesley Publishing, 2003.

VI SEMESTER (ELECTIVE-II)	L	T	P	C
	3	-	-	3
19ME5E06: AUTOMOBILE ENGINEERING				

COURSE OBJECTIVE: The main objectives of this course are

- To make the student familiar with fundamentals of automobiles.
- To gain knowledge about transmission systems and steering systems used in automobiles.
- To understand the important functions of braking and suspension systems.
- To inculcate the knowledge about various components of electrical systems, lubrication systems and safety systems used in automobiles.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Classify and describe the different parts of an automobile engine.	K2
2	Illustrate working principle of transmission system and describe parts of transmission system.	K3
3	Distinguish different steering components and steering .	K2
4	Illustrate working principle of various parts of automobile such suspension and braking systems.	K3
5	Describe the various components of electrical systems, lubrication systems and safety systems used in automobiles.	K2

UNIT I

Introduction: Classification of automobiles, Major components of four wheeler automobile – chassis and body , power plant, power transmission, Types of drives - rear wheel drive, front wheel drive, four wheel drive, Car body styles. Super charger and Turbo Charger - Crank case ventilation.

Engine Specifications: Engine Specifications with regard to power, speed, torque, number of cylinders and arrangement, lubrication and cooling systems.

UNIT II

Transmission System:

Clutches – single plate, multi plate, magnetic, centrifugal, semi centrifugal clutches, Fluid fly wheel, Gear boxes – sliding mesh, constant mesh, synchromesh gear boxes, epicyclic gear box, Torque Converter, Propeller shaft, Universal joint, Differential, Rear axle. Rear axle drives – hotchkiss drive, torque tube drive. Rear axle shaft supporting – semi floating, full floating, and three quarter float axles.

UNIT III

Steering System:

Steering geometry – camber, castor, king pin rake, combined angle toe-in, toe-out, Center point steering, Steering mechanism – Ackerman steering mechanism, Davis steering mechanism, Steering gears, Steering linkages.

UNIT IV

Braking System:

Braking Requirements, Types of Brakes - drum Brakes, disc Brakes, mechanical brakes, hydraulic brakes - master cylinder, wheel cylinder, Tandem master cylinder, Bleeding of hydraulic brakes, Pneumatic brakes, Vacuum brakes.

Suspension System:
Object of suspension systems, Types of suspension springs - Steel springs, Leaf springs, tapered leaf spring, coil spring and torsion bar, Telescopic shock absorber, Rigid axle suspension system, Independent axle suspension system – Wishbone type, MacPherson strut type, vertical guide type and swinging half axle type.

UNIT V
Electrical System:
Charging circuit, Generator circuit, Need for cut-out, Current voltage regulator, Bendix drive mechanism (Starting System), Solenoid switch, Horn, Wiper, Fuel gauge indicator, Lighting system.

Engine Lubrication:
Engine lubrication- splash and pressure lubrication systems, Oil filters – Cartridge type, edge type and centrifugal type, Oil pumps – gear pump, rotor pump, vane pump and plunger pump.
Safety Systems:
Introduction, Seat belt, Air bags, Bumper, Anti-lock brake system (ABS), Wind shield, Suspension sensors, Traction control, Speed control, Mirrors, Central locking, Electric windows.

TEXT BOOKS:
1. Kirpal Singh, Automobile Engineering – Volume-1 and Volume-2, 12th Edition, Standard Publications, 2012.
2. R. K. Rajput, A Text book of Automobile Engineering, 2nd Edition, Lakshmi Publications, 2015.

REFERENCES:
1. G. B. S. Narang, Automobile Engineering, 5th Edition, Khanna Publishers, 2015.
2. R.B. Gupta, Automobile Engineering, 7th Edition, Satya Prakashan Publications, 2010.
3. P.S Gill, Automobile Engineering, Volume 1&2, 2nd Edition, S.K. Kataria& Sons, 2012.
CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3					3						2		3
2	3					3						2		3
3	3					3						3		3
4	3					3						3		3
5	3					1						1		3
Avg	3					2.6						2.2		3

VI SEMESTER (ELECTIVE-II)	L	T	P	C
	3	-	-	3
19ME5E07 - UNCONVENTIONAL MACHINING PROCESSES				

COURSE OBJECTIVE:

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications.

Course Outcomes:

CO No	Co Statement	Knowledge Level
1	Describe the need for unconventional machining processes and its classification.	K2
2	Compare various mechanical energy based processes.	K4
3	Summarize various chemical and electro-chemical energy based unconventional machining processes.	K2
4	Illustrate about electrical based unconventional machining processes.	K2
5	Describe various Nano abrasives based unconventional machining processes.	k2

UNIT – I

Introduction

Need for non-traditional machining methods-Classification of modern machining processes, considerations in process selection, materials, applications, comparison of traditional and non-traditional machining methods

Recent Developments Non-traditional machining processes, working principles, equipments, effect of process parameters, applications, advantages and limitations.

UNIT – II

Cold cutting Process

Abrasive Jet Machining (AJM), Water Jet Machining (WJM) and Abrasive Water Jet Machining (AWJM) - Basic principles, process variables, process Mechanism of metal removal, applications and limitations. Ultrasonic Machining - Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

UNIT – III

Chemical and Electro-chemical energy based processes

Chemical machining and Electro-Chemical machining (CHM and ECM), Etchants, Maskant, techniques of applying maskants, Process Parameters, surface finish and MRR, Applications. Principles of ECM - equipment, Surface Roughness and MRR Electrical circuit, process Parameters, ECG and ECH - Applications.

UNIT – IV

Electric discharge machining:

General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes, Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining

accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

UNIT – V

High energy beam machining:

Laser Beam Machining (LBM), Electron Beam Machining (EBM), Plasma Beam Machining (PBM) - Mechanism of metal removal, process characteristics, accuracy and surface quality, application

Advanced Nano finishing processes

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing their working principles, equipments, effect of process parameters, applications, advantages and limitations.

TEXT BOOKS:

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 1st edition, 2010
2. Gary F. Benedict. "Nontraditional Manufacturing Processes" CRC Press, 1st edition, 2017.

REFERENCES:

1. Suneev Anil Bansal "Advances in Nonconventional Machining Processes", Bentham Science Publishers, 1st edition, 2020.
2. J. Paulo Davim "Nontraditional Machining Processes Research Advances", Springer London,1st edition, 2013.
3. J. Paulo Davim, Kaushik Kumar, Nisha Kumari, "Non-Conventional Machining in Modern Manufacturing Systems" IGI Global., 3rd Edition , 2018.

CO-PO-PSO MAAPPING:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	3	-	-	-	2	-	-	-	-	1	1	-
1	-	3	-	1	-	2	-	-	-	-	1	2	-
1	1	3	-	2	-	2	-	-	-	-	1	2	-
1	-	3	-	1	-	2	-	-	-	-	1	2	-
1	-	3	-	1	-	2	-	-	-	-	1	2	-
1	**1**	**3**		**1.25**		**2**					**1**	**1.8**	

VI SEMESTER (ELECTIVE-II)	L	T	P	C
	3	-	-	3
19ME6E08 - INDUSTRIAL ENGINEERING AND MANAGEMENT				

COURSE OBJECTIVES

1. To impart fundamental knowledge and skill sets required in the Industrial Management and Engineering profession, which include the ability to apply basic knowledge of mathematics, probability and statistics, and the domain knowledge of Industrial Management and Engineering.

2. To produce graduates with the ability to adopt a system approach to design, develop, implement and innovate integrated systems that include people, materials, information, equipment and energy.

3. To enable students to understand the interactions between engineering, business, technological and environmental spheres in the modern society.

4. To enable students to understand their role as engineers and their impact to society at the national and global context.

Course Outcomes:

CO No	Co Statement	Knowledge Level
1	Describe management principles and integrate these principles into job situations.	K2
2	Interpret the techniques of work study, and time study.	K2
3	Describe layouts of manufacturing operations.	K2
4	Explain the principles of material handling and materials management.	K2
5	Describe the quality control techniques and decision-making concept.	K2

UNIT - I

MANAGEMENT SCIENCE: Basic concepts of Management, Contribution of Taylor and Fayol to Scientific Management, Motivation and Control, Maslow's hierarch of needs, Leadership styles, Managerial Grid.

UNIT - II

WORK STUDY: Introduction, Techniques of work study, Method study- procedure, recording techniques, Principles of motion economy, Micro-motion analysis, Work measurement – Time study, work/activity sampling, Predetermined motion time standards, Job evaluation and Merit rating- Procedure and Methods.

UNIT - III

PLANT LOCATION: Importance and factors affecting plant location, Single and Multi- facility plant location problems.

PLANT LAYOUT: Need, Importance, Objectives and Principles of good plant layout, Types of layout and applications.

UNIT-IV

MATERIAL HANDLING: Principles of material handling, Types of material handling equipment and selection.

MATERIALS MANAGEMENT: Objectives, Inventory control- Purpose, types, functions, basic EOQ, safety stock inventory control systems, selective control of inventory ABC and VED analysis, Inventory control system-periodic review system, Store Management and stores record, purchase management.

UNIT - V

DECISION MAKING: Introduction, Decision making environments, Decision tree analysis.

INSPECTION AND QUALITY CONTROL: Types of Inspections, Statistical Quality Control techniques, acceptance sampling plan, Introduction to Total Quality Management, Quality Circles, ISO 9000 series procedures.

TEXT BOOKS

1. Kumar Pravin, Industrial Engineering and Management, 2nd edition, Pearson India, 2015.
2. S.C. Sharma, T.R. Banga, Industrial Engineering and Management, 1st edition, Khanna publishing house,India, 2019.

REFERENCE BOOKS

1. Kaushik Kumar, Divya Zindani, Industrial Engineering and Management, 1st edition, I K.International pvt. ltd, 2021.
2. O. P. Khanna, Industrial Engineering and Management, Revised edition, Dhanpat Rai Publications, 2018.

CO-PO-PSO MAAPPING:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
2	2	2	1	1	1	1	1	2	1	1	1	-	2
2	1	1	2	1	1	2	1	2	1	2	1	-	2
3	2	2	2	1	2	1	1	1	1	3	1	-	2
2	1	1	1	1	2	2	1	1	1	1	1	-	2
3	2	3	1	1	1	1	1	3	1	3	1	-	2
2.4	**1.6**	**1.8**	**1.4**	**1**	**1.4**	**1.4**	**1**	**1.8**	**1**	**2**	**1**		**2**

SEMESTER-VI (ELECTIVE-II)	L	T	P	C
	3	-	-	3
19CS5E22 - INTERACTIVE COMPUTER GRAPHICS				

COURSE OUTCOMES:

CO No	Co Statement	Knowledge Level
1	Define the operations of Display Devices and develop algorithms for graphics primitives	K1
2	Draw lines, circles, ellipse and Design 2D-object Transformations and Viewing.	K2
3	Illustrate 3D-object representations, Transformations and Viewing.	K3
4	Analyze different Visibility Detection methods	K3
5	Develop simple Graphics Animation Applications.	K4

UNIT- I:

Introduction: Application areas of Computer Graphics, Overview of Graphics Systems: video-display devices, raster-scan systems, random scan systems, storage tube graphics display, Raster scan display and input devices.

Output primitives : Points and lines, line drawing algorithms: DDA, Bresenhams, Mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms.

UNIT- II:

2-D geometrical transforms: Translation, scaling, rotation, reflection and shear transformations homogeneous coordinates, composite transforms, transformations between coordinate systems.

2-D viewing : The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, Cohen-Sutherland and Liang-Barsky line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm

UNIT- III:

3-D Object Representation: Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and Surfaces. 3-D Geometric transformations: Translation, Rotation, Rotation about an arbitrary axis in space,scaling, reflection and shear transformations, composite transformations

UNIT- IV:

3-D Viewing : Viewing pipeline, Viewing Coordinates, View Volume, Projections: Parallel Projection, Perspective Projections Clipping.

Visible Surface Detection Methods: Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, Area Sub-division and Octree methods

UNIT –V:

Computer Animation: Design of Animation Sequence, General Computer Animation Functions, Raster Animation, Computer Animation Languages, Key Frame,Motion Specifications. Introduction to Multimedia.

TEXT BOOKS:

1. Computer Graphics C version, Donald Hearn, M.Pauline Baker, Pearson
2. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH

REFERENCE BOOKS:

1. Computer Graphics Principles & practice, 2/e, Foley, VanDam, Feiner, Hughes, Pearson .
2. Computer Graphics, Zhigandxiang, Roy Plastock, Schaum's outlines, 2/E, TMH.
3. Procedural elements for Computer Graphics, David F Rogers, 2/ e, TMH.
4. Principles of Interactive Computer Graphics, Neuman ,Sproul, TMH Principles of Computer Graphics, ShaliniGovil, Pai, 2005, Springer

VI SEMESTER (ELECTIVE-III)	L	T	P	C
	3	-	-	3
19ME6E09 - VEHICLE DYNAMICS AND CONTROL				

COURSE OBJECTIVES:

- To develop the basic knowledge of the students in automotive field in the areas of vehicle vibrations.
- To develop the skills of the students in the tire dynamics with respect to force & moments.
- To acquire knowledge on different effects on the dynamic characteristics of the vehicle
- To gain knowledge on aerodynamic forces & moments, load distribution in the various vehicles
- To develop knowledge on testing of effective steering geometry, vehicle handling & directional control of vehicle

COURSE OUTCOMES: Students are able to

Co No	Co Statement	Knowledge Level
1	Understand the basics of vibration when the vehicle is at dynamic condition.	K2
2	Describe the tire dynamics with respect to force & moments.	K2
3	Describe the effective cornering stiffness when considering the elastic elements in the wheel suspension and be able to analyze effect on the dynamic characteristics of the vehicle	K2
4	Illustrate the aerodynamic forces & moments, load distribution in the various vehicles.	K2
5	Infer the effective steering geometry, vehicle handling & directional control of vehicle	K2

UNIT – I: CONCEPT OF VIBRATION:

Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification Factor, Transmissibility, Vibration Absorber, Vibration Measuring Instruments, Torsional Vibration, Critical Speed.

UNIT – II: TIRE DYNAMICS

Tire Forces and Moments, Tire Structure, Longitudinal and Lateral Force at Various Slip Angles, Rolling Resistance, Tractive and Cornering Property of Tire. Performance of Tire on Wet Surface. Ride Property of Tires. Magic Formulae Tire Model, Estimation of Tire Road Friction. Test on Various Road Surfaces. Tire Vibration.

UNIT – III: VERTICAL DYNAMICS

Human Response to Vibration, Sources of Vibration. Design and Analysis of Passive, Semi-Active and Active Suspension Using Quarter Car, Half Car and Full Car Model. Influence of Suspension Stiffness, Suspension Damping, and Tire Stiffness. Control Law for LQR, H-Infinite, Skyhook Damping. Air Suspension System and Their Properties.

UNIT – IV: LONGITUDINAL DYNAMICS

Aerodynamic Forces and Moments. Equation of Motion. Resistance, Rolling Resistance, Load Distribution for Three Wheeler and Four Wheeler. Calculation of Maximum Acceleration, Reaction Forces for Different Drives. Braking and Driving Torque. Prediction of Vehicle Performance.

UNIT – V: LATERAL DYNAMICS

Steady State Handling Characteristics. Steady State Response to Steering Input. Testing of Handling Characteristics. Transient Response Characteristics, Direction Control Of Vehicles Roll Center, Roll Axis, Vehicle Under Side Forces. Stability of Vehicle Running on Slope, Banked Road and During Turn, Effect of

Suspension on Cornering, Latest Trends in Vehicle Dynamic Testing Like Four Poster, Multi Axis Simulator, etc.

TEXT BOOKS

1. Singiresu S. Rao, Mechanical Vibrations, 5th Edition, Prentice Hall, 2010.
2. Martin Meywerk, Vehicle Dynamics,1st edition, John Wiley, 2015 .
2. Wong. J. Y.,Theory of Ground Vehicles, 3rd Edition, Wiley-Inter science, 2014.
3. Rajesh Rajamani, Vehicle Dynamics and Control, 1st edition, Springer, 2015.

REFERENCES

1. Dean Karnopp, Vehicle Stability, 1st edition, Marcel Dekker, 2014.
2. Nakhaie Jazar. G., Vehicle Dynamics: Theory and Application, 1st edition, Springer, 2015.

VI SEMESTER (ELECTIVE-III)	L	T	P	C
	3	-	-	3
19ME7E14 - STEAM AND GAS POWER SYSTEMS				

COURSE OBJECTIVES:

- To learn the working and performance of vapour power cycles
- To learn the different types of boilers and steam nozzles and their performance parameters.
- To learn the different types of steam turbines.
- To learn the types of condensers and their performance parameters.
- To understand the principle of jet propulsion and working principles of various jet engines and rocket engines.

COURSE OUTCOMES: Students are able to

Co No	CO Statement	Knowledge Level
1	Analyze and compare the performance of different vapour power cycles	K4
2	Describe working of high pressure boilers and analyze the performance steam nozzles.	K4
3	Describe the working and analyze the performance of both impulse and reaction turbines.	K4
4	Illustrate the working and analyze the performance of different condensers	K4
5	Describe the working of gas turbines and jet propulsion principles.	K2

UNIT – I

VAPOUR POWER CYCLES:

Rankine cycle- schematic layout, thermodynamic analysis, Methods to improve cycle performance – regeneration, reheating, Binary vapour cycle, Fuels and combustion-classification of fuels, stoichiometric air fuel ratio, Exhaust gas analysis-Orsat apparatus, Adiabatic flame temperature.

UNIT – II

STEAM BOILERS:

Classification of steam boilers, Description of high and supercritical boilers -LaMont boiler, Benson boiler, Loeffler boiler, Use of various mountings and accessories of steam boiler.

STEAM NOZZLES:

Nozzle shapes, Thermodynamic analysis – assumptions, critical pressure ratio, nozzle efficiency, Super saturated flow- its effects, Degree of super saturation and degree of under cooling - Wilson line.

UNIT – III

STEAM TURBINES:

Classification, Impulse turbine - velocity diagram, effect of friction, power developed, axial thrust, blade or diagram efficiency, condition for maximum efficiency, Methods to reduce rotor speed-velocity compounding, pressure compounding, combined velocity diagram for a velocity compounded impulse turbine. 106

Reaction turbine-Principle of operation, Thermodynamic analysis of Parson's reaction turbine - degree of reaction, velocity diagram, condition for maximum efficiency, calculation of blade height.

UNIT – IV

STEAM CONDENSERS:

Classification - jet condenser, surface condensers, requirements, advantages, Daltons law of partial pressures, Measurement of vacuum in a condenser - vacuum efficiency, condenser efficiency, mass of cooling water required, Sources of air leakages into condenser, Effects of air leakage.

UNIT – V

GAS TURBINES: Simple gas turbine plant – ideal cycle, essential components, Parameters of performance– regeneration, inter cooling and reheating, Actual cycle, Closed and semi-closed cycles – merits and demerits, Types of combustion chambers.

JET PROPULSION : Principle of operation, Classification of jet propulsive engines – working principles with schematic diagrams and representation on T-s diagram, Thrust, thrust power and propulsive efficiency, Turbo jet engines – schematic diagram, thermodynamic cycle, Performance evaluation, Thrust augmentation – methods.

TEXT BOOKS:

1. Sadhu Singh, Thermal Engineering, Pearson India Publications, 3rd Edition, 2018
2. R. K. Rajput, Thermal Engineering, Lakshmi Publications, 10th Edition, 2018
3. Mahesh M Rathore . Thermal Engineering, Tata McGraw Hill, 4th Edition, 2010
4. V. Ganesan, Gas Turbines, TMH, 3rd Edition, 2010

REFERENCES:

1. Yunus A. Çengel, Michael A. Boles, Thermodynamics: An Engineering Approach, McGraw-Hill, 8th Edition, Reprint, 2014
2. P.K.Nag,"Engineering Thermodynamics" 6thedition,Tata McGraw Hill Education Private Limited,2017.
3. R. S Khurmi and J. S. Gupta , Thermal Engineering, 4thedition, S. Chand Company limited, 2009.

