ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABI

OF

MECHANICAL ENGINEERING

FOR

B.TECH REGULAR FOUR YEAR DEGREE PROGRAM

(For the batches admitted from 2020-2021)

&

FOR B.TECH LATERAL ENTRY PROGRAM

(For the batches admitted from 2021-2022)

CHOICE BASED CREDIT SYSTEM

SREE VIDYANIKETHAN ENGINEERING COLLEGE

(AUTONOMOUS)

(Affiliated to JNTUA, Ananthapuramu, Approved by AICTE, Programs Accredited by NBA, Accredited by NAAC with 'A' grade)
SREE SAINATH NAGAR, A. RANGAMPET -517102:: NEAR TIRUPATI (A.P)

VISION

To be one of the Nation's premier Engineering Colleges by achieving the highest order of excellence in Teaching and Research.

MISSION

➢ To foster intellectual curiosity, pursuit and dissemination of knowledge.
➢ To explore students' potential through academic freedom and integrity.
➢ To promote technical mastery and nurture skilled professionals to face competition in ever increasing complex world.

QUALITY POLICY

Sree Vidyanikethan Engineering College strives to establish a system of Quality Assurance to continuously address, monitor and evaluate the quality of education offered to students, thus promoting effective teaching processes for the benefit of students and making the College a Centre of Excellence for Engineering and Technological studies.

DEPARTMENT OF MECHANICAL ENGINEERING

<u>VISION</u>

To become and be recognized as a nationwide center of