VI SEMESTER (ELECTIVE-III)	L	T	P	C
	3	-	-	3
19ME6E11- AUTOMATION IN MANUFACTURING				

COURSE OBJECTIVE: The main objective of this course is

- To study the types and strategies and various components in Automated Systems.
- To understand the automated flow lines, line balancing, material storage and retrieval and inspection.
- To understand the automated assembly systems, part delivery, workstation, single and multi-station Assembly machines.
- To impart the necessary basic concepts of Automated Material Handling And Storage Systems, Types of equipment, functions, conveyor systems, automated guided vehicle systems.
- To impart the knowledge on application of adaptive control in machining operations, types of inspection methods and equipment.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Describe the strategies and various components in Automated Systems.	K2
2	Analyze the line balancing problems in the various flow line systems with and without use buffer storage.	K4
3	Summarize various automated assembly systems, part delivery and workstation	K2
4	Describe the different automated material handling, storage and retrieval systems	K2
5	Describe the different automated inspection systems. Use of Adaptive Control principles and implement the same online inspection and control	K2

UNIT-I:

Introduction: Types and strategies of automation, pneumatic and hydraulic components, circuits, automation in machine tools, mechanical feeding and tool changing and machine tool control. Advantages and disadvantages of Automation in Manufacturing.

UNIT-II:

Automated Flow Lines: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations. Analysis of automated flow lines – General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT-III:

Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi-Station Assembly Machines, Single Station Assembly Machines, Partial
Automation

UNIT-IV:

Automated material handling and storage systems: Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems, Monorails and other Rail

Guided Vehicles. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

Automatic Identification methods: Overview**,** bar code technologies, redio frequency identification, other technologies.

UNIT-V:

Adaptive Control Systems: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration in the adaptive controls systems.

Automated Inspection: Fundamentals, types of inspection methods and equipment, Coordinate Measuring Machines, Machine Vision,

TEXT BOOK

1. Mikell P. Groover, Automation Production Systems and Computer Integrated Manufacturing, 4th Edition, Pearson Education, 2016.
2. P.Radhakrishnan, S.Subramanyam, V.Raju, CAD / CAM/ CIM, 4th Edition, New Age International Pvt Ltd, 2018.
3. P. N. Rao, "CAD /CAM – Principles and Applications", 2nd Ed., Tata McGraw Hill, 2004.

REFERENCES

1. Ibrahim Zeid and R. Sivasubramanian, "CAD / CAM – Theory and Practice", 2nd Edition, Tata McGraw Hill, 2010**.**
2. Dr Chris Mcmahon and Prof Jimmie Browne, CADCAM: Principles, Practice and Manufacturing Management, 2nd Edition, Prentice Hall, 1998.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2		2	2						2	3	
2		3	2	1	2							2	3	
3	3		2	3	2	2						2	3	
4	3		2	3	2	2						2	3	
5	3		2	3	2	3						2	3	
Avg	3	3	2	2.5	2	2.25						2	3	

VI SEMESTER (ELECTIVE-III)	L	T	P	C
	3	-	-	3
19ME6E12 - TOTAL QUALITY MANAGEMENT				

COURSE OBJECTIVES:

- To understand the concept of Quality
- To understand the principles of quality, customer focus and satisfaction.
- To understand statistical process control.
- To implement TQM tools and techniques.
- To implement quality systems.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Describe the concept of Total Quality Management and discriminate product and service quality	K2
2	Analyze various principles of Total Quality Management that are practically applicable.	K4
3	Illustrate different Statistical Quality Control methods.	K4
4	Distinguish various tools and techniques of Total Quality Management and Recognize the importance of six sigma in Quality Management.	K4
5	Evaluate the various ISO standards that are used for testing the quality of a product in the present scenario.	K4

UNIT I

INTRODUCTION

Introduction - Need for quality, Evolution of quality, Definitions of quality, Dimensions of product and service quality, Basic concepts of TQM, TQM Framework, Contributions of Deming, Barriers to TQM.

UNIT II

TQM PRINCIPLES

Leadership, Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal, Continuous process improvement, PDCA cycle, 5S, Kaizen

CUSTOMER FOCUS AND SATISFACTION:

The importance of customer satisfaction and loyalty- Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction

UNIT III

STATASTICAL PROCESS CONTROL

Significance of statistical process control (SPC), Construction of control charts for variables and attributed, Process capability – significance and measurement, concepts of process capability. Business process Improvement (BPI)– principles, applications, reengineering process, benefits and limitations

UNIT IV

TQM TOOLS AND TECHNIQUES

The seven traditional tools of quality, New management tools, Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking- reason to benchmark, benchmarking process, FMEA - stages, types. Control Charts, Process Capability, Quality Function Development (QFD), Taguchi quality loss function, Total Productive Maintenance (TPM)– concepts, terotechnology, improvement needs, performance measures.

UNIT V

QUALITY SYSTEMS

Need for ISO 9000, ISO 9001-2008 Quality System, Elements, Documentation, Quality Auditing, QS 9000, ISO 14000, Concepts, Requirements and Benefits, TQM Implementation in manufacturing and service sectors.

TEXTBOOKS

1. Besterfield Dale H., Besterfield Carol,, Besterfield Glen H., Besterfield Mary, Urdhwareshe Hemant, Urdhwareshe Rashmi, Total Quality Management (TQM), 5th Edition, Pearson Publication, 2018.
2. Dr. Gunmala Suri and Dr. Puja Chhabra Sharma, Total Quality Management, 1st Edition, Wiley India- - 2013.

REFERENCES

1. Poornima M. Charantimath, Total Quality Management, 3rd Edition, Pearson Education, 2017.
2. Subburaj Ramasamy, Total Quality Management, 1st Edition, McGraw Hill, 2009.

3. CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2		2	2						2	3	
2		3	2	2	2							2	3	
3	3		2		2	2						2	3	
4	3		2		2	2						2	3	
5	3		2		2	2						2	3	
Avg	3	3	2	2	2	2						2	3	

VI SEMESTER (ELECTIVE-III)	L	T	P	C
	3	-	-	3
19CS6E23 - OBJECT ORIENTED PROGRAMMING THROUGH JAVA				

COURSE OUTCOMES:
At the end of the course student able to

CO No	CO Statement	Knowledge Level
1	Describe the differences between procedural oriented programming and object oriented programming (OOP) paradigms, Apply OOP Concepts.	K2
2	Describe Java features and Java Concepts.	K2
3	Illustrate the concepts of Inheritance and polymorphism	K3
4	Implement the Packages and Interfaces	K4
5	Apply Exception handling Concepts.	K4

UNIT -I

Basics of Object Oriented Programming: Introduction to OOP: Paradigms of Programming Languages - Basic concepts of Object Oriented Programming – Differences between Procedure Oriented Programming and Object Oriented Programming - Objects and Classes – Data abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic binding, Message communication – Benefits of OOP – Application of OOPs. Introduction to Java: History – Java features, Creating and Executing a Java program – Java Tokens: Keywords, Character set, Identifiers, Literals, Comments in Java program Separator – Java Virtual Machine (JVM).

UNIT -II

Java Basics Data types, variables, scope and life time of variables, arrays, operators, expressions, control Statements, type conversion and casting, simple java program, classes and objects – concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, parameter passing, recursion and string handling methods.

UNIT -III

Inheritance: Defining a subclass – Deriving a sub class – Single Inheritance – Multilevel Inheritance – Hierarchical Inheritance – Overriding methods – Final variables and methods – Final classes - Abstract methods and classes – Visibility Control: public access, private access, protected. Member access rules, super keyword and abstract keyword.

UNIT-IV

Packages and Interfaces:

Packages: Defining, Creating and Accessing a Package, Understanding Class path, importing packages.
Interfaces: Defining an interface, implementing interface, Differences between classes and interfaces, variables in interface and extending interfaces.

UNIT-V

Exception handling: Concepts of exception handling, benefits of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally keywords, built-in and user defined exceptions.

Multithreading: Define thread, Differences between multi-threading and multitasking, Creating Threads, Running Thread, Life Cycle of a Thread, Thread Methods, Thread Priority, Synchronization, Implementing runnable interface and thread groups.

Text Books:

1. Herbert Schildt: "Java The complete reference", 7th Edition, Tata McGraw Hill, 2011.
2. E.Balaguruswamy: "Programming with Java A Primer", 4th Edition, Tata McGraw Hill, 2009.

Reference Books:

1. Programming in Java by saurabh chaudhary , sachin malhotra, oxford edition.
2. Java: How to Program, 8/e, Dietal, Dietal, PHI
3. JAVA Programming, K.Rajkumar, Pearson.
4. Core JAVA, Black Book, NageswaraRao, Wiley, Dream Tech.

VI SEMESTER	L	T	P	C
	-	-	4	2
19ME6L01- HEAT TRANSFER LAB				

COURSE OBJECTIVES:

- To impart necessary skills to perform analysis and interpret results to draw valid conclusions on modes of heat transfer.
- To determine thermal properties and performance of radiation heat transfer, heat exchanger.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Determine the thermal conductivity of metal rod, lagged pipe and composite wall .	K3
2	Determine the temperature distribution, efficiency and effectiveness of a fin.	K3
3	Determine the convective heat transfer co- efficient and the rate of heat transfer by natural and forced convection.	K3
4	Calculate LMTD, Effectiveness and overall heat transfer coefficient for the parallel flow and counter flow heat exchangers	K3
5	Determine Emissivity of the given gray body	K3

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LIST OF EXPERIMENTS

1. Determine the thermal resistance, thermal conductivity of composite wall.
2. Determine the thermal conductivity of lagged material for the given pipe.
3. Determine the thermal conductivity of given insulating powder.
4. Determine the thermal conductivity of given metal rod.
5. Determine the temperature distribution, efficiency and effectiveness of a pin fin.
6. Determine heat transfer co efficient and heat transfer rate for a heated vertical cylinder in natural convection.
7. Determine the convective heat transfer co- efficient and the rate of heat transfer by forced convection for flowof air.
8. Determine LMTD, Effectiveness and overall heat transfer coefficient for the parallel flow and counter flowheat exchangers.
9. Determine critical heat flux of given Nicrome wire.
10. Determine the Emissivity of the given gray body.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	2	2	2	2	3	2	1	2		3
2	3	2	2	2	2	2	2	2	2	2	2	2		3
3	3	2	2	2	2	2	2	2	2	2	2	2		3
4	3	2	2	2	2	2	2	2	2	2	2	2		3
5	3	2			2	2	2	2	1	2	2	2		3
Avg	3	2	2	2	2	2	2	2	2	2	1.8	2		3

VI SEMESTER	L	T	P	C
	-	-	3	1.5
19ME6L02 METROLOGY AND INSTRUMENTATION LAB				

COURSE OBJECTIVES

1. Measurement of linear and angular dimensions
2. Measurement of pressure, flow, speed, displacement and temperature.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Demonstrate the correct methods for measurement and calibration of various measuring devices.	K3
2	Relate the effective methods of measuring gear profile, screw threads.	K3
3	Compute the internal bore diameter measurement by bore gauge and telescope gauge.	K3
4	Compute the temperature measurement using thermocouple, thermistor, hot wire anemometer, resistance temperature detector	K3
5	Compute the displacement measurement, pressure measurement using suitable measuring devices	K3

LIST OF EXPERIMENTS:

1. Measurement of lengths and diameters by using vernier caliper and micrometer.
2. Measurement of central distance between two holes by using vernier height gauge.
3. Measurement of gear tooth profile using gear tooth vernier.
4. Angle and taper measurements by Bevel protractor, Sine bar.
5. Thread measurement by using Tool maker's microscope.
6. Calibration Of Strain Gauge for Temperature Measurement
7. Study And Calibration of Photo and Magnetic Speed Pickups for The Measurement Of Speed
8. Calibration of hot wire anemometer for temperature measurement.
9. Calibration of Thermistor for Temperature Measurement.
10. Calibration of thermocouple for temperature measurement.
11. Study of resistance temperature detector for temperature measurement.
12. Study and calibration of LVDT transducer for displacement measurement
13. Calibration of capacitive transducer for angular displacement.
14. Pressure measurement using strain gauge setup.

Note: Any 10 experiments from the above experiments to be conducted

CO-PO-PSO MAAPPING:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	-	-	-	3	-	-	-	-	-	-	-	2	-
2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1	-	-	-	-	-	-	-	-	-	-	1	-
2	2	-	-	-	-	-	-	-	-	-	-	1	-
2.2	**1.33**			**3**								**1.33**	

VI SEMESTER	L	T	P	C
	-	-	2	1.0
19HS6L03: ADVANCED ENGLISH COMMUNICATION SKILLS				

At the end of the course students will be able to prepare themselves for their career which may require them to listen and speak in English both for their professional and interpersonal communication in the globalized context.

Course objectives

- Analyzing a topic of discussion and relating to it.
- Planning and executing an assignment creatively.
- Presenting ideas coherently within a stipulated time.
- Communicating ideas effectively in prescribed oral activities.
- Applying relevant writing formats for resume and presentations.
- Facing interviews with confidence.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1.	Gather ideas and organize information relevantly and coherently.	K2
2.	Participate in group discussions and face interviews with confidence.	K3
3.	Write Resume with covering letter.	K2
4.	Make oral presentations and public speaking.	K3
5.	Take part in social and professional communication.	K3

SYLLABUS

The following course content is prescribed for the **Advanced English Communication Skills Lab:**

UNIT I

Communication Skills

- Introduce Yourself
- JAM
- J2M

➢ Identifying one's career objective, projecting strengths and skills, organization of ideas within given time.

UNIT II

Interaction Skills

- Body Language
- Role- Plays

➢ Students start a conversation - Respond appropriately and relevantly in different situations with right body language.

UNIT III

Oral Skills

- Presentations
- Public Speaking

➢ Planning preparation and presentation - organization of ideas with clarity , coherence and style.

UNIT IV

Writing Skills

- Covering Letter
- Resume Writing

➢ To communicate the ideas relevantly and coherently in writing.

UNIT V

Team Work Skills

- Group Discussion

➢ Dynamics of Group Discussion - Modulation of voice, Body language , relevance , fluency and coherence.

UNIT VI

Interview Skills

➢ Pre-interview planning, opening strategies, answering strategies, interview through tele and video conference.

Reference Books:

1. Ashraf Rizvi- Effective Technical Communication - McGraw Hill Education- 2017.
2. Madhavi Apte - A Course in English Communication – Prentice - Hall of India- 2007.
3. Dr. Shalini Verma - Body Language – Your Success Mantra- S. Chand- 2006.
4. Sunita Mishra & C.Murali Krishna- Communication Skills for Engineers - Pearson Education - 2007.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								2	2	3		1		
2								2	2	3		1		
3								2	2	3		1		
4								2	2	3		1		
5								2	2	3		1		
Avg								**2**	**2**	**3**		**1**		

VI SEMESTER	L	T	P	C
	2	-	-	-
19GE0M03: PROFESSIONAL ETHICS AND INTELLECTUAL PROPERTY RIGHTS				

COURSE OUTCOMES:

Students are able to

CO No	Co Statement	Knowledge Level
C319.1	Identify the professional roles played by an engineer and illustrate the process of Social experimentation .	K3
C319.2	Determine Engineer's responsibilities and rights towards the society.	K2
C319.3	Analyze various aspects of Intellectual Property Rights and recognize the process of protecting the copyrights .	K3
C319.4	Describe the registration process of Patents and trademarks and also demonstrate the concept of trade secrets and cybercrimes.	K2

UNIT-I

ENGINEERING ETHICS:

Importance of Engineering Ethics-–Professional and Professionalism –Professional Roles to be played by an Engineer –Professional Ethics.

UNIT-II

ENGINEERING AS SOCIAL EXPERIMENTATION :

Role of engineering in knowledge society- Knowledge acquired – Conscientiousness – Relevant Information –Engineers as Managers, Consultants, and Leaders.

ENGINEERS' RESPONSIBILITY FOR SAFETY AND RISK: Role and importance of Safety and risk-Types of Risks –Threshold Levels for Risk– RiskBenefit Analysis.

UNIT-III

ENGINEERS' RESPONSIBILITIES AND RIGHTS:

Collegiality-Conflict of Interest-solving conflict problems – Ethical egoism-Collective bargaining - Confidentiality-Acceptance of Bribes/Gifts--Occupational Crimes-industrial espionage-Whistle Blowing-types of whistle blowing.

UNIT IV

INTELLECTUAL PROPERTY AND COPY RIGHTS:

Introduction to Intellectual Property Law - Types ofIntellectual Property – Infringement,Copyrights**:**Introduction to Copyrights – Principles of Copyright – Rights Afforded byCopyright Law –Copyright Formalities and Registration.

UNIT-V

PATENTS AND TRADEMARKS:

Introduction to Patent Law –Rights under Patent Law – Patent Requirements – Patent Application Process and Granting of Patent – Double Patenting – Patent Cooperation Treaty**.** Trademarks:Introduction to Trade Mark – Trade Mark Registration Process – Trade Markmaintenance – Likelihood of confusion

TEXT BOOKS:

1. M.Govindarajan, S.Natarajan and V.S.SenthilKumar- "Engineering Ethics and Human Values" by PHI Learning Pvt. Ltd-2009.

2. Deborah E.Bouchoux, "Intellectual Property". Cengagelearning , NewDelhi, BS Publications (Press)

3. PrabhuddhaGanguli,' Intellectual Property Rights" Tata Mc-Graw – Hill, New Delhi

VII SEMESTER	L	T	P	C
	3	-	-	3
19ME7T01: 3D PRINTING AND DESIGN				

COURSE OBJECTIVES:

- To explore technology used in additive manufacturing.
- To acquire knowledge for selecting correct CAD formats in manufacturing process.
- To understand the operating principles and limitations of liquid, solid and laser based additive manufacturing system.
- To design the process of additive manufacturing including tools used for design.
- To acquire knowledge on important process parameters for bio-manufacturing

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Assess the fundamentals and need of Additive Manufacturing in Product development	K2
2	Infer the appropriate design and Additive Manufacturing Process for Product/Prototype development	K2
3	Predict the technical challenges in 3D printing and recommend the appropriate use of 3D printing technology	K2
4	Identify real-life scenarios opportunities to apply 3D printing technology for time and cost savings	K2
5	Describe the applications, advantages and limitations of each 3D printing technology	K2

UNIT I

INTRODUCTION

3D printing Overview, History , Need, Classification ,Additive Manufacturing Technology in product development, Materials for Additive Manufacturing Technology

UNIT II

REVERSE ENGINEERING

Basic Concept –3D Scanning Digitization techniques, Model Reconstruction, Data Processing for Additive Manufacturing Technology, Part Orientation and support generation, Model Slicing, Tool path Generation.

UNIT III

ADDITIVE MANUFACTURING SYSTEMS

SOLID& LIQUID BASED- Classification , Stereo lithography Apparatus (SLA) - Principle, process, advantages, Fused Deposition Modeling – Principle, process, advantages.

LASER BASED - Selective Laser Sintering – Principle, Process, advantages, Three Dimensional Printing – Principle, process, advantages - Laser Engineered Net Shaping (LENS)

UNIT IV

DESIGN FOR AM

Motivation, Design for Manufacturing and Assembly (DFMA)- concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM - Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts, Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.

UNIT V

APPLICATIONS OF 3D PRINTING.

Customized implants and prosthesis: Design and development, Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE), Applications of 3D Printing in Aerospace, Automotive, Manufacturing and Architectural Engineering.

TEXT BOOKS

1. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, Third Edition, World Scientific Publishers, 2016.

2**.** Gebhardt A,Rapid prototyping, Hanser Gardener Publications, 2017.

3. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications, World Scientific Publishers, Fourth Edition of Rapid Prototyping, 2018.

REFERENCES

1. Liou L.W. and Liou F.W., Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2017.

2. Kamrani A.K. and Nasr E.A., Rapid Prototyping: Theory and practice, Springer, 2016.

3. Hilton P.D. and Jacobs P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2015.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	3			2	2			2		3	
2	3	3	2	2			2	2			2		3	
3	3	3	2	3			2	1			2		3	
4	3	3	2	3			2	2			2		3	
5	3	3	2	3			2	2			2		3	
Avg	3	3	2	2.8			2	1.8			2		3	

VII SEMESTER (ELECTIVE-IV)	L	T	P	C
	3	-	-	3
19ME7E13 - INDUSTRIAL ROBOTICS				

COURSE OBJECTIVE:

1. Understand classification of robots and basic components

2. Get acquainted with performing spatial transformations and solve kinematics of the robot.

3. Get acquainted with performing spatial transformations and solve Dynamics of the robot.

4. Analysis skills associated with trajectory planning.

5. Understand the present &future applications of a robot.

Course Outcomes:

CO No	CO Statement	Knowledge Level
CO1	Summarize the basic components of robots and its classification.	K2
CO2	Learn the various motion analysis principles to solve problems involving Manipulator Kinematics.	K3
CO3	Formulate Jacobian and Lagrangian principles to solve manipulator Dynamics Problems.	K3
CO4	Develop program a robot to perform tasks in industrial applications	K3
CO5	Classify different Applications of Robots in industry	K2

UNIT – I

INTRODUCTION: Robotics- Classification with respect to geometrical configuration (Anatomy), controlled system & chain type, Serial manipulator & Parallel Manipulator. Components of Industrial robotics, Precession of movement-resolution, accuracy & repeatability, Dynamic characteristics- speed of motion, load carrying capacity, speed of response, Sensors-Internal sensors: position sensors, velocity sensors, External sensors- proximity sensors, tactile Sensors, force or torque sensors.

UNIT – II

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation- problems, Euler Angles, Manipulator kinematics- D-H Notations, joint coordinates and world coordinates, forward and inverse kinematics, problems of simple robotic manipulators.

UNIT – III

MANIPULATOR DYNAMICS: Differential transformation of manipulators, Jacobians, Lagrange, Euler and Newton, Euler formulations- Problems.

CONTROL: Architecture- position, path velocity and force control systems, Computed torque control, Adaptive control and Servo system for robot control.

UNIT – IV

TRAJECTORY PLANNING: Joint space scheme, Cubic polynomial fit, Obstacle avoidance in operation space, Cubic polynomial fit with via point, blending scheme, Cartesian space scheme, Robot programming-languages and software packages.

UNIT – V

ROBOT APPLICATIONS IN MANUFACTURING: Material Transfer, Machine loading and un-loading Operations, Processing Operations, Spot and continuous arc welding , Spray painting, Assembly Operations , Inspection , Safety in Robotics, Training , Maintenance.

TEXT BOOKS:

1. John J. Craig , Introduction to Robotics , Pearson, 2019.
2. Mikell P. Groover , Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, Industrial Robotics , 2nd edition, TATA McGraw-Hill Education, 2008.
3. R.K. Mittal, I. J. Nagrath , Robotics and Control , Tata Mc Graw Hill Publishing Company Ltd , 2003.

REFERENCES:

1. K.S. Fu, R.C.Gonzalez, C.S.G Lee , Robotics, control Sensing, vision and intelligence , Tata Mc Graw Hill Education.
2. Saeed B. Niku / Pearson , Introduction to Robotics – Analysis, Systems, Applications , Education, 2011
3. Lung-Wen Tsai , Robot Analysis – Mechanics of Serial and Parallel Manipulators , John-Wiley Publications, New York.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		3	2		2						3	2	
2	3	3	2	3		1						2	3	
3	2	3	3	2		3						3	3	
4	1	2	2	3		1						1	2	
5	2	2	3	1		2						3	3	
Avg	2.2	2.5	2.6	2.2		1.8						2.4	2.6	

VII SEMESTER (ELECTIVE-IV)	L	T	P	C
	3	-	-	3
19ME7E14 - REFRIGERATION AND AIR CONDITIONING				

COURSE OBJECTIVES:

- To learn the various methods of refrigeration and working principle of Air Refrigeration cycles.
- To learn about the various components and working principle of vapour compression refrigeration system.
- To learn the operation of vapour absorption, steam jet and non conventional refrigeration systems.
- To learn air conditioning systems by cooling load calculations.
- To learn the requirements of comfort air conditioning, types of air conditioning systems and their equipments

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Identify the necessity and applications of refrigeration and analyze various air refrigeration cycles.	K4
2	Illustrate the properties of refrigerants and analyze the performance of vapour compression refrigeration cycle	K4
3	Describe the working of Vapour absorption system, Steam jet refrigeration system and other non-conventional refrigeration systems	K3
4	Apply psychometric properties & processes for estimating thermal load	K3
5	Analyze the requirements of an air conditioning system for human comfort and industrial applications and differentiate various Air Conditioning Systems and their components.	K4

UNIT – I

FUNDAMENTALS OF REFRIGERATION: Introduction to refrigeration, Necessity and applications, Unit of refrigeration, C.O.P- Refrigerator and Heat pump, Methods of refrigeration.

AIR REFRIGERATION SYSTEM: Introduction, Working principle of air refrigeration system, Reversed Carnot cycle, Bell Coleman cycle, Open and dense air systems, Air craft refrigeration systems.

UNIT – II

VAPOUR COMPRESSION REFRIGERATION (VCR) SYSTEM: Working principle - Simple Vapour Compression Refrigeration cycle - T-s and P-h charts, COP, effect of sub cooling and superheating, Actual vapour compression cycle.

REFRIGERANTS: Classification, Desirable properties, thermodynamic properties, Commonly used refrigerants.

VCR SYSTEM COMPONENTS: Compressors, Condensers, Evaporators – Classification, Working, Working of flooded and dry expansion type evaporator, Expansion devices – Classification, working of automatic expansion valve, thermostatic expansion valve, Capillary tube**.**

UNIT – III

VAPOUR ABSORPTION REFRIGERATION (VAR) SYSTEM: Simple absorption refrigeration system- Working principle, COP, Practical Aqua ammonia refrigeration system, Lithium Bromide Water refrigeration system, Electrolux refrigeration system.

STEAM JET REFRIGERATION SYSTEM: Principle of working, analysis, applications.

NON- CONVENTIONAL REFRIGERATION METHODS: Principle and operation of thermoelectric refrigeration and Vortex tube.

UNIT – IV

PSYCHROMETRY: Introduction, Psychrometric properties and relations - Psychrometric chart, Air conditioning processes, Sensible, Latent and Total heat factors , Bypass factor, Load concepts of RSHF, GSHF problems, concept of ESHF and ADP temperature.

LOAD CALCULATIONS: Sources of load- internal heat gains, system heat gains, Cooling and heating load estimation.

UNIT – V

HUMAN COMFORT: Thermal Comfort - effective temperature, comfort chart, Comfort and Industrial Air conditioning.

AIR CONDITIONING SYSTEMS: Classification, Central, Unitary systems, Summer, Winter, Year round systems.

AIR CONDITIONING EQUIPMENT: Air Cleaning-air filters, Construction and working of Humidifiers, Dehumidifiers, Fans, Blowers, Grills and Registers.

TEXT BOOKS:

1. C. P. Arora, Refrigeration and air conditioning, 3rd edition, Tata McGraw Hill, 2013
2. S. C. Arora, Domkundwar, A course in Refrigeration and Air Conditioning, 8th edition, Dhanapat Rai and Sons 2017.
3. R. S. Khurmi and J. K. Gupta, Refrigeration and Air conditioning, 5th edition S. Chand Publications, 2018.

REFERENCES:

1. Manohar Prasad, Refrigeration and Air Conditioning,3rd edition, New Age International (P) Ltd Publishers,2015
2. Roy J. Dossat, Principles of Refrigeration, 4th edition, Pearson Education 2010.
3. W. F. Stoecker and J. W. Jones,Refrigeration and Air Conditioning, 2nd edition, McGraw Hill,2014

DATA BOOK:

Refrigerants &Psychrometric Properties, M.L. Mathur& F.S. Mehta 2010.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	3		3	3					2		3
2	3	3	2	2	1	1	1					2		3
3	3	3	2	2	3	3	3					2		3
4	3	3	2	2	3	3	3					2		3
5	3	2	2	3	1	3	1					2		3
Avg	3	2.6	2.2	2.4	2	2.6	2.2					2		3

VII SEMESTER (ELECTIVE-IV)	L	T	P	C
	3	-	-	3
19ME5E15 - LEAN MANUFACTURING				

COURSE OBJECTIVES:

- To impart knowledge for facilitating worker environment to identify hidden manufacturing wastes.
- To understand the knowledge on systematic approach for implementing lean manufacturing practices.

COURSE OUTCOMES: Students are able to

Co No	CO Statement	Knowledge Level
1	To State the hidden manufacturing wastes in industries.	K1
2	To Analyze the effectiveness of lean manufacturing tools.	K2
3	To Describe the elements of just in time manufacturing.	K3
4	To Develop a roadmap for successful implementation of lean principles.	K4
5	To Evaluate various case studies of implementation of lean manufacturing at industries.	K5

UNIT I

Principles of Lean Manufacturing

Review of manufacturing paradigm - Objectives of lean manufacturing, key principles and implications of lean manufacturing, traditional versus lean manufacturing characteristics, Value creation and waste elimination - major kinds of manufacturing waste, concept of takt time, continuous flow, continuous improvement, single piece flow.

UNIT II

Lean Manufacturing Tools and Methodologies

Values stream mapping - Current state and future state value stream mapping, Standard work - Communication of standard work to employees, visual controls, Quality at the source, 5S principles, Total Productive Maintenance, Changeover and setup time reduction, Production levelling - Failure mode and effect analysis, line balancing, mistake proofing.

UNIT III

Cellular Manufacturing, JIT, TPM

Cellular Manufacturing – Types of layout, principles of cell layout, implementation, JIT – Principles of JIT and implementation of Kanban, TPM – Pillars of TPM, principles and implementation of TPM.

UNIT IV

Lean Manufacturing Implementation

Road map for lean manufacturing implementation, Reconciling lean with other systems, Lean six sigma, integrating lean principles in ERP and PLM, Lean production in Industry 4.0, impact of industry 4.0 on lean production system.

UNIT V

Case Studies: Various case studies of implementation of lean manufacturing at industries.

TEXTBOOKS

1. Micheal Wader, "Lean Tools: A Pocket Guide to Implementing Lean Practices", 2nd Edition, Productivity and Quality Publication, 2018.
2. Lonnie Wilson "How To Implement Lean Manufacturing" 2nd Edition, McGraw-Hill Education, 2015.
3. William M Feld, "Lean Manufacturing: Tools, Techniques and How to Use Them," 1st Edition, CRC Press, 2001.

REFERENCES

1. Beata Mrugalska, Magdalena K. Wyrwicka, "Towards Lean Production in Industry 4.0", 2nd Editon, Springer international publishing, 2017.
2. S. R. Devadasan, V. Sivakumar, P. R. SHALIJ "Lean and Agile Manufacturing: Theoretical, Practical and Research futurities", 1st Edition, PHI Learning, 2012.
3. Askin R G, Goldberg J B, "Design and Analysis of Lean Production Systems", 3rd Edition, John Wiley and Sons Inc., 2007.

VII SEMESTER (ELECTIVE-IV)	L	T	P	C
	3	-	-	3
19ME5E16 - SUPPLY CHAIN MANAGEMENT				

COURSE OBJECTIVES:

- To understand the fundamentals of concept of supply chain management.
- To find the sourcing and transportation in supply chain management.
- To make optimization models for supply chain management.
- To acquire the current trends in supply chain management.
- To discern the Supplier and customer relationship management.

COURSE OUTCOMES: Students are able to

Co No	CO Statement	Knowledge Level
1	Describe fundamental supply chain management concepts	K2
2	Apply strategically method to evaluate and manage an effective supply chain	K3
3	Develop optimization models for supply chain management	K3
4	Apply the current supply chain recent trends	K3
5	Determine information system developments	K3

UNIT I

INTRODUCTION TO SCM: Supply Chain –Fundamentals, importance, decision phases, Process View of a Supply Chain: Push/Pull and Cycle Views, Supply Chain performance, Strategic Fit and Scope, Supply Chain Drivers and Metrics.

UNIT II

SOURCING: In-Sourcing and Out-Sourcing, Types of purchasing strategies, Supplier Evaluation Selection, Third Party Logistics, Supplier Quality Management, Creating a world-class supply base and World Wide Sourcing.

TRANSPORTATION: Modes of Transportation in a Supply Chain Management, Design option for Transportation Network, Role of IT in Transportation.

UNIT III

NETWORK DESIGN IN SUPPLY CHAINS: Factors Influencing the Network Design Decision, Framework for Network Design Decisions, Models for Facility Location and Capacity Location - Gravity Location Models, Supply Chain Network Optimization Models.

UNIT IV

RECENT TRENDS: E-Business, Framework and role of Supply Chain in e-business and b2b practices, Supply Chain IT Framework, Internal Supply Chain Management, Fundamentals of transaction management and Supply Chain in IT Practice.

UNIT V

INFORMATION SYSTEM DEVELOPMENTS: Role of IT in a Supply Chain**,** Supply Chain IT framework, Supplier relationship management, Customer Relationship Management, Future of IT in Supply Chain Management.

TEXTBOOKS

1. Sunil Chopra and Peter Meindl, Supply Chain Management –Strategy Planning and Operation, 6th Edition Indian Reprint, Pearson Education, 2016.
2. Monczka et al., Purchasing and Supply Chain Management, 4th Edition, South-Western Cengage Learning, 2009.

REFERENCES

1. Altekar Rahul V, Supply Chain Management –Concept and cases, 8th Edition, Prentice Hall India, 2012.
2. Ballou Ronald H, Business Logistics and Supply Chain Management,5th Edition, Pearson Education, 2007.
3. Shapiro Jeremy F, Modeling the Supply Chain, 2nd Edition, Cengage Learning, 2006.

SEMESTER-VII (ELECTIVE-IV)	L	T	P	C
	3	-	-	3

19CS7E25 - PRINCIPLES OF SOFTWARE ENGINEERING

COURSE OUTCOMES:

At the end of the course, the student should be able to

Co No	CO Statement	Knowledge Level
1	Identify, formulate and solve software engineering problems	K2
2	Elicit, analyze and specify software requirements with various stakeholders of a software development project and different software development process models	K3
3	Apply systematic procedure for software design and deployment	K4
4	Compare and contrast the various testing methods	K3
5	Identify the key activities in managing a software project.	K3

UNIT I

INTRODUCTION AND SOFTWARE PROCESS: Evolving Role of Software, Software Characteristics, Changing Nature of Software, Software Myths, Software Engineering- A layered Technology, a Process Framework, Capability Maturity Model Integration(CMMI), Process Assessment, Process Models – Waterfall Model, Incremental Process Models, Evolutionary Process Models, The Unifies Process.

UNIT II

REQUIREMENTS ANALYSIS AND SPECIFICATION: Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management- Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

UNIT III

SOFTWARE DESIGN: Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design – Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV

TESTING AND IMPLEMENTATION: Software testing fundamentals-Internal and external views of Testing-white box testing- basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging – Software Implementation Techniques: Coding practices-Refactoring.

UNIT V

PROJECT MANAGEMENT: Estimation – FP Based, LOC Based, Make/Buy Decision, COCOMO II – Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection, RMMM – Scheduling and Tracking –Relationship between people and effort, Task Set & Network, Scheduling, EVA – Process and Project Metrics.

TEXT BOOK:

1. Software Engineering, A practitioner's Approach- Roger S. pressman, 8th edition, McGraw-Hill lnternational Edition, 2014.
2. Software Engineering, Ian Sommerville, 10th Edition, Pearson Education Asia, 2016.

REFERENCE BOOKS:

1. Software Engineering, Pankaj Jalote, A Precise Approach", Wiley India, 2010.
2. Systems Analysis and Design- Shely Cash man Rosenblatt, 9th Edition,Thomson publications, 2016.
3. Software Project Management, Bob Hughes, Mike Cotterell and Rajib Mall, Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
4. https://nptel.ac.in/courses/106101061/

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	1	-	-	1	-	-	-	2	-	-	-	-	-
-	3	-	-	1	2	-	-	2	-	-	2	-	-
-	-	3	1	1	1	-	-	2	-	2	2	-	-
-	-	-	2	1	1	-	2	2	-	-	2	-	-
-	-	-	1	2	1	2	-	1	-	-	-	-	-
3	**2**	**3**	**1.33**	**1.2**	**1.25**	**2**	**2**	**1.8**		**2**	**2**		

VII SEMESTER	L	T	P	C
	-	-	3	1.5
19ME7L01 - AUTOMATION AND ROBOTICS LAB				

COURSE OBJECTIVE:

The objective of this course is to impart knowledge about basic mathematics related to industrial robots for their control, design and application in robotics & automation Industries.

Course Outcomes:

CO	CO Statement	Knowledge Level
1	Describe the concept of various configurations of robot.	K2
2	Analyze the Forward and Inverse kinematics of robots.	K3
3	Impart the practical skills sufficient to design and realize basic automation process.	K2
4	Demonstrate the various automation process by using PLC	K3
5	Develop the knowledge in programming for performing various operations.	K3

LIST OF EXPERIMENTS

RoboAnalyzer

1. Verification of transformation (Position and orientation) with respect to gripper and world Coordinate system.
2. Work space analysis for different configurations of robot.
3. To analyze Forward kinematics of robots by using RoboAnalyzer.
4. To analyze Inverse kinematics of robots by using RoboAnalyzer.

PLC

5. To develop the ladder logic diagram using Bit Instructions.
6. To identify encoder interfacing with PLC.
7. Performance of Stepper motor / Servo motor control using PLC.
8. Performance of PLC based parking station using Counter and Bit Instructions.

CPRog

9. Robot programming and simulation for pick and place operation.
10. Robot programming and simulation for machining (cutting, welding)

ADD ON EXPERIMENT

1. Robot Teaching Using VAL Programming.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1		1						2	2	
2	1	3	3	2		1						2	3	
3	1	3	3	2		1						2	3	
4	2	3	3	2		1						1	2	
5	2	2	2	2	2	2						1	2	
Avg	1.6	2	2.6	1.8	2	1.2						1.6	2.4	

VII SEMESTER	L	T	P	C
	-	-	3	1.5
19ME7L02:CAD/CAM LAB				

COURSE OBJECTIVES:

- To impart the students with necessary computer aided modeling skills using standard CAD packages.
- To expose the students to different applications of simulation and analysis tools.
- To expose the students to the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-codes and writing part program for simple machine parts**.**

Course Outcomes:

Co No	CO Statement	Knowledge Level
1	Modeling of simple machine parts and assemblies from the part drawings using standard CAD packages.[	K2
2	Analyze various machine parts by using analysis software.	K3
3	Develop CNC Turning and Milling codes for different operations using standard CAM packages.	K3
4	Describe the manual part programming using ISO codes for turning and milling operations.	K2

I. COMPUTER AIDED DESIGN

1. **2D DRAFTING**: Introduction to CAD, Elements of Drawing, Development of 2D Drawings like Orthographic and Isometric Drawings, Applying Dimensions to the Drawings, Scanning and plotting procedures.
2. **3D MODELLING**: Sketching, Part drawing and Assembly process for the mechanical components.
3. **ANALYSIS:** Determination of Deflection and stresses in 2D and 3D Trusses and Beams, Determination of Stresses in 3D structure, Estimation of Natural Frequencies and Steady state heat transfer analysis of plane components.

II. COMPUTER AIDED MANUFACTURING

1. **CNC Lathe:** Machining of simple components like Step Turning, Taper Turning using CNC Lathe.
2. **CNC Milling:** Machining of simple components like Linear Interpolation and Circular Interpolation.

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	2							2		3	
2	3	3	2	1							2		3	
3	3	2		3							1		3	
4	3	3		2							3		3	
Avg	**3**	**2.5**	**2.5**	**2**							**2**		**3**	

VII SEMESTER	L	T	P	C
	-	-	6	3.0
19ME7P01: MINI PROJECT				

Course Outcomes:

Co No	CO Statement	Knowledge Level
1	Identify the problem, define objectives and scope of the mini project.	K1
2	Analyze the problem from state of the art for arriving at feasible solutions.	K4
3	Perform experimentation/ simulation/ programs/ fabricate / collect and interpret data.	K5
4	Prepare an organized report employing elements of technical writing and critical thinking.	K5

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2							2	2	3	2		
2	2	2	3	1	2		2		2	2	2	2		
3	1	2	1	3	2				1		2	2	3	3
4								3	3	3	1	2		
Avg	2	2	2	2	2		2	3	2	2.33	2	2	3	3

VII SEMESTER	L	T	P	C
	-	-	2	1.0
19ME7I01: INTERNSHIP				

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Construct the company profile by compiling the brief history, management structure, products / services offered, key achievements and market performance for his / her organization of internship.	K3
2	Assess its Strengths, Weaknesses, Opportunities and Threats (SWOT).	K4
3	Determine the challenges and future potential for his / her internship organization in particular and the sector in general.	K3
4	Test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period.	K4
5	Apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship organization.	K4

CO-PO-PSO MAAPPING:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	-	-	1	-	-	1	1	2	1	-	1
1	1	2	1	1	2	1	1	3	1	1	2	1	-
1	1	2	1	2	1	1	1	2	1	1	1	1	-
3	2	-	1	1	1	-	1	2	2	1	1	1	1
1	-	-	-	1	1	1	2	1	3	2	1	-	-
1.4	**1.25**	**1.67**	**1**	**1.25**	**1.2**	**1**	**1.25**	**1.8**	**1.6**	**1.4**	**1.2**	**1**	**1**

VIII SEMESTER (ELECTIVE-V)	L	T	P	C
	3	-	-	3
19ME8E17: DESIGNING FOR THE HUMAN BODY				

COURSE OBJECTIVES:

- To provide basic understanding to the students about the concept and significance of Human Factors Engineering.
- To gain knowledge about visual, auditory and cognitive aspects of human factors.
- To inculcate the skill among the students for analyzing human systems integration and improving overall decision making and the performance of the system.
- To inculcate analyzing skills among the students with respect to work place design, working postures and lifting tasks.
- To provide thorough knowledge about assessment about occupational exposure to heat stress, noise, vibrations and RSPM.

COURSE OUTCOMES:

Students will be able to

Co No	CO Statement	Knowledge Level
1	Apply the basic concept and significance of Human Factors Engineering.	K3
2	Apply the basic knowledge of effect of factors like visual, auditory and cognitive on performance to design suitable work systems.	K3
3	Analyze the factors affecting decision making and improve the same	K4
4	Analyze the level of risk in a job causing stress, fatigue and musculoskeletal disorders among the employees of an organization	K4
5	Estimate occupational environmental factors like heat stress, noise, vibration and RSPM in a company.	K4

UNIT – I

INTRODUCTION: Introduction to Human Factors in Engineering, scope of human factors, the study of human factors as a science, Historical evolution of ergonomics, ergonomics and human factors engineering, Goals of human factors engineering, Introduction to research methods, overview of research methods, experimental research methods, Experimental design.

UNIT – II

VISUAL SENSORY SYSTEMS: The stimulus; light the receptor system; the eye ball and optic nerve, visual receptive system, contrast sensitivity, reading, colour sensation, night vision, Bottom-up vs top down processing, depth perception, Visual search, detection, discrimination.

UNIT – III

DECISION MAKING: Decision making models; normative and descriptive decision making models, Heuristics and biasness, Dependency of decision making on the decision context, Factors affecting decision making performance, improving human decision making

UNIT – IV

BIOMECHANICS OF WORK: The musculoskeletal system, Biomechanical models, Low back problems, NOISH lifting guide, Manual material handling, Seated work and chair design, Upper extremities cumulative trauma disorders. Causes & prevention of CTD, hand tool design. Strain index method for DUE

risk assessment. Work posture risk assessment using OWAS, Rapid Upper Limb Assessment and Rapid Entire Body Assessment tools.

UNIT – V

WORK PHYSIOLOGY: Muscle structure and metabolism, Circulatory and respiratory system, the respiratory system, Lung capacity, Lung capacity measurement using Spirometry. Measurement of workloads. Physical work capacity and whole body fatigue, causes and Control of whole body fatigue. Bio Energies. Stress and workloads. RSPM assessment.

TEXT BOOKS

1. Christopher D W, John D Lee. Gordon Becker, Human Factors Engineering, second edition, PHI, 2011.
2. MI Khan, Industrial Ergonomics, second edition, PHI, 2011.
3. Sanders Mark S and McCormick Ernert J, Human Factors in Engineering and Design, first edition McGraw- Hill Inc., 2013.

REFERENCES

1. John B West, Respiratory Physiology, Wolter Kulwer Lippincott Williams & Wilkins, 11th edition, 2015.
2. David J. Oborne, Ergonomics at Work, first edition, John Willey & Sons, 2014.

VIII SEMESTER (ELECTIVE-V)	L	T	P	C
	3	-	-	3
19ME8E18 - POWER PLANT ENGINEERING				

COURSE OBJECTIVES:

- To learn the working of different circuits of the steam power plant
- To learn the layout and auxiliaries of the diesel and Gas power plants
- To learn the different elements in the hydro electric power plants
- To learn the principal components and types of reactors in the Nuclear power plants
- To learn the concepts of power plant economics and pollution standards to be observed in the power plants.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1	Describe the layout of steam power plant and various handling equipment of coal, ash etc.	K2
2	Describe the equipment used for combustion of coal and other supporting systems.	K2
3	Illustrate the operation of diesel, gas turbine power plants, and different hydroelectric power plants.	K2
4	Distinguish different technologies adopted in nuclear power plants	K2
5	Estimate various costs and load calculations involved in a power plant and identify environmental considerations.	K4

UNIT – I

Introduction to the sources of energy –Resources and Development of Power in India.

STEAM POWER PLANT: General layout of modern thermal power Plant, Site selection, materials required for thermal power plants, Classification of coal - out-plant handling of coal, coal storage, in-plant handling of coal, Pulverized fuel handling system, Ash handling systems.

BURNING OF COAL AND COMBUSTION NEEDS: Coal burning methods – overfeed, underfeed stokers - chain grate, traveling grate, spreader stokers, single and multi retort stokers, Pulverized fuel burning system and its components, Draught system, Dust collectors, Cooling towers, Feed water treatment.

UNIT – II

DIESEL ELECTRIC POWER PLANT: Fields of use, General layout of diesel power plant, Different systems of diesel power plant – fuel supply system, air- supply system, water-cooling system, lubrication system , starting system, Super charging of diesel engines, Advantages and disadvantages of diesel power plants over thermal plants.

GAS TURBINE PLANT: Classification, construction layout with auxiliaries, Working principles of closed and open cycle gas turbines, combined cycle power plants .

UNIT –III

HYDRO ELECTRIC POWER PLANT

Hydrology, hydrological cycle, Rain fall and run-off its measurement, Hydrographs, Flow duration curves, mass curve and storage, Classification of dams, spill ways, Water hammer, Surge tanks.

Classifications of hydro electric power plants, Typical layouts-plant auxiliaries, plant operation, Pumped storage plants.

UNIT – VI

NUCLEAR POWER STATION: Nuclear fuel, breeding and fertile materials, Nuclear reactor-construction, operation.

TYPES OF REACTORS: Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR), Sodium-Graphite Reactor (SGR), Fast Breeder Reactor (FBR), Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT –V

POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS:

Capital cost- investment of fixed charges, operating costs, General arrangement of power distribution-load curves and load duration curve, Definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises.

Effluents from power plants, Impact on environment, Pollutants, Pollution standards, Methods of pollution control.

TEXTBOOKS:

1. Subhash C. Arora, S. Domkundwar, Power Plant Engineering, Dhanpat Rai, 8th Edition, 2016.
2. R. K Rajput, Power Plant Engineering, Laxmi Publications,3rd Edition, 2016.

REFERENCES:

1. P.K. Nag, Power Plant Engineering, Tata McGraw-Hill Education, 3rd Edition, 2014.
2. P.C. Sharma, Power plant Engineering, S. K. Kataria & Sons, 1st Edition, 2009.

CO-PO-PSO MAAPPING:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	2	1	-	-	-	-	-	-	-	-	-	2	-
3	2	1	-	-	-	-	-	-	-	-	-	1	1
3	1	1	-	-	-	-	-	-	-	-	-	1	1
2	3	2	-	-	-	-	-	-	-	-	-	2	1
2	3	2	-	-	-	-	-	-	-	-	-	2	1
2.6	**2.2**	**1.4**										**1.6**	**1**

VIII SEMESTER (ELECTIVE-V)	L	T	P	C
	3	-	-	3
19ME8E19 - MEMS				

COURSE OBJECTIVE:

1. To introduce the students about the different materials used for MEMS.
2. To impart knowledge about various sensors and actuators.
3. Understand the micro-opto-electro mechanical systems
4. Explain the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.
5. Get the knowledge of chemical and bio medical micro systems

COURSE OUTCOMES: Students will be able to

Co No	CO Statement	Knowledge Level
1	Classify various micro electro mechanical system components.	K2
2	Discuss thermal sensors and actuators.	K2
3	Illustrate micro-opto-electro mechanical systems.	K2
4	Summarize Radio Frequency system.	K2
5	Describe chemical and bio medical micro systems	K2

UNIT – I

INTRODUCTION: Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.

MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT – II

SENSORS AND ACTUATORS: Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, Peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, magnetic MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

UNIT – III

MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

UNIT – IV

RADIO FREQUENCY (RF) MEMS: RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

MICRO FLUIDIC SYSTEMS: Applications, considerations on micro scale fluid, fluid actuation methods, dielectrophoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps.

UNIT – V

CHEMICAL AND BIO MEDICAL MICRO SYSTEMS: Sensing mechanism & principle, membrane transducer materials, chem.-lab-on-a-chip (CLOC) chemo resistors, chemo capacitors, chemo transistors, electronic nose (Enose), mass sensitive chemo sensors, fluorescence detection, calorimetric spectroscopy.

TEXT BOOKS:

1. Mahalik N P,MEMS, McGraw-Hill Education (India) Pvt Limited, 2008.
2. Rai - Choudhury P, MEMS and MOEMS Technology and Applications, PHI Learning Private Limited, 2009.
3. Nadim Maluf, An Introduction to Micro Electro Mechanical System Design, Artech House, 2000.

REFERENCES:

1. Chang Liu Foundation of MEMS, , Prentice Hall Ltd,2005.
2. Gerald Urban, Bio-MEMS (Micro systems), Springer.2006
3. Tai-Ran Hsu, MEMS and Micro Systems: Design and Manufacture, TMH Publishers.2008
4. Mohamed Gad el Hak, MEMS Handbook, CRC Press, 2002.

VIII SEMESTER (ELECTIVE-V)	L	T	P	C
	3	-	-	3
19ME5E20 - OPTIMIZATION TECHNIQUES				

COURSE OBJECTIVES:

- To impart the students to understand the concepts of optimization and their application.
- To get the knowledge of solving an engineering problem from a numerical point of view.
- To impart the students to understand the concept of genetic algorithms.
- To get knowledge of developing genetic programming to solve engineering problems.
- To develop applications of optimization in design and manufacturing.

COURSE OUTCOMES: Students are able to

Co No	CO Statement	Knowledge Level
1	Identify the concepts of optimization and develop problem equation for a given scenario	K2
2	Generalize, apply, solve an engineering problem from a numerical point of view.	K2
3	Create the Genetic algorithms to solve a engineering problem.	K3
4	Versed with Genetic programming methods to solve a engineering problem	K2
5	Develop a problem formulation for a cantilever beam problem, and solve it.	K3

UNIT-I:

CLASSICAL OPTIMIZATION TECHNIQUES: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, KuhnTucker conditions, merits and demerits of classical optimization techniques.

UNIT-II:

NUMERICAL METHODS FOR OPTIMIZATION: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, Pattern search methods, conjugate method, types of penalty methods for handling constraints, advantages of numerical methods.

UNIT-III:

GENETIC ALGORITHM (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA

UNIT-IV:

GENETIC PROGRAMMING (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

MULTI-OBJECTIVE GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non dominated sorted GA, convergence criterion, applications of multi objective problems.

UNIT-V:

APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS: Some typical applications like optimization of path synthesis of a four bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

TEXT BOOKS:

1. S.S.Rao, Engineering Optimization, 3rd Edition, New Age Publishers, 2017.
2. CE Ebeling, An Introduction to Reliability and Maintainability Engineering, 3rd Edition, Waveland Printers Inc, 2017.
3. Jasbir Arora, Optimal design,3rd Edition, Mc Graw Hill (International) Publishers, 2018.

REFERENCE BOOKS:

1. D.E.Goldberg, Genetic algorithms in Search, Optimization, and Machine learning, 13th Edition, Addison Wesley Publishers, 2017.
3. Kalyanmoy Deb, Multi objective Genetic algorithms, 2nd Edition, PHI Publishers, 2013.

SEMESTER-VIII (ELECTIVE-V)	L	T	P	C
	3	-	-	3
19CS8E28 - ARTIFICIAL INTELLIGENCE				

COURSE OUTCOMES:

After undergoing this course, the students will be able to:

Co No	CO Statement	Knowledge Level
1	Summarize concepts, history, characteristics and state space representation	K2
2	Apply uninformed and informed search strategies for solving AI problems using algorithms	K3
3	Use different Probabilistic Reasoning and knowledge representational schemes on the given facts to infer new facts.	K3
4	Summarize different ML tasks, Applications and their importance	K2
5	Demonstrate various Reinforcement Learning and illustrate their importance	K2

UNIT I:

Introduction: Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.

UNIT II:

Search Algorithms: Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

UNIT III:

Probabilistic Reasoning: Probability, conditional probability, Bayes Rule, Bayesian Networks-representation, construction and inference, temporal model, hidden Markov model.

UNIT IV:

Markov Decision process: MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

UNIT V:

Reinforcement Learning: Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.

TEXT BOOKS

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition,Prentice Hall
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill
3. Trivedi, M.C., “A Classical Approach to Artifical Intelligence”, Khanna Publishing House,Delhi.
4. Saroj Kaushik, “Artificial Intelligence”, Cengage Learning India, 2011

VIII SEMESTER (ELECTIVE-VI)	L	T	P	C
	3	-	-	3
19ME8E21 - ADVANCED MECHANICS OF SOLIDS				

COURSE OBJECTIVES:

- To understand the concepts of energy methods, fixed and continuous beams.
- To understand the concepts of unsymmetrical bending.
- To understand the concepts of columns and struts, stresses due to rotation and torsion of generalized elements.

Subject:	Advanced Mechanics of Solids	Semester: VIII
Co No	CO Statement	Knowledge Level
1	Describe and evaluate the strain energy and energy theorems	K4
2	Calculate the Fixed moments, slope and deflection of the fixed beams of uniform and non-uniform sections and analyze the reaction supports of the continuous Beams	K3
3	Analyze stress and deflections in unsymmetrical sections due to Bending	K4
4	Evaluate the loads and deflections in columns and struts	K4
5	Calculate the stresses in the wheel Rims and Analyze the Torsion of different types of Bars, thin walled tubes and closed sections	K3

UNIT – I

Energy Methods: Introduction, Principles of superposition, Strain energy, Reciprocal relations, Maxwell-Betti theorem, Elastic strain energy in tension and compression, Strain energy in beams subjected to bending and shafts to torsion, Impact loading in tension and bending, first & second theorem of Castigliano and its applications.

UNIT – II

Fixed Beams:

Fixing moments for a fixed beam of uniform and variable sections, Effect of sinking support, Slope and Deflection.

Continuous Beams: Analysis of continuous Beam, Reactions at the supports, Effect of sinking of supports.

UNIT – III

Unsymmetrical Bending: Bending stresses in Beams subjected to non-symmetrical bending; Deflection of straight beams due to non-symmetrical bending.

UNIT – IV

Columns and Struts:

Columns with one end free and the other fixed, both ends fixed, one end fixed and other end hinged, Limitation of Euler's formulae, Column carrying Eccentric load, Empirical formulae.

UNIT – V

Stresses due to Rotation: Wheel Rim, Disc of Uniform Thickness, Disc of Uniform Strength.

Torsion of generalized Element Section: Introduction, Torsion of General Prismatic Bars–Solid Sections, Torsion of Circular and Elliptical Bars, Torsion of Equilateral Triangular Bar, Torsion of Rectangular Bars, Membrane Analogy, Torsion of Thin-walled Tubes, Torsion of Thin-walled Multiple-Cell Closed Sections.

TEXT BOOKS:

1. R.K. Rajput, Strength of Materials,7th Edition, S.Chand & Company 2018
2. J.M. Gere and S.P. Timoshenko, Mechanics of Material, 6th Edition, CBS publisher, 2004
3. L.S.Srinath, Advanced Mechanics of Solids, 2nd edition, India, Tata McGraw-Hill, 2003.

REFERENCES:

1. F.P. Bear and E.E. Johnston, Mechanics of Material,8th Edition, McGraw Hill, 2020.
2. S.P. Timo Shenko, Strength of Material, Vol. I and II, EWP Press 2004.
3. Dr. Sadhu Singh, Strength of Material,11th Edition Khanna Publishers 2013.
4. R. K Bansal, Strength of Materials, 6th Edition, Laxmi Publications (P) Ltd, 2015.

VIII SEMESTER (ELECTIVE-VI)	L	T	P	C
	3	-	-	3
19ME8E22- COMPUTATIONAL FLUID DYNAMICS				

COURSE OBJECTIVE

The course will equip the students with the necessary knowledge to use computational techniques to solve problems related to flow mechanics. In particular, students will have hands-on experience in using computational fluid dynamics to solve engineering problems.

Co No	CO Statement	Knowledge Level
1	Describe the differential equations for flow phenomena and numerical methods for their solution	K2
2	Illustrate the stability analysis in CFD	K3
3	Estimate equipment error and fluid flow properties	K3
4	Analyze the appropriate model equations to investigate fluid flow in steady flow cases	K4
5	Evaluate partial differential equations in the form of algebraic equations	K3

UNIT I

INTRODUCTION: History and Philosophy of computational fluid dynamics, CFD as a design and research tool, Applications of CFD in engineering, Programming fundamentals, MATLAB programming, Numerical Methods.

UNIT II

REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: Introduction, Conservation of mass, Newton's second law of motion, expanded forms of Navier-Stokes equations, Conservation of energy principle, Special forms of the Navier-Stokes equations.

UNIT III

ERRORS AND STABILITY ANALYSIS: Introduction, First order wave equation, Stability of hyperbolic and elliptic equations, Fundamentals of fluid flow modeling- conservative property, upwind scheme.

UNIT IV

STEADY FLOW: Dimensions form of momentum and energy equations, Navier-Stokes equation and conservative body force fields, Stream function, Vorticity formulation, Boundary layer theory, Buoyancy driven convection and stability.

UNIT V

FINITE VOLUME METHOD: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.

TEXT BOOKS:

1. John .D. Anderson, Computational Fluid Dynamics: Basics with applications, 3rd edition, McGraw-Hill International Edition, India,2012.
2. J Chung, Computational Fluid Dynamics, 2nd edition, Cambridge University Press, India, 2010.

REFERENCES:

John.F Wendt, Computational fluiddynamics: An introduction, 3rd edition, Springer publishers , 2018.
1. Pradip Majumdar, Computational Fluid Flow and Heat Transfer, CRC Press, 2021.
2. Tapan K. Sengupta , Fundamentals of Computational Fluid Dynamics, Universities Press, 2004.

VIII SEMESTER (ELECTIVE-VI)	L	T	P	C
	3	-	-	3
19ME8E23: FLEXIBLE MANUFACTURING SYSTEMS				

COURSE OBJECTIVES:

- To understand the role of Flexible Manufacturing Systems(FMS) in manufacturing,
- To understand the concept of manufacturing cell and just in time.
- To understand the automated features of machining centers.
- To understand the benefits of automation
- To understand the control of cutting tools and tool management.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1.	Describe the basic components, various hardware and software requirements of Flexible Manufacturing Systems.	K2
2.	Discuss the concepts of Manufacturing cell and Just In Time	K2
3.	Classify the turning and machining centers and Explain their automated features.	K2
4.	Describe and Classify the Coordinate Measuring Machine and Explain about the Automated Material Movement and Storage Systems.	K2
5.	illustrate about the control of cutting tool management, strategies and discuss the system hardware and general functionality	K2

UNIT—I

FMS Introduction and Description

Introduction, Definition, Basic Component of FMS, Significance of FMS, General layout and configuration of FMS, Principle Objectives of FMS, Benefits and limitations of FMS, Area of Application of a FMS in Industry, Various Hardware and Software required for an FMS, CIM Technology, Hierarchy of CIM, and FMS Justification.

UNIT – II

Manufacturing Cell

Introduction, Description and Classifications of Cell, Unattended Machining, Cellular versus Flexible Manufacturing.

Just In Time (JIT): Introduction, Concepts, Goals and Objectives, Ingredients, Quality and Quantity principles of JIT, Benefits and Implementation.

UNIT – III

Turning and Machining Centre Introduction, Types, Construction and Operation Performed on Turning enter, Automated Features and Capabilities of Turning Centres, General Advantages and Disadvantages of

Vertical and Horizontal Machining Centres, Pallet and Part Loading and Programming Options in Machining Centres, Automated features and capabilities of a Machining Centres

UNIT – IV

Coordinate Measuring Machine: Introduction, Construction, Types of CMM, Functions, Operational cycle description, Advantages & Limitations.

Automated Material Movement and Storage System: Introduction, Types of AGV and Their principle of working, Advantages, Limitation and General AGV Guide path, Robots, Benefits of using Industrial Robots, Basic components and benefits of Automated Storage and Retrieval Systems, Conveyors and Pallet Flotation System, Queuing Carrousels and Automatic Work Changers, Coolant and Chip Disposal and Recovery system.

UNIT – V

Cutting Tools and Tool Management

Introduction, Control of Cutting Tools, Tool Management, Tool Strategies, Tool Preset, Identification and Data Transfer, Tool Monitoring and Fault Detection

System Hardware and General Functionality: Introduction**,** Programmable logic controller, cell controllers, communication Networks.

FMS Software Structure: Introduction, General Structure and Requirements, Advantages Of Modular Software Design and Development, Types of FMS software Modules.

UNIT – VI

TEXT BOOKS:

1. Groover M.P, Zimmers E.W, CAD/CAM, Prentice Hall of India, 12th Edition, 2017
2. H. K. Shivanand, M. M. Benal, V. Koti, Flexible Manufacturing System, New Age Publishers, 16th Edition, 2014

REFERENCE BOOKS:

1. Groover M.P, Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India, 3rd Edition, 2016
2. Nanua Singh, Approach to Computer Integrated Design and Manufacturing, John Wiley and Sons, 4th Edition, 2015

CO-PO-PSO MAAPPING:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
1	3	2	-	2	-	-	-	-	-	-	-	-	3	-
2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
3	2	2	-	-	-	-	-	-	-	-	-	-	3	-
4	3	3	-	2	-	-	-	-	-	-	-	-	2	-
5	3	3	-	3	3	-	-	-	-	-	-	-	2	-
Avg	**2.8**	**2.4**		**2.33**	**3**								**2.40**	

VIII SEMESTER (ELECTIVE-VI)	L	T	P	C
	3	-	-	3
19ME8E24 - STATISTICAL QUALITY CONTROL				

COURSE OBJECTIVES:

- To help students understand the concepts underlying statistical quality control.
- To know control charts and evaluate revised control limits.
- To develop their ability to apply those concepts to the design and management of quality control processes in industries.
- To Analyze process capability and operating characteristic curves for Statistical quality control
- The emphasis will be on ensuring that the students gain both a broad perspective of quality control as well as the technical skills necessary to implement quality control in any industrial setting.

Course Outcomes:

CO No	CO Statement	Knowledge Level
1.	Describe the basic concept of Quality, Control Charts and Acceptance Sampling.	K2
2.	Construct control charts and evaluate revised control limits.	K3
3.	Apply control chart for individual measurements and multi-vari chart.	K3
4.	Analyze process capability and operating characteristic curves.	K4
5.	Determine whether to accept or reject a production lot of material.	K3

UNIT I:

Introduction

Quality Dimensions, Quality definitions, Inspection, Quality control, Quality Assurance, Quality planning, Quality costs, Economics of quality, Quality loss function.

UNIT II:

Control Charts

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u-Construction and application.

UNIT III:

Special Control Procedures

Warning and modified control limits, Control chart for individual measurements, Multi-vari chart, X - chart with a linear trend, Chart for moving averages and ranges, Cumulative-sum and exponentially weighted moving average control charts.

UNIT IV:

Statistical Process Control

Process stability, Process capability analysis using a Histogram or probability plots, Control chart, Gauge capability studies, Setting specification limits.

UNIT V:

Acceptance Sampling

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TEXT BOOKS

1. Douglas C Montgomery, Introduction to Statistical Quality Control, 7th Edition, John Wiley, 2012.
2. Grant E.L. and Leavenworth, Statistical Quality Control, 7th Edition, McGraw Hill Education, 2017.
3. Douglas C. Montgomery, Statistical Quality Control: A Modern Introduction 6th Edition, Wiley; 2010
4. O.P Khanna, Industrial Engineering and management, 6th Edition, Khanna Publishers, 2018.

REFERENCE BOOKS:

1. Martand Telsang, Industrial Engineering and Production Management,3rd Edition, S.Chand& Company Ltd, 2018.
2. S. C. Sharma & TR. Banga, Industrial Engineering and Management, 1st Edition, Khanna Publishers, 2017.
3. N.V.SRaju, Industrial Engineering and Management, 1st Edition, Cengage Publishers, 2013.

CO-PO-PSO MAAPPING:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
2	2	3	-	-	-	-	-	-	-	-	-	-	1	-
3	2	3	-	-	-	-	-	-	-	-	-	-	3	-
4	3	2	-	-	-	-	-	-	-	-	-	-	-	3
5	3	2	-	-	-	-	-	-	-	-	-	-	-	3
Avg	**2.6**	**2.40**											**2**	**3**

SEMESTER-VIII (ELECTIVE-VI)	L	T	P	C
	3	-	-	3
19CS8E29 - VIRTUAL REALITY AND AUGMENTED REALITY				

COURSE OUTCOMES:

At the end of the course student are able to

CO No	CO Statement	Knowledge Level
1.	Adopt various principles and concepts of Virtual Reality and its Application.	K2
2.	Apply appropriate method of Geometric Modeling	K3
3.	Analyze various VR Hardware and Software	K3
4.	Describe the concepts of Augmented Reality.	K2
5.	Define Augmented Reality Contents and its Applications	K1

UNIT – I:

INTRODUCTION TO VIRTUAL REALITY

Virtual Reality & Virtual Environment: Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environments –requirement – Benefits of Virtual Reality - Historical development of VR : 3D Computer Graphics - Human Factors – Vision - Vision and Display Technology – Hearing – Tactile - Equilibrium.

UNIT – II:

GEOMETRIC MODELING

Geometric Modeling : Introduction – From 2D to 3D – 3D space curves – 3D boundary representation – Other modeling strategies – Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances – Picking – Flying – Scaling the VE – Collision detection – A Generic VR system : Introduction – The virtual environment – The Computer environment – VR Technology – Model of interaction – VR System.

UNIT – III:

VR HARDWARE, SOFTWARE AND APPLICATIONS

Introduction-Computers-Tracking-Input Devices-Output Devices-Glasses-Displays-Audio-VR-Software Features-Web-based VR-Division's dVISE, Blueberry 3D-Boston Dynamics-Multigen-Introduction-Industrial-Training Simulators-Entertainment-VR Centres.

UNIT – IV:

INTRODUCTION TO AUGMENTED REALITY

Introduction to Augmented Reality-Definition and Scope-A Brief History of AR-Examples-Related Fields-Augmented Reality Concepts-How does AR Work-Concepts Related AR-Ingredients of an AR-AR Hardware and Software-Major Hardware Components for AR Systems- Major Software Components for AR Systems.

UNIT – V:

AR CONTENT, INTERACTION AND ITS APLLICATIONS

AR Content-Introduction-What is Content-Creating Visual Content-Creating Audio Content-Creating Content for Other Senses-Representation and Perceptual Issues-**AR Interaction**-Introduction-What is Interaction-Mobile AR-**AR Applications**-Introduction-Application Areas-Collaborative AR-Applying AR to a Problem-Evaluating AR Applications-Example AR Applications-The Future of Augmented Reality.

TEXT BOOKS:

1. Virtual Reality Systems, John Vince, Pearson Education Asia, 2016.
2. Introduction to Virtual Reality, John Vince, Springer London, 2016.
3. Augmented Reality, Principles and Practice, Dieter Schmalsteig, Tobias Hollerer, Pearson Education,2016.
4. Understanding Augmented Reality Concepts and Applications, Alan B. Craig, Elsevier -Morgan Kaufmann Publications ,2013.

REFERENCE BOOKS:

1. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
2. Grigore C. Burdea, Philippe Coiffet , Virtual Reality Technology , Wiley-Interscience, First Edition,1994
3. Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.
4. https://nptel.ac.in/courses/106105195/13
   https://www.mooc-list.com/course/making-your-first-virtual-reality-game-coursera

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19EEXO01 :: ELECTRICAL SAFETY MANAGEMENT				

COURSE OUTCOMES:

At the end of the course student are able to

CO No	CO Statement	Knowledge Level
1.	Explain the Electrical Safety precautions and Prevention	K2
2.	Illustrate Safety aspects during Installation of Plant and Equipment	K2
3.	Estimate the electrical safety in residential, commercial and agricultural installations	K5
4.	Categorize various Electrical Safety in Hazardous Areas	K4
5.	List the electrical systems safety management and IE rules	K1

UNIT-I : ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION

Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety.

Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

UNIT-II : SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT

Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switch yard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

UNIT-III : ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT-IV : ELECTRICAL SAFETY IN HAZARDOUS AREAS

Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

EQUIPMENT EARTHING AND SYSTEM NEUTRAL EARTHING: Introduction, Distinction between system grounding and Equipment Grounding, Equipment Earthing, Functional Requirement of earthing system, description of a earthing system, , neutral grounding(System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals.

UNIT-V : SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS

Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.

REVIEW OF IE RULES AND ACTS AND THEIR SIGNIFICANCE: Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and fire fighting facility. The Electricity Act, 2003, (Part1, 2, 3,4 & 5)

TEXT BOOKS:

1 S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi, 1988.(units-I to V)

2 www.apeasternpower.com/downloads/elecact2003.pdf (Part of unit-V)

REFERENCE BOOKS:

1 Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.

2. The Electricity Act, 2003 MINISTRY OF LAW AND JUSTICE (Legislative Department) New Delhi, the 2nd June, 2003.Jyaistha 12, 1925 (Saka)

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19EEXO02 :: NON CONVENTIONAL ENERGY SOURCES				

COURSE OUTCOMES:

At the end of the course student are able to

CO No	CO Statement	Knowledge Level
1.	Show the need of energy conversion and the analysis of solar radiation.	K1
2.	Analyze solar radiation data, extraterrestrial radiation, radiation on earth's surface and solar thermal systems.	K4
3.	Identify the methods and analysis of Wind energy generation and its maximum power point techniques.	K3
4.	Dscribe basic principle and working of hydro and tidal energy systems.	K2
5.	Explain the Biomass, Fuel cells and Geothermal energy, its mechanism of production and its applications	K2

UNIT-I : FUNDAMENTALS OF ENERGY SYSTEMS:

Energy conservation principle – Energy scenario (world and India) – Solar radiation: Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces – Numerical problems.

UNIT-II : SOLAR THERMAL SYSTEMS

Liquid flat plate collections: Performance analysis –Introduction to solar air heaters – Concentrating collectors and solar pond– Numerical problems.

Solar Photovoltaic Systems : Solar Photovoltaic cell, Module,Array – Construction– Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Applications and systems – Maximum power point tracking.

UNIT-III : WIND ENERGY

Sources of wind energy – Wind patterns – Types of turbines – Horizontal axis and vertical axis machines – Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine – Selection of generator(synchronous, induction) – Maximum power point tracking.

UNIT-IV : HYDRO AND TIDAL POWER SYSTEMS

Basic working principle – Classification of hydro systems: Large, small, micro – measurement of head and flow – Energy equation – Types of turbines – Numerical problems. Tidal power – Basics – Kinetic energy equation – Numerical problems – Wave power – Basics – Kinetic energy equation.

UNIT-V : BIOMASS, FUEL CELLS AND GEOTHERMAL SYSTEMS

Biomass Energy: Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing. Fuel cell: Classification of fuel for fuel cell – Fuel cell voltage – Efficiency – VI characteristics. Geothermal: Classification – Dry rock and hot acquifer – Energy analysis.

TEXT BOOKS:

1 Renewable Energy Resoures, John Twidell and Tony Weir, Taylor and Francis -second edition, 2013
2 Non conventional sources of Energy by G.D.Rai, Kanna Publications.
3 Renewable Energy Technologies /Ramesh & Kumar /Narosa.

REFERENCE BOOKS:

1. Energy Science: Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press, 2017**.**
2. Renewable Energy- Edited by Godfrey Boyle-oxford university, press, 3rd edition, 2013.
3. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore
4. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
5. Non conventional energy source –B.H. Khan- TMH-2nd edition
6. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19EEXO03::ELECTRICAL VEHICLE				

COURSE OUTCOMES:

At the end of the course student are able to

CO No	CO Statement	Knowledge Level
1.	Describe the basics of electric vehicles fundamentals.	K2
2.	Discuss different energy storage concepts used for electric vehicles.	K2
3.	Describe about fundamental of electrical Machines	K2
4.	Analyze various drive trains suitable for electric vehicles	K3
5.	Describe about different types of EV Systems.	K2

UNIT-I : INTRODUCTION TO ELECTRIC VEHICLES

Components of an EV ,EV History, EV Advantages ,EV mechanics , Roadway Fundamentals , Laws of Motion , Vehicle Kinetics , Dynamics of Vehicle Motion , Propulsion Power, Velocity and Acceleration, Propulsion System Design

UNIT-II : BATTERY

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Lead-Acid Battery, Alternative Batteries, Battery Parameters, Technical Characteristics, Targets and Properties of Batteries , Battery Modeling

UNIT-III : DC & AC ELECTRICAL MACHINES

Motor and Engine rating, Requirements, Fundamental concepts of DC machines- Three phase A/c machines- Induction machines- permanent magnet machines-switched reluctance machines

UNIT-IV : ELECTRIC VEHICLE DRIVE TRAIN

EV Transmission Configurations , Transmission Components, Ideal Gearbox, EV Motor Sizing

UNIT-V : HYBRID ELECTRIC VEHICLES

Types of Hybrids, Internal Combustion Engines , Design of an HEV ,Drive train, sizing of components.

TEXT BOOKS:

1 Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

REFERENCE BOOKS:

1 James Larminie and John Lowry,“Electric Vehicle Technology Explained”, Wiley, 2003.

2 Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay and Ali Emadi, ““Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.

3 Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2004.

4 Introduction to hybrid and electric vehicles: Dr Praveen Kumar & Dr S Majhi, IIT Guwahati , https://nptel.ac.in/courses/108/103/108103009/ .

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19EEXO04:: ELECTRICAL ENERGY CONSERVATION AND AUDITING				

COURSE OUTCOMES:

At the end of the course student are able to

CO No	CO Statement	Knowledge Level
1.	Describe energy efficiency, conservation and various technologies [K2]	K2
2.	Identify the concepts of energy management and energy audit [K3]	K2
3.	Describe energy conservation in HVAC systems.[K2]	K2
4.	Analyze the concepts of different energy efficient devices [K4]	K3
5.	Estimate life cycle costing analysis and energy efficient Technologies [K5]	K1

UNIT-I : BASICS OF ENERGY AND ITS VARIOUS FORMS

Energy consumption –choice of fuels. Energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity and humidity & heat transfer, units and conversion.

UNIT-II : ENERGY MANAGEMENT & AUDIT

Energy conservation schemes: Short term - Medium term - Long term energy conservation schemes – Industrial energy use - Energy index – Cost index. Representation of energy consumption: Pie charts - Sankey diagrams – Load Profile.

Energy auditing: General Auditing, Detailed Energy Audit. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

UNIT-III : ENERGY EFFICIENCY IN INDUSTRIAL & ELECTRICAL SYSTEMS

Heat – Heat content – Rate of heat transfer – Heat transfer coefficient - Conduction – Convention and radiation. Thermal insulation & its importance - space heating – HVAC system – Heating of Buildings. Energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

UNIT-IV : ENERGY EFFICIENT INSTRUMENTS

Digital Energy Meter – Data loggers – Thermo couples – Pyranometer – Lux meters – Tong testers – Power analyzers – Power factor – effects with non-linear loads – effect of harmonics on power factor – Power Factor Improvement – Capacitor rating - Effects of power factor improvements - Electric lighting – Types of lighting – Luminaries – Energy efficient lighting.

UNIT-V : ECONOMICAL ASPECTS & FINANCIAL ANALYSIS

Costing Techniques – cost factors – break-even charts – sources of capital and hire charges -capital recovery – depreciation – budgeting and standard costing – charging energy – cash flow

diagrams and activity charts. Financial appraisal and profitability : investment decision- methods of investment appraisal discounted cash flow – summary of investment appraisal techniques – Cost optimization – optimization with one variable – optimization with more than one variable.

TEXT BOOKS:

1 Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications.
2 Hand Book of Energy Audit by Sonal Desai- Tata McGraw hill
3 Energy management hand book by W.C.Turner, John wiley and sons.
4 Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
5 Economic Analysis of Demand Side Programs and Projects - California Standard Practise Manual, June 2002 – Free download available online
6 Energy Efficiency And Management For Engineers, November 2020, TMH, by Mehmet Kanoglu , Yunus A. Cengel

REFERENCE BOOKS:

1 Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition,1998.
2 Energy management and conservation –k v Sharma and pvenkataseshaiah-I K International Publishing House pvt.ltd,2011
3 Fundamentals of Energy Engineering by Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey, 1984.
4 Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
5 Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19CEXO01: DISASTER MANAGEMENT				

Course Outcomes:

At the end of the course student are able to

CO No	CO Statement	Knowledge Level
1.	Identify the tools of integrating disaster management principles in disaster mitigation process	K2
2.	Discuss about different approaches needed to manage pre and post-disaster activities**.**	K2
3.	Prepare the process of risk management and develop a basic understanding method for the role of public in risk management.	K3
4.	Administer the role of technology in Disaster management.	K4
5.	Conclude the planning strategies for education and community preparedness programmes	K3

.UNIT-I : 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.

UNIT-II: **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.

UNIT-III: **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.

UNIT-IV: **Role of Technology in Disaster managements**:
Disaster management for infra structures, taxonomy of infrastructure - 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.

UNIT-V: **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.

Textbooks:

1. Rajib shah & R. Krishnamurthy, 'Disaster Management - Global Challenges and Local Solutions' Universities press-2009.
2. Tushar Bhattacharya, 'Disaster Science & Management', Tata McGraw Hill Education Pvt. Ltd., New Delhi.-2012
3. Jagbir Singh , 'Disaster Management - Future Challenges and Opportunities' , I K International Publishing House Pvt. Ltd-2017

References:

1. H K Gupta , 'Disaster Management', Universities press-2003
2. Prof. R.B. Singh , "Disaster Management and Mitigation", World Focus 2016

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19CEXO02: ENVIRONMENTAL POLLUTION AND CONTROL				

Course Outcomes:

Students are able to

1. Identify the air pollutant causes and control devices
2. Differentiate the treatment techniques used for sewage and industrial wastewater treatment methods.
3. Understand the fundamentals of solid waste management, practices adopted in his town/village and its importance in keeping the health of the city.
4. know the causes for noise pollution and ISO14000 standards
5. Treatment and management of hazardous waste

SYLLUBUS

UNIT – I : Air Pollution

Air pollution causes-control methods–particulate control devices – methods of controlling Gaseous Emissions – Air quality standards.

UNIT –II: Industrial wastewater Management

Strategies for pollution control – Volume and Strength reduction – Neutralization – Equalization – Proportioning – Common Effluent Treatment Plants – Recirculation of industrial wastes – Effluent standards.

UNIT – III : 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.

UNIT – IV: Noise Pollution

Noise standards, Measurement and control methods – Reducing residential and industrial noise – ISO14000

UNIT – V: Hazardous Waste

Characterization – Nuclear waste – Biomedical wastes – Electronic wastes – Chemical wastes – Treatment and management of hazardous waste-Disposal and Control methods.

Text/References books:

1. Ruth F. Weiner and Robin Matthews , ‘Environmental Engineering‘, 4th Edition Elesevier, 2003.
2. J.G. Henry and G.W. Heinke,‘Environmental Science and Engineering‘– Pearson Education,2002
3. Mackenzie L Davis & David A Cornwell, “Environmental Engineering ‘,McGraw Hill Publishing,2002.
4. K. Sasi Kumar, S.A. Gopi Krishna ,”Solid Waste Management”,PHI New Delhi,2014
5. D. Srinivasan, “Environmental Engineering”, PHI Learning Private Limited, New Delhi, 2011.
6. Howard S. Peavy, Donald R. Rowe, Teorge George Tchobanoglus,”Environmental Engineering”, Mc-Graw-Hill Book Company, New Delhi, 1985.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19CEXO03: SOLID WASTE MANAGEMENT				

Course Outcomes:

Students are able to

1. Understand classification of solid waste generated
2. know the collection systems of solid waste of a town
3. analyze the importance of transfer and transport of solid waste
4. apply the knowledge in processing of solid waste
5. design treatment of municipal solid waste and landfill

SYLLUBUS:

UNIT- I

Introduction to Solid Waste Management:

Goals and objectives of solid waste management, Classification of Solid Waste - Factors Influencing generation of solid waste - sampling and characterization – Future changes in waste composition, major legislation, monitoring responsibilities.

UNIT- II

Collection of Solid Waste:

Type and methods of waste collection systems, analysis of collection system - optimization of collection routes– alternative techniques for collection system.

UNIT- III

Transfer and Transport:

Need for transfer operation, compaction of solid waste - transport means and methods, transfer station types and design requirements.

UNIT- IV

Processing and Treatment:

Processing of solid waste – Waste transformation through combustion and composting, anaerobic methods for materials recovery and treatment – Energy recovery – biogas generation and cleaning– Incinerators.

UNIT- V

Disposal of Solid Waste:

Methods of Disposal, Landfills: Site selection, design and operation, drainage and leachate collection systems –designated waste landfill remediation.

Text/ Reference books:

1. George Techobanoglous, Frank Kreith ,Integrated Solid Waste Management- McGraw Hill Publication, 1993.
2. R.Saravanan, R.Dinesh Kumar, A.Suriya , Muncipal solid waste management , Lakshmi publications- 2015.
3. Vesilind, P.A., Worrell, W., Reinhart, D.,“Solid Waste Engineering”, Cenage learning, New Delhi, 2004.
4. Charles A. Wentz, “Hazardous Waste Management”,; McGraw Hill Publication, 1995.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19CEXO04: BUILDING PLANNING AND DRAWING				

COURSE OUTCOMES

Students are able to

1. Understand the building bye-laws, plan various buildings as per the building by-laws.
2. Plan the individual rooms with reference to functional and furniture requirements.
3. prepare different sign conventions and bonds
4. Learn the skills of drawing building elements like doors and windows.
5. Develop the skills of Drawing Plans, Sections and Elevations of different buildings.

SYLLABUS:

UNIT-I

BUILDING BYELAWS AND REGULATIONS: Introduction - terminology - objectives of building Bye laws - floor area ratio - floor space index - principles under laying building bye laws - classification of buildings - open space requirements - built up area limitations- height of buildings- wall thickness - lightening and ventilation requirements.

UNIT -II

RESIDENTIAL AND PUBLIC BUILDINGS

Residential buildings: Minimum standards for various parts of buildings -requirements of different rooms and their grouping- characteristics of various types residential buildings.

Public buildings: Planning of educational institutions, hospitals, dispensaries, office buildings, banks, industrial buildings, hotels & motels, buildings for recreation.

UNIT-III

SIGN CONVENTIONS AND BONDS : Brick, stone, plaster, sand filling, concrete, glass, steel, cast iron, copper alloys, aluminum alloys etc., lead, zinc, tin etc., earth, rock, timber and marbles. English bond and Flemish bond- odd and even courses for one, one-half, two and two & half brick walls in thickness at the junction of a corner.

UNIT- IV

DOORS, WINDOWS, VENTILATORS AND ROOFS: Panelled door, panelled and glassed door, glassed windows, paneled windows, swing ventilators, fixed ventilators, coupled roof, collar roofs. King Post truss, Queen Post truss Sloped and flat roof buildings: drawing plans, Elevations and Cross Sections of given sloped roof buildings.

UNIT-V

PLANNING AND DESIGNING OF BUILDINGS: Draw the Plan, Elevation and sections of a Residential & Public buildings from the given line diagram.

Text /Reference Books:

1. Y.S. Sane., Planning and Design of buildings, 2010.
2. Gurucharan Singh and Jagadish Singh , Planning, designing and scheduling, 2015.
3. M. Chakravarthi., Building planning and drawing, 2015.
4. ‘A’ Series & ‘B’ Series of JNTU Engineering College, Anantapur.
5. Shah and Kale , Building drawing, 2013.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19MEXO01: 3D PRINTING				

COURSE OBJECTIVES:

- To explore technology used in additive manufacturing
- To acquire knowledge for selecting correct CAD formats in manufacturing process.
- To understand the operating principles and limitations of liquid, solid and laser based additive manufacturing system.
- To understand the operating principles and limitations of laser based additive manufacturing system.
- To acquire knowledge on important process parameters for bio-manufacturing

COURSE OUTCOMES: Students are able to

Co No	CO Statement	Knowledge Level
1	Assess the need of Additive Manufacturing in Product development	K2
2	Judge the correct Additive Manufacturing Process for Product/Prototype development	K2
3	Evaluate real-life scenarios and recommend the appropriate use of 3D printing technology	K2
4	Identify opportunities to apply 3D printing technology for time and cost savings	K2
5	Describe the applications, advantages and limitations of each 3D printing technology	K2

UNIT I

INTRODUCTION

Overview, History, Need, Classification, Additive Manufacturing Technology in product development - Materials for Additive Manufacturing Technology

UNIT II
REVERSE ENGINEERING

Basic Concept –3D Scanning Digitization techniques , Model Reconstruction, Data Processing for Additive Manufacturing Technology, Part Orientation and support generation, Model Slicing, Tool path Generation.

UNIT III
LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS

Classification, Stereo lithography Apparatus (SLA) - Principle, Process, advantages, Fused Deposition Modeling – principle, process, advantages.

UNIT IV

LASER BASED ADDITIVE MANUFACTURING SYSTEMS
Selective Laser Sintering - Principle, Process, advantages, Three Dimensional Printing – Principle, process, advantages, Laser Engineered Net Shaping (LENS).

UNIT V

APPLICATIONS OF 3D PRINTING

Customized implants and prosthesis: Design and development, Bio-Additive Manufacturing, Computer Aided Tissue Engineering (CATE), Applications of 3D Printing in Aerospace, Automotive, Manufacturing and Architectural Engineering.

TEXT BOOKS

1. Chua C.K., Leong K.F., and Lim C.S., Rapid prototyping: Principles and applications, Third Edition, World Scientific Publishers, 2016.

2**.** Gebhardt A,Rapid prototyping, Hanser Gardener Publications, 2017.

3. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications, World Scientific Publishers, Fourth Edition of Rapid Prototyping, 2016.

REFERENCES

1. Liou L.W. and Liou F.W., Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2017.

2. Kamrani A.K. and Nasr E.A., Rapid Prototyping: Theory and practice, Springer, 2016.

3. Hilton P.D. and Jacobs P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2015.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19MEXO02 - FARM MACHINERY				

COURSE OBJECTIVES:

- To impart the students to understand the fundamentals of machinery in farming.
- To enable the students to acquire knowledge on tillage and equipment used.
- To introduce the students about various types of earth moving equipment.
- To enable the students to acquire knowledge on seeding and spraying equipment.
- To introduce the fundamentals of transplanting machinery and fertilizer equipment.

COURSE OUTCOMES: Students will be able to

Co No	CO Statement	Knowledge Level
1	Illustrate various types of machinery in farming.	K3
2	Illustrate different types of farm operation for craft cultivation with scientific understanding.	K3
3	classify various types of earth moving equipment.	K4
4	Summarize various seeding methods and sprayer types.	K2
5	Describe transplanting methods and fertilizer equipment.	K2

UNIT I

Farm Mechanization: Objectives of Farm Mechanization, sources of farm power, classification of farm machines. Materials of construction and heat treatment. Principles of operation and selection of machines used for production of crops - Field capacities of different implements and their economics. Problems on field capacities and cost of cultivation

UNIT II

Tillage and Equipment: Classification and types of tillage, Primary tillage implements-Mould board plough and its parts, Disc plough, and other ploughs, Secondary tillage equipment- Disc harrows, implements- Cultivators, and intercultural implements. Forces acting on tillage tools, Problems on forces analysis, Draft measurement of tillage equipment, Draft and unit draft related problems.

UNIT III

Earth Moving Equipment: Earth moving equipment-terminology, Earth moving equipment, construction and their working principles, Earth moving equipment- shovels, Bulldozers, Earth moving equipment- Trenches and elevators.

UNIT IV

Seed Drills and Sprayer:

Seeding methods, Different types of seed metering mechanism, different types of furrow openers. Calibration of Seed drills. Adjustment of Seed Drills - Objectives and uses of plant protection equipment. Types of sprayers and dusters. Sprayer calibration and selection. Constructional features of different components of sprayers and dusters and their adjustments.

UNIT V

Transplanting and Fertilizer: Transplanting methods, different types of Transplanting machinery and their working principle,adjustments in Transplanting equipment. Fertilizer application equipment – fertilizer meeting mechanism calibration of fertilizer equipment.

TEXTBOOKS

1. Triveni Prasad Singh, Farm Machinery. India, Prentice Hall India Pvt., Limited, 2016.
2. Jagadeshwar Sahay, Elements of Agricultural Engineering, Agro Book agency, Patna, 1992.
3. Borshahov Mansurov Sergecy, Land Reclamation Machinery, Mir Publishers, Moscow,1988.
4. Kepner R A, Bainer R and Barger E L, Principles of Farm Machinery, CBS Publishers and Distrubutors, New Delhi, 1987.
5. Michael A M and Ojha T P, Principles of Agricultural Engineering, Jain Brothers, New Delhi, 1985, Vol.I.
6. Smith H P, Farm Machinery and Equipment, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1971.
7. Stone A A, Farm Machinery, John Wiley & Sons, New York.

REFERENCES

1. Srivastaba A.C, Elements of Farm Machinery, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 1990.
2. Krutz, Gary, Thompson Lester and Claar, Paul, Design of Agricultural Machinery", John Wiley and Sons, 1984.
3. Lal, Radhey and Dutta, A.C. Agricultural Engineering through solved examples, Saroj Prakashan Publishers, Allahabad, 1971

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19MEXO03 - BIO-MECHANICAL ENGINEERING				

COURSE OBJECTIVES:

The student should be made to:

- Explain the principles of mechanics.
- Discuss the mechanics of musculoskeletal system.
- Explain the linear kinetics and angular kinetics
- Illustrate the mathematical models used in the analysis of biomechanical systems

COURSE OUTCOMES: Students are able to

CO1 Infer the introduction of Bio mechanics. [K4]
CO2 Learn about mechanics of musculoskeletal system. [K2]
CO3 Relate the concept of kinetics with human motion. [K3]
CO4 Develop knowledge on mechanical analysis of human motion. [K3]
CO5 Analyze human movements. [K4]

UNIT-I

INTRODUCTION TO BIO MECHANICS

Principles of mechanics in human movement, Qualitative and quantitative Analysis, Key mechanical concepts of mechanics and basic units, Nine fundamentals of biomechanics, Nine principles for application of Biomechanics.

UNIT-II

MECHANICS OF MUSCULOSKELETAL SYSTEM

Principles of joint motions, Muscle structures, Mechanical method of muscle action analysis, Tissue loads and forces, Biomechanics of bones and ligaments, Three mechanical characters of muscle, SSC.

UNIT-III

LINEAR KINETICS AND ANGULAR KINETICS

Vector analysis of angle of pull and muscle angle pull, Contact forces, Impulse-Momentum Relationship, Force-Time Principle, Work-Energy relationship, Segmental interaction principle, Torque, Equilibrium, Center of gravity and Principle of balance.

UNIT-IV

MECHANICAL ANALYSIS OF HUMAN MOTION

Linear kinematics - linear kinematic analysis, position and displacement, velocity and speed, acceleration, differentiation and integration, kinematics of running, kinematics of projectiles, equations of constant acceleration. Angular kinematics - angular motion, measurements of angles, types of angles, representation of angular motion vectors, lower extremity joint angles, relationship between angular and linear motion, angular kinematics of running.

UNIT-V

APPLICATIONS OF ENGINEERING EDUCATION & MEDICAL REHABITATION

Qualitative analysis of Kicking technique, batting, catching, throwing techniques, Injury risk assessment, Equipment design for strength training, Injury mechanics, Injury prevention.

TEXT BOOKS:

1. Ronald L.Huston, Principles of Biomechanics,1st edition CRC Press, 2019
2. Joseph E.Muscolino, " Kinesology", 3rd edition, Mosby, 2016.
3. Subrata Pal, "Textbook of Biomechanics", 1st edition, Springer US, 2016.

REFERENCE BOOKS:

1. Duane Knudson, "Fundamentals of Biomechanics", 2nd edition, Springer, 2013.
2. Ajay Bahl, "Basics of Biomechanics", 1st edition, Jaypee Brothers Medical Publishers, 2010.
3. Robert frost, "Applied Kinesiology", 1st edition, North Atlantic Books; 2013
4. David A. Winter, "Biomechanics and Motor Control of Human Movement", John Wiley & sons,Inc., 2009.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19MEXO04- WASTE TO ENERGY CONVERSION				

COURSE OBJECTIVES:

- To enable students to understand of the concept of Waste to Energy.
- To link legal, technical and management principles for production of energy form waste.
- To learn about the best available technologies for waste to energy.
- To facilitate the students in developing skills in the decision making process.

COURSE OUTCOMES: Students are able to

Co No	CO Statement	Knowledge Level
1	Infer the concept of Waste to Energy, classifications and principles.	K2
2	Summarize the Technical and management principles for production of energy form waste	K2
3	Asses the best available technologies for waste to energy.	K2
4	Use different Waste to Energy Options Landfill gas, RDF,AFR andenergy from Plastics.[	K2
5	Illustrate the planning and operations of Waste to Energy plants	K2

UNIT-I

Introduction: Principles of Waste Management and Waste Utilization, Waste Management Hierarchy and 3R Principle of Reduce, Reuse and Recycle, Waste as a Resource and Alternate Energy source.

UNIT-2

Waste Sources & Characterization: Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous), Characterization of waste for energy utilization, Waste selection criteria.

UNIT- 3

Technologies for Waste:Energy Biochemical Conversion – energy production from organic waste through anaerobic digestion and fermentation, Thermo-chemical Conversion – combustion, incineration, heat recovery, pyrolysis, gasification, Plasma Arc Technology, other newer technologies.

UNIT- 4

Waste to Energy Options: Landfill gas, collection and recovery, Refuse Derived Fuel (RDF) – fluff, briquettes, pellets, Alternate Fuel Resource (AFR) – production and use in cement plants, thermal power plants, Industrial boilers, Conversion of wastes to fuel resources for other useful energy applications, Energy from Plastic Wastes – non-recyclable plastic wastes for energy recovery, Energy recovery from wastes and optimization of its use, benchmarking and standardization, Energy Analysis.

UNIT-5:

Waste to Energy Plants

Waste management activities – collection, segregation, transportation and storage requirements, Location and Siting of 'Waste to Energy' plants, Industry Specific Applications – In-house use

Waste to Energy & Environmental Implications: Environmental standards for Waste to Energy Plant operations and gas clean-up. Savings on non-renewable fuel resources, Carbon Credits- carbon foot calculations, carbon credits transfer mechanisms.

TEXT BOOKS:

1. B.T. Nijaguna, Biogas Technology, 1st Edition, New Age International Pvt Ltd, 2002.
2. Marc Rogoff Francois Screve, Waste-to-Energy, 3rd Edition, William Andrew,2019.
3. Vishal Prasad, BarkhaVaish, Advances in Waste-to-Energy Technologies, 1stEdition, CRC Press, 2019
4. Dev Vrat Kamboj, Manoj Kumar Solanki, Waste to Energy: Prospects and Applications, 1st Edition, Springer,2021

REFERENCE BOOKS:

1. Khandelwal, K. C. and Mahdi.S.S, Biogas Technology - A Practical Hand Book, 1st Edition, 1986.
2. Challal,D.S, Food Feed and Fuel from Biomass, 1st Edition, IBH Publishing Co. Pvt. Ltd, 1991.
3. C. Y. WereKo-Brobby and E. B. Hagan, Biomass Conversion and Technology, 1st Edition, John Wiley& Sons, 1996.

Desai, Ashok V, Non-Conventional Energy, 1st Edition, Wiley Eastern Ltd, 1990

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19CSXO01 - INTERNET OF THINGS AND APPLICATIONS				

Course Outcome:

Students are able to

1. Describe Arduino IDE tool and Arduino Programming concept.
2. Illustrate concept hardware configuration with Firmata protocols.
3. Describe the knowledge Arduino pin configuration.
4. Differentiate various sensors configuration and workflows.
5. Define architecture of IoT.
6. Describe the knowledge in cloud based web application.

UNIT-I (Introduction to Arduino)
Introduction to Arduino, history of Arduino, variants, Uno board block diagram, installation of Arduino, Arduino IDE, Arduino programming, functions and statements.

UNIT-II (Configuration)
Connecting Arduino borad, introducing the Firmata Protocol, uploading a Firmata sketch to the Arduino board, testing the Firmata protocol.

UNIT-III (Components)
List of components, software flow design, hardware flow design, hardware prototyping software, designing the hardware prototype, Arduino sketch default functions and custom function, setting Arduino board, pin configuration, working with pins.

UNIT-IV (Prototype)
Potentiometer-continuous observation from an analog input connection, Buzzer-generating sound alarm pattern, DC motor-controlling motor speed using PWM, LED- controlling LED brightness using PWM, Servomotor- moving the motor to a certain angle.

UNIT-V (Networking and cloud)
Arduino and computer networking, networking fundamentals, Obtaining the IP address, Networking extensions for Arduino with libraries and class, architecture of IoT web applications, IoT cloud platforms, develop cloud-based IoT applications.

Textbooks:
1. Python programming for Arduino by Pratik desai, Packt Publishing.
2. Internet of Things with Arduino Cookbook by Marco Schwartz.
3. Introduction to Arduino by Alan G. Smith.

References
1. Beginning Arduino by Michael McRoberts, 2e.
2. Getting Started with Arduino Massimo Banzi Second Edition.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19CSXO02 - FOUNDATION TO DATA ANALYTICS				

COURSE OUTCOMES: Students are able to

1. Describe the basics of Excel as business analytics.
2. Describe the basic functions and statistical functions in Excel
3. Discuss about using of pivot tables and charts
4. Describe the advanced business analytics related charts
5. Discuss about statistical concepts for data analysis and basics of Power BI.

UNIT – I

Introduction to spreadsheets: reading data, manipulating data. Basic spreadsheet operations and functions.
Introduction to Business analytics: Introduction, Types of Analytics, Area of Analytics.

UNIT – II

Spreadsheet Functions to Organize Data: Conditional formatting, Logical functions: Lookup and reference functions, IF, Nested IF, VLOOKUP, HLOOKUP, MATCH, INDEX and OFFSET functions in Excel.
Statistical functions: Introduction, SUMIFS, COUNTIF, PERCENTILE, QUARTILE, STDEV, MEDIAN and RANK Function

UNIT – III

Introduction to Filtering, Pivot Tables, and Charts: Introduction to the data filtering capabilities of Excel, the construction of Pivot Tables to organize data and introduction to charts in Excel.
Pivot Table Introduction: Creating a Pivot Table, Grouping in Pivot Table, Custom Calculated Field and Calculated Item, Slicer Introduction, Creating a Slicer

UNIT – IV:

Advanced Graphing and Charting: Constructing various Line, Bar and Pie charts. Using the Pivot chart features of Excel. Understanding and constructing Histograms and Scatterplots.
Business analytics with Excel: Introduction, Histogram, Data Table, Descriptive Statistics.

UNIT – V:

Data Analysis Using Statistics: Introduction, Moving Average, Hypothesis Testing, ANOVA, Covariance, Correlation, Regression, Normal Distribution.
Power BI: Introduction, Power Pivot, Power View, Power Query, Power Map.

Reference Books:

1. Advanced Analytics with Excel 2019: Perform Data Analysis using Excel's Most Popular Features (English Editions), 2020
2. Beginning Excel What-If Data Analysis Tools: Getting Started with Goal Seek, Data Tables, Scenarios, and Solver – Illustrated, Paul Cornell, 2005.

Website Link for Reference:

1. https://www.excel-easy.com/data-analysis.html

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19CSXO03 - DATA ENGINEERING				

COURSE OUTCOMES:

Students will be able to:

1. Apply the skills of data inspecting and cleansing.
2. Determine the relationship between data dependencies using statistics
3. Can handle data using primary tools used for data science in Python
4. Represent the useful information using mathematical skills
5. Can apply the knowledge for data describing and visualization using tools.

UNIT I INTRODUCTION

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications

UNIT II DESCRIBING DATA I

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – interquartile range – variability for qualitative and ranked data

UNIT III PYTHON FOR DATA HANDLING

Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

UNIT IV DESCRIBING DATA II

Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean

UNIT V PYTHON FOR DATA VISUALIZATION

Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three dimensional plotting – geographic data – data analysis using statmodels and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (first two chapters for Unit I)
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Chapters 1–7 for Units II and III)

3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Parts of chapters 2–4 for Units IV and V)

REFERENCES:

1. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19CSXO04 - MACHINE LEARNING				

Course outcomes: Students are able to

1. Define basic concepts of machine learning.
2. Evaluate and compare the performance or, other qualities of regression and logistic regression.
3. Describe concepts of artificial intelligence.
4. Design a supervised or unsupervised learning system.
5. Define the knowledge about SVM.

UNIT I: Introduction

Well-posed learning problems, designing a learning system, Perspectives and issues in machine learning. Concept learning and the general to specific ordering – Introduction, a concept learning task, Concept learning as search, Find- S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias.

UNIT II: Linear Regression & Logistic Regression

Predicting numeric values: regression – Finding the best fit lines with linear regression, locally weighted linear regression, Shrinking Coefficients, The bias / Variance tradeoff. Logistic Regression: Classification with logistic regression and the sigmoid function, using optimization to find the best regression coefficients.

UNIT III: Artificial Neural Networks

Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptions, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition, Advanced topics in artificial neural networks.

UNIT IV: Evaluation Hypotheses

Motivation, Estimation hypothesis accuracy, Basics of sampling theory, a general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms.

UNIT V: Support vector machines & Dimensionality Reduction techniques

Separating data with the maximum margin, finding the maximum margin, efficient optimization with SMO algorithm, speeding up optimization with full platt SMO, Using Kernels for more Complex data. Dimensionality Reduction techniques: Principal Component analysis, Example.

Instance-Based Learning

Introduction, k -Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

TEXT BOOKS

1. Machine Learning, Tom M. Mitchell, MGH
2. Machine Learning in Action, Peter Harington, 2012, Cengage.`

REFERENCE BOOKS

1. Introduction to Machine Learning, Ethem Alpaydin, PHI, 2004

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19ECXO01: NANO TECHNOLOGY AND APPLICATIONS				

COURSE OUTCOMES:

Students are able to

CO1. Define Nano materials and Nano Technology with properties
CO2.Describe Synthesis as Fabrication methods of Nano Technology
CO3. Demonstrate Characterization techniques of Nano Materials
CO4. Analyze carbon Nano technology and application of Nano technology.

UNIT-I
INTRODUCTION: History of nano science, definition of nano meter, nano materials, nano technology, Classification of nano materials, Applications in material science, biology and medicine, surface science, energy and environment, Crystal symmetries, crystal directions, crystal planes, Band structure,

UNIT-II
PROPERTIES OF MATERIALS: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

UNIT-III
SYNTHESIS & FABRICATIONMETHODS: Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top Down Approach – Ball milling, micro fabrication, lithography.

UNIT-IV
CHARECTERIZATION TECHNIQUES: X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy.

UNIT-V
CARBON NANO TECHNOLOGY: Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nanocrystalling diamond films, grapheme, applications of carbon nanotubes, carbon nanotubes for nanoelectronics devices.

TEXT BOOKS:

1. Nano science and nano technology by M.S RamachandraRao, Shubra Singh, Wiley publishers. **(UNITS-I,II&III)**
2. Fundamentals of nano electronics by George W Hanson Pearson publications, India 2008 **(Unit- I, IV&V)**

REFERENCE BOOKS:

1. Introduction to Nano Technology by Charles P. Poole, Jr., Frank J.Owens, Wiley publishers.
2. Principles of Nanotechnology by Phani Kumar, Scitech.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19ECXO02 - GLOBAL POSITIONING AND NAVIGATION SATELLITE SYSTEMS				

COURSE OUTCOMES:
Students are able to

CO1: Describe the concepts of GNSS based positioning methods, the core components of a satellite navigation system and their purposes**.**
CO2: Estimate and represent the GPS coordinate frames and GPS orbits.
CO3: Analyze the impact of various error sources on the precision of positioning.
CO4: Dramatize the examples of their role of goods and services based on the GSP in sustainable development.

UNIT - I
Overview of GPS: Basic concept, system architecture, space segment, user segment, services of GPS, applications of GPS.

UNIT - II
GPS Signals: Signal structure, anti spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.

UNIT - III
GPS coordinate frames, Time references: Geodetic and Geo centric coordinate systems, ECEF coordinate world geodetic 1984 (WGS 84), GPS time.

UNIT - IV
GPS orbits and satellite position determination: GPS orbital parameters, description of receiver independent exchange format (RINEX)–Observation data and navigation message data parameters, GPS position determination.

UNIT - V
GPS Errors: GPS error sources – clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver.

TEXT BOOKS:

1. G. S. RAO, Global Navigation Satellite Systems, 2nd Edition, McGraw-Hill publications, New Delhi, 2010. **(UNIT-I-V)**

REFERENCE BOOKS:

1. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, 'GPS – Theory and Practice', 4th Edition, Springer – Wien, New York , 2001. (UNIT-I-III)
2. Sateesh Gopi, "Global Positioning System: Principles and Applications", 3rd Edition, TMH, 2005. (UNIT-I-II)
3. James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software Approach', 3rd Edition, John Wiley & Sons, 2001. (UNIT-IV-V)
4. Elliot D. Kaplan, "Understanding GPS Principles and Applications", 2nd edition, Artech House, 2005. (UNIT-I-III)

E-REFERENCES:

1. http://www.unoosa.org/oosa/sk/ourwork/psa/gnss/gnss.html
   https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/gps/howitworks/
2. https://www.princeton.edu/~alaink/Orf467F07/GNSS.pdf
3. https://www.euspa.europa.eu/european-space/eu-space-programme/what-gnss

   https://www.gps.gov/systems/gnss/

OPEN ELECTIVE	L	T	P	C
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19ECXO03 - REMOTE SENSING				

COURSE OUTCOMES:

Students are able to

CO1: Describe the subject of satellite communication and remote sensing with the core knowledge of space and satellite, communication and the international space laws.
CO2: Comprehend different remote sensing signaling techniques, capable of interpreting signature of satellite communication from bodies like soil, vegetation and ocean.
CO3: Analyze various components used in satellite communication and remote sensing applications.
CO4: Acquire and keep abreast of designing satellite remote sensing system and also analyze the sensor data for drawing inference and conclusions.

UNIT I

Introduction: Historical background, International space laws, Advantages of space based observations, Global coverage, Multiscale observation, repeat observation immediate transmission and digital format, Source of information on remote sensing region.

UNIT II

Principles of remote sensing: Fundamentals of remote sensing signals, Theelectromagnetic spectrum, Terms and units of measurements, EM radiation laws,Spectral signature in the solar spectrum, vegetation reflectance, soil reflectance,water in the solar spectrum, The thermal infrared domain, characteristics of EM radiation in thermal infrared, Thermal properties of vegetation, Soils thermal domain, thermal signature of water and snow, The microwave region, Atmospheric interaction.

UNIT III

Sensors and remote sensing satellite: Type of sensors, Resolution of sensor systems, spatial, spectral, radiometric, temporal, angular - resolution, passive sensors, photographic cameras, cross and along track - scanners, active sensors, Radar and Lidar, satellite remote missions, Satellite orbits, Landsat programs, SPOT satellites, IRS program, High resolution commercial satellites, Polar orbiting meteorological satellites, Terra Aqua, Geostationary meteorological satellites.

UNIT IV

Basis for interpretations of remote sensing images: Constraints in using remote sensing data, types of interpretation, Costs of data acquisitions, end-user requirements, Thematic classification, Generation of biophysical variables, Change detection, spatial patterns, organization of remote sensing project, interpretation phase, presentation of study cases.

UNIT V

Characteristic of photographic images, Feature identification, criteria for visual interpretation, Brightness, color, texture, spatial contexts, shadows, spatial patterns, shape and size, stereoscopic view, period of acquisition, elements of visual analysis, Geometric characteristics of satellite image, Color composites, Multitemporal approaches.

TEXTBOOKS:

1. Emilio Chuvieco, “Fundamentals of Satellite Remote Sensing”, CRC press, Edition,2009.

REFERENCES:

1.C. H. Chen, “Signal Processing for Remote Sensing‖, CRC press, Edition-2007.
2. R. N Mutagi, “Satellite Communication Principles and Applications”, Oxford University press, 2016.
3. Enrico Del Re, and Marina Ruggieri, “Satellite communications and navigation systems”, Springer.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19ECXO04 - MOBILE COMMUNICATION AND APPLICATIONS				

COURSE OUTCOMES:

Students are able to

CO1. Design Hexagonal shaped cells and how these are implemented in real world.

CO2. Describe different types of antenna systems in mobile communication.

CO3. Analyze Handoffs and different types of handoffs and Dropped call rates and their evaluation.

CO4. Describe the Parameters of Mobile multipath channels, Types of small scale fading.

UNIT-I

INTRODUCTION :

Evolution of Mobile Communications, Mobile Radio Systems around the world, First, Second, Third Generation Wireless Networks, Wireless Local Loop(WLL), Wireless LANs, Bluetooth, Personal Area Networks(PANs), A Simplified Reference Model, Applications.

UNIT-II

ELEMENTS OF MOBILE COMMUNICATIONS:

General description of the problem, concept of frequency channels, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system, Cell splitting, consideration of the components of Cellular system.

UNIT-III

THE MOBILE CONCEPT :

Introduction, Frequency reuse, Handoff strategies, Interference and System Capacity: Co- Channel Interference, Channel Planning, Adjacent Channel Interference, Power control for reducing interference, Trunking and Grade of Service, Cell Splitting, Sectoring.

UNIT-IV

MOBILE RADIO PROPAGATION :

Introduction, Free space propagation model, The three basic propagation models-Reflection, Diffraction and Scattering, Two-ray model, Outdoor propagation models, Indoor propagation models, Signal Penetration into building, Small scale multipath Propagation, Parameters of Mobile multipath channels, Types of small scale fading.

UNIT-V

FREQUENCY MANAGEMENT AND CHANNEL ASSIGNMENT:

Numbering and grouping, setup access and paging channels channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non fixed channel assignment.

TEXTBOOKS:

1. Wireless Communications by Theodore S. Rappaport, principles and practice,2nd Editions. (**Unit-I, III, IV & V)**

2. Mobile Cellular Communication by Gottapu Sasibhushana Rao, Pearson International, 2012.

(UNIT - I, II, III &IV)

3. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn., 2006. **(UNIT - V & VI)**

REFERENCES:

1. Wireless and Mobile Communications-Lee, McGraw Hill, 3rd Edition, 2006.

2. Wireless Communications and Networks-William Stallings, Pearson Education, 2004.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19ITXO01 : SOFTWARE ENGINEERING PRINCIPLES				

COURSE OUTCOMES

After the completion of the course the students are able to

1. Identify, formulate, and solve software engineering problems.
2. Elicit, analyze and specify software requirements with various stakeholders of a software development project.
3. Implement the techniques for project planning and estimation.
4. Participate in design, development, deployment and maintenance of a medium scale software development project.
5. Evaluate the impact of potential solutions to software engineering problems in a global society, using the knowledge of models, tools, and techniques.

UNIT-I

Introduction to Software Engineering: The evolving role of software, Software Characteristics, Changing Nature of Software, Software myths.

A Generic view of Process: Software engineering- A layered technology, a Process framework, The Capability Maturity Model Integration (CMMI), Process assessment, Product and Process.

UNIT-II

Process models: The waterfall model, Incremental process models, Evolutionary process models, The Unified process.

Software Requirements: User requirements, System requirements, Functional and non-functional requirements, the Software Requirements Document (SRS).

UNIT-III

Requirements Engineering Process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

Project planning and estimation: Project Planning Activities, Software Metrics and Measurements, Project Size Estimation, Effort Estimation Techniques: COCOMO, PERT/CPM method.

UNIT-IV

Design Engineering: Design process and Design quality, Design concepts, Software Architecture, Architectural Styles and Patterns.

Object-Oriented Design: Objects and object classes, An Object-Oriented design process, Design evolution

UNIT-V

Performing User Interface Design: Golden Rules, User interface analysis and design, interface design steps, Design evaluation.

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, Validation testing, System testing , the art of Debugging, Black-Box and White-Box testing.

Text Books:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, McGrawHill International Edition.
2. Software Engineering- Sommerville , 9th edition, Pearson education.

References Books:

1. Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers
2. Software Engineering, an Engineering approach- James F. Peters, WitoldPedrycz, John Wiely.
3. Systems Analysis and Design- ShelyCashman Rosenblatt, Thomson Publications.
4. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies.

OPEN ELECTIVE	L	T	P	C
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19ITXO02 : CLOUD COMPUTING PRINCIPLES				

COURSE OUTCOMES

After the completion of the course the students are able to

1. Explain basics of cloud computing technology.
2. Demonstrate the concept of virtualization and the development of Cloud Computing.
3. Analyze various cloud services and service providers.
4. Explain and Uses cloud scalability, security and disaster management.
5. Understand the different cloud platforms and its application.

UNIT-I

Introduction to Cloud: Cloud Computing at a Glance, the Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model. Characteristics and Benefits, Challenges Ahead, Historical Developments.

UNIT-II

Virtualization: Introduction, Characteristics of Virtualized Environment, Classification of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples-VMware and Microsoft Hyper-V.

Before the Move into the Cloud: Know Your Software Licenses, The Shift to a Cloud Cost Model, Service Levels for Cloud Applications.

UNIT-III

Cloud Computing Architecture : Introduction, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance.

UNIT-IV

Defining the Clouds for Enterprise: Storage as a service, Database as a service, Process as a service, Information as a service, and Integration as a service and Testing as a service. Scaling cloud infrastructure - Capacity Planning, Cloud Scale. Disaster Recovery: Disaster Recovery Planning, Disasters in the Cloud, Disaster Management.

UNIT-V

Cloud Applications: Scientific Applications – Health care, Geo science and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.

Cloud Platforms in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google AppEngine-Architecture and Core Concepts, Application Life-Cycle, cost model. Microsoft Azure- Azure Core Concepts, SQL Azure.

Text Books:

1. "Mastering Cloud Computing" by Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi from TMH 2013.
2. George Reese "Cloud Application Architectures", First Edition, O'Reilly Media 2009.

Reference Books:

1. Cloud Computing and SOA Convergence in Your Enterprise, *A Step-by-Step Guide* by David S. Linthicum from Pearson 2010.
2. Cloud Computing, 2nd Edition by Dr. Kumar Saurabh from Wiley India 2012.
3. Cloud Computing, – web based Applications that change the way you work and collaborate Online – Micheal Miller.Pearson Education.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19ITXO03 : E-COMMERCE				

COURSE OUTCOMES

Students are able to

1. Define the fundamentals E-commerce framework.
2. Describe the basics of Consumer Oriented Electronic models.
3. Distinguish different electronic payment systems and their issues.
4. Demonstrate Inter-organizational and intra-organizational electronic commerce.
5. Discuss about advertising and marketing on the Internet, consumer search and resource discovery and key multimedia concepts.

UNIT-I

Electronic Commerce-Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications.

UNIT-II

Consumer Oriented Electronic commerce - Mercantile Process models, Electronic payment systems - Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems.

UNIT-III

Inter Organizational Commerce - EDI, EDI Implementation, Value added networks. Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management.

UNIT-IV

Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses. Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing process, market research.

UNIT-V

Consumer Search and Resource Discovery - Information search and Retrieval, Commerce Catalogues, Information Filtering.

Multimedia - key multimedia concepts, Digital Video and electronic Commerce, Desktop video processing, Desktop video conferencing.

Text Books:

1. Frontiers of electronic commerce – Kalakata, Whinston, Pearson.

References Books:

1. E-Commerce fundamentals and applications Hendry Chan, Raymond Lee, TharamDillon,Ellizabeth Chang, John Wiley.
2. E-Commerce, S.Jaiswal – Galgotia.E-Commerce, Efrain Turbon, Jae Lee, David King, H.Michael Chang.
3. Electronic Commerce – Gary P.Schneider – Thomson.
4. E-Commerce – Business, Technology, Society, Kenneth C.Taudon, Carol GuyericoTraver.

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19ITXO04 : WEB TECHNOLOGY PRINCIPLES				

COURSE OUTCOMES

Students are able to

1. Discuss about World Wide Web.
2. Develop Simple HTML Web Pages
3. Create Style Sheets for HTML Pages.
4. Acquire Knowledge about Client – side validation through Java Script.
5. Discuss about XML Documents.

UNIT-I

Introduction to WWW: Protocols and programs, secure connections, application and development tools, the web browser, What is server, choices, setting up UNIX and Linux web servers, Logging users, dynamic IP.

Web Design: Web site design principles, planning the site and navigation.

UNIT- II

HTML5: Introduction, Basic Formatting Tags, Block and inline elements, Lists, Image, Hyperlink, Table, Iframe, Form Elements, Layout Elements and Miscellaneous.

UNIT-III

CSS3: Introduction, CSS Syntax, Selectors, Add CSS to HTML : External, Internal and Inline, CSS Styling : Backgrounds, Text, Fonts, Links, Lists, Tables, CSS Box Model.

UNIT-IV

Javascript : Client side scripting, What is Javascript, How to develop Javascript, simple Javascript, variables, functions, conditions, loops and repetition, Javascript own objects, the DOM and web browser environments, forms and validations.

UNIT-V

XML EXTENSIBLEMARKUP LANGUAGE: XML- Document type Definition, XML schemas, Document object model.

TEXT BOOKS:

1. Internet and World Wide Web – How to program by Dietel and Nieto PHI/Pearson Education Asia.
2. Web Technologies – Black Book, Kogent Learning solutions Inc sol. Dreamtech press.

REFERENCE BOOKS:

- W3Schools Online Web Tutorials (https://www.w3schools.com/)

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19BMXO01 : INNOVATIONS AND ENTREPRENEURSHIP				

UNIT-I INNOVATION MANAGEMENT: Concept–Objectives-types of Innovation-process of Innovation- sources of Innovation-Levels of Innovation -barriers of Innovation-–Open and Closed Innovation-challenges faced while managing innovation.

UNIT-IICREATIVEINTELLIGENCE: Concept of Creativity-Importance-Characteristics-Types of Creativity-Traits Congenial to Creativity-Triarchic theory of Intelligence – Creative thinking –Types-process of creative thinking-Sources and techniques for generating ideas.

UNIT-III ENTREPRENEURSHIP: Concept- characteristics-Importance-classification-Theories of Entrepreneurship-entrepreneurship development-entrepreneurial process- challenges-Women Entrepreneurs.

UNIT-IVPROJECT FORMULATION AND APPRAISAL: Concept -Need-Significance-steps - Economic Analysis; Financial analysis; Market analysis; Technical feasibility-project Appraisal-techniques of project appraisal.

UNIT-V INSTITUTIONS PROMOTING SMALL BUSINESS ENTERPRISES: Central level Institutions; SIDBI, NSIC, KVIC,SSIDC - State level Institutions- DICs – SFC- SSIDC- other financial assistance, Government policy and taxation benefits- government policy for SSIs

TEXT BOOKS:

1. Vasanth Desai, ―Entrepreneurship, Himalaya Publishing House, New Delhi, 2012
2. Arya Kumar: ―Entrepreneurship, Pearson, Publishing House, New Delhi, 2012.
3. Keith Goffin and Rick Mitchell-Innovation Management,Springer,2016

REFERENCES BOOKS:

1. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata McGraw Hill, 2004.
2. Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19BMXO02 : INDUSTRIAL SOCIOLOGY AND PSYCHOLOGY				

UNIT I: Industrial Sociology: Nature and Scope of Industrial Sociology-Development of Industrial Sociology, Factors of social change – the technological factors, the cultural factors, effects of technology on major social institutions, social relations in industry.

UNIT II: Group Dynamics: Concept- factors influencing individual behaviour- Work Teams & Groups, Group Behavior, Group formation & development, Decision Making by Individuals, Groups Decision making process-techniques.

UNIT III Industrial Psychology: Nature and Meaning of Industrial Psychology, Role of Industrial Psychology, Organizational Attitude, Motivation at work-Theories of Motivation (Theory X and Y, McClelland's Theory, Maslow's Need Theory, Herzberg's Two Factor Theory), Cultural Differences in Motivation.

UNIT IV: Organizational Design and Leadership: Organizational Design & Structure- organizational design- process, Structural differentiations, factors influencing design of organizations, Leadership-concept, types, Leadership vs. Management, Leadership Theories, Emerging issues in Leadership.

UNIT V Organizational Conflictsand Change management: Concept - Causes and Consequences of Conflict-Conflict handling techniques, Managing Change, Forces for change in Organization, Resistance to change.

TEXT BOOKS:

1. Nelson, Quick and Khandelwal, ORGB : An innovative approach to learning and teaching Organizational Behaviour. A South Asian Perspective, Cengage Learning, 2012

2. Luthans, Fred, Organizational Behavior, McGraw Hill, 2008.

3.Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.

REFERENCES BOOKS:

1. Gisbert Pascal, Fundamentals of Industrial sociology, Tata McGraw Hill Publishing Co., New Delhi, 1972.

2. Schneider Engno V., Industrial Sociology 2nd Edition, McGraw Hill Publishing Co., New Delhi,2011.

3.Ivancevich, Konopaske &Maheson, OrganisationalBehaviour& Management, 7th edition, Tata McGraw Hill, 2008.

OPEN ELECTIVE	L	T	P	C
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19BMXO03 : DIGITAL MARKETING				

UNIT I- Introduction to Digital Marketing: Concept – scope- importance of digital marketing - Traditional marketing versus digital marketing – Types of digital marketing-marketing mix and its implications for digital marketing--Challenges and opportunities for digital marketing

UNIT II- Content Marketing: Understanding Content Marketing, Content Creation Framework, Content marketing strategy and planning- Types of content marketing -Measuring and Analysing Your Content-Viral Marketing-Blog Marketing.

Unit III- Search Engine Optimization (SEO): What is SEO? SEO Importance and Its Growth in recent years, Ecosystem of a search Engine , kinds of traffic, Keyword Research & Analysis (Free and Paid tool & Extension), Recent Google Updates

UNIT IV-Email and Mobile Marketing: Introduction, process, design, content,email marketing metrics. Mobile Marketing: Concept, Process-tools-opportunities and challenges.

UNIT V-Social Media Marketing: Concepts- Process - Tools- Google and the Search Engine, Facebook, Twitter, YouTube and LinkedIn- Issues: Credibility, Fake News, Paid Influencers; social media and Hate/ Phobic campaigns.

TEXT BOOKS:

1. Puneet Singh Bhatia, "Fundamentals of Digital Marketing", Pearson Education Publications, 2nd edition 2019
2. Seema Gupta, "Digital Marketing", McGraw Hill Publications", 2nd edition 2020
3. Ryan Deiss, Russ Henneberry, "Digital Marketing For Dummies", Wiley Publications, 2020

REFERENCES BOOKS:

1. Joe Pulizzi, "Epic Content Marketing", McGraw Hill Education, 2019
2. Puneet Singh Bhatia , "Social Media & Mobile Marketing", Wiley Publications, 2019

OPEN ELECTIVE	L	T	P	C
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19BMXO04 : BUSINESS ENVIRONMENT				

Unit-I Business Environment: Components and Significance – Economic Scope – Factors Influencing Business Environment – Dimensions of International Business Environment – Challenges.

Unit-II: Structure of Indian Economy: Economic systems- Economic planning with special reference to last three plans, public, private joint and cooperative sectors - Industrial Policy - Policy Resolutions of 1991- Economic Reforms-PPP

Unit-III Indian Business Environment: Competitiveness, Changes and Challenges, Sustainable Development, Social Responsibilities, Ethics in Business- Competition Act 2002 - Emerging Trend in Indian Business Environment

Unit-IV: International Trade: Balance of Payments – Concepts, Disequilibrium in BOP: Methods of Correction - Trade Barriers and Trade Strategy - Free Trade vs. Protection -World Financial Environment: Foreign Exchange Market Mechanism, Exchange Rate Determination, and Euro Currency.

Unit-V: Globalisation: International Economic Integration, Country Evaluation and Selection, Foreign Market Entry Methods, International Trading Blocks – WTO Origin, Objectives, Organisation, Structure and Functioning – WTO and India.

TEXT BOOKS:

1. Chidambaram, Indian Business Environment, Vikas, New Delhi
2. Suresh Bedi: Business Environment, Excel, New Delhi.
3. K.V.Sivayya and VBM Das: Indian Industrial Economy, Sultan Chand Publishers, Delhi.

REFERENCES BOOKS:

1. Pandey G.N., Environmental Management, Vikas Publishing House.
2. Sundaram & Black, International Business Environment – The Text and Cases, Prentice Hall of India.
3. Ghosh PK., Business Environment,Sultan Chand & Sons, New Delhi
4. Daniel John D and Redebough, Lee. H., International Business, Addision Wesley India
5. Saleem, Business Environment, Pearson, New Delhi.
6. Bhalla, V.K., & S. Sivaramu, International Business Environment and Business, Annual Publications

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19MAXO01 : OPERATIONS RESEARCH				

COURSE OBJECTIVES:

1.Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, machines etc) more effectively.

2.Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry

UNIT—I

LINEAR PROGRAMMING:

Introduction-General formulation LPP- Formulation of LP problems - Graphical solution –Slack and Surplus and Artificial variables-simplex method (simple problems) - artificial variable techniques – twophase method, Big-M-method(simple problems) –Concept of Duality-general rules for converting any primal into its dual.

UNIT – II

TRANSPORTATION PROBLEM:

Introduction-mathematical formulation-Feasible, Basic Feasible and Optimum solution -Methods for initial basic feasible solution to transportation problem-optimal Test by u, v method(MODI)-Degeneracy in Transportation problems –.Unbalanced Transportation problems

UNIT – III

SEQUENCING PROBLEM:

Introduction –Johnson's Algorithm for n jobs 2 machines- Optimal Solution for processing n jobs through two machines- processing n jobs through three machines - processing n jobs through m machines - processing two jobsthrough m machines

UNIT – IV

REPLACEMENT PROBLEMS:

Introduction – replacement policy for items whose maintenance cost increases with time, and money value is constant – Money value, present worth Factor and Discount Rate- replacement policy when maintenance cost increases with time and money valuechanges with constant rate – Individual Replacement Policy-group replacement of items that fail completely.

UNIT – V

WAITING LINES:

Introduction- transient and steady states-Probability Distributions in Queening systems-Kendall's notation for Representing Queening models- Single channel-Poisson arrivalsExponential service times-with infinitepopulation model (M/M/1: FIFO/∞/∞)

INVENTORY:

Introduction – types of inventory models – Costs involved in Inventory problems-Variables in inventory problem-Classification of Inventory Models-Concept of EOQ-The EOQ model without shortage – Quantity Discounts-purchase inventory models with one price break - purchase inventory models with two price breaks- purchase inventory models with any number of price breaks-shortages are not allowed

COURSE OUTCOMES: Students can able to

CO1: Formulate the resourcemanagement problem andidentify appropriate methods to solve them. [K3]

CO2: Applytransportation model to optimize the industrial resources. [K3]

CO3: Solve sequencing problems using operation research techniques. [K3]

CO4: Apply thereplacement model to increase the efficiency of the system. [K3]

CO5: Apply theinventory and queuingmodel to increase the efficiency of the system. [K4]

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TEXT BOOKS:

1. Operations Research / S.D.Sharma, Ramnath co,Meerut
2. Operations Research, P.K.Gupta, D.S.Hira,S.Chand

REFERENCE BOOKS:

1. Operations Research /A.M.Natarajan,P.Balasubramani, A.Tamilarasi/PearsonEducation.
2. Operations Research / R. Pannerselvam, PHI Publications.

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19MAXO02 : OPTIMIZATION MODELS				

COURSE OBJECTIVES:

1.Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals,materials,machines etc.,) more effectively.

2.Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry

UNIT—I

INTRODUCTION TO LINEAR PROGRAMMING:

Introduction-Linear programming problem formulation – General formulation of Linear programming problem- formulation of LP problems - Graphical solution – simplex method (simple problems) - artificial variable techniques – twophase method, Big-M-method – general rules for converting any primal into its dual.

UNIT – II

ASSIGNMENT MODELS::

Formulation –mathematical formulation of assignment problem – Hungarian method for assignment problem- Unbalanced assignment Problems-variations in the assignment problem-Travelling Salesman problem.

UNIT – III

THEORY OF GAMES:

Introduction – minimax (maxmin) criterion and optimal strategy –solution of games with saddle points – rectangular games without saddle points –reduce game by dominance –-graphicmethod for m x 2 & 2 x n games-arithmetic method for finding optimum strategies and game value.

UNIT – IV

DECISION THEORY:

Introduction –decision making environments - decision making under conditions of certainty- decision making under conditions of uncertainty-Maximax criterion-maximin criterion-minimax regret criterion-Hurwitz criterion-Laplace criterion-decision making under conditions of risk-expected value criterion-expected opportunity loss criterion-expected value of perfect information.

UNIT-V

PROJECT MANAGEMENT:

Phases of project management-network logic-numbering the events(Fulkerson's rule)- – identifying critical path – probability of completing the project within given time- Project Evaluation and Review Technique.

COURSE OUTCOMES: Students are able to

CO1: Apply linear programming techniques to solve industrial optimization problems. [K3]
CO2: Solve assignment problems using operation research techniques. [K3]
CO3: Analyze game theory and apply them for optimization. [K4]
CO4: Solvethe decision theory problem through the applications of game theory. [K4]
CO5: Scheduling the production and manage the project [K4]

TEXT BOOKS:

1. Operations Research / S.D.Sharma, Ramnath co,Meerut
2. Operations Research / R.Pannerselvam,PHIPublications

REFERENCE BOOKS:

1. Operations Research /A.M.Natarajan,P.Balasubramani, A.Tamilarasi/PearsonEducation.
2. Operations Research, P.K.Gupta, D.S.Hira,S.Chand

OPEN ELECTIVE	L	T	P	C
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19BSXO01 : QUANTUM COMPUTING				

Pre-requisite: Basics of Quantum Mechanics and Computer Science

Objective of the course: The objective of this course is to provide the students an introduction to quantum computation. Much of the background material related to the algebra of complex vector spaces and quantum mechanics is covered within the course.

Unit – I

Background Mathematics, Physics and Introduction to Quantum Computation: Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis, Quantum bits, Bloch sphere representation of a qubit, multiple qubits. **(8 Hours)**

Unit – II

Quantum Circuits: Single Qubit gates, multiple qubit gates, design of quantum circuits. **(8Hours)**

Unit – III

Quantum Information and Cryptography: Comparison between classical and quantum information theory. Bell states. Quantum teleportation.QuantumCryptography, no cloning theorem. **(8 Hours)**

Unit – IV

Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Data base Search, FFT and prime factorization, Deutsch's Algorithm. **(8 Hours)**

Unit – V

Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation, Physical implementation of quantum computers. **(8 Hours)**

Text Books:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press (2002).
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computationand Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific (2004).
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms (2000).

OPEN ELECTIVE	L	T	P	C
	3	-	-	3
19BSXO02 : OPTOELECTRONICS				

COURSE OBJECTIVES:

A deep understanding of the fundamentals of optoelectronics including Optical emission from semiconductors ,quantum efficiency, heterojunction, quantum well, Optoelectronic modulators. Be familiar with recent trends in optoelectronics.

COURSE OUTCOME:

Students are able to

- Describe the fundamental concepts of Optoelectronics;
- Discuss the concept of optoelectronic modulators
- Design single-mode junction lasers at different wavelengths to meets specs;
- Describe hetero structures and quantum wells to improve device performance;
- Design junction & avalanche photodiodes to meet specs

UNIT – I

Electronic properties of Semiconductors:

Effect of temperature on band gap, density of carriers in intrinsic and extrinsic semiconductors, conduction processes in semiconductors, electron-hole pair formation and recombination, PN junction, carrier recombination and diffusion, Injection efficiency, heterojunction, internal quantum efficiency, double heterojunction, quantum well and super lattices.

UNIT – II

Opto Electronic Modulators: Basic principles, Polarization, birefringence. Electro-optic Modulators-electro optic effect, integrated optical modulator, EO materials. Kerr modulators, scanning and switching.

Magneto Optic Modulators: Faraday effect, Accusto-optic Modulators, Magneto-optic modulators.

UNIT – III

Opto-electronic devices: Injection luminescence and LED, LED structures, LED-Materials, Power and efficiency, hetereostructure LED. Laser: Basic concepts, Optical emission from semiconductors- Hetero junction lasers. Semiconductor Injection Lasers, Injection laser structures- gain guided lasers, index guided lasers, Distributed Feedback Lasers.

UNIT – IV

Opto-electronic Display devices: Photo luminescence, cathode luminescence, Electro luminescence, CRT, Plasma panel display, LCD and LED displays- liquid crystals, properties, Numeric displays

UNIT – V

Optoelectronic detectors: Thermal detectors, Photon devices- Photo emissive detectors, Photo conductive detectors, Photomultipliers (PMT), Image intensifiers, Photo diodes- PIN & APD, photo transistors.

Design of detector arrays: CCD, Solar cells.

Text Books:

1. Opto electronics - An introduction - J Wilson and J F B Hawkes. (PHI)
2. Optical fiber communication - J M Senior (Pearson, 2nd Ed)
3. Fiber Optics and Optoelectronics – R P Khare, (Oxford University Press, 4th Ed)

References:

1. Solid State Electronic Devices - Ben G Streetman, Sanjaykumar Banerjee, PHI, 6th Ed, 2006)
2. Fundamentals of Photonics- B E A Saleh and M C Teich, (John Wiley, 2007)

VIII SEMESTER	L	T	P	C
	-	-	18	9
19ME8P01 - PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY				

Course Outcomes: Students are able to

CO No	CO Statement	Knowledge Level
1	Review literature to identify the gaps, objectives & scope of the working advanced areas of mechanical engineering and define a problem.	K1
2	Analyze the problems of mechanical engineering to formulate objectives of project.	K4
3	Design a system, component, or process to meet the desired needs within certain realistic constraints such as economic, environmental, social, safety, manufacturability, and sustainability.	K6
4	Demonstrate the techniques, skills, and modern engineering tools necessary for engineering practice.	K5
5	Apply knowledge to solve engineering problem in multidisciplinary functional teams to communicate effectively and ethically and prepare a professional report as per recommended format and defend the work.	K6

CO-PO-PSO MAAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3							3	2		2	3	3
2	3	3				3			3			2	3	3
3	3	3	3	2	2	3	3	3		2	3	2	3	3
4	2	2	2	2	2				2	2	1	1	3	3
5	2	3	3		3	3		3		2		2	3	3
Avg	2.6	2.8	2.67	2	2.33	3	3	3	2.67	2	2	1.8	3	3

ABSOLUTELY

NO TO RAGGING

1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the College.
4. Outsiders are prohibited from entering the College and Hostel without permission.
5. Girl students must be in their hostel rooms by 7.00 p.m.
6. All the students must carry their Identity Card and show them when demanded.
7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.

SWARNANDHRA
COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
NAAC with 'A' Grade (3.32/4.00 CGPA)
Approved by A.I.C.T.E, New Delhi, Permanently Affiliated to J N T U K, KAKINADA
Seetharampuram, NARSAPUR – 534 280, W.G.Dist, Andhra Pradesh, Tel: 08814 – 240599

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

	Imprisonment upto	Fine Upto
Teasing, Embarrassing and Humiliation	6 Months	Rs.1,000/-
Assaulting or Using Criminal Force or Criminal Intimidation	1 Year	Rs.2,000/-
Wrongfully restraining or confining or causing hurt	2 Years	Rs.5000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	5 Years	Rs.10,000/-
Causing death or abetting suicide	10 Years	+ Rs.50,000/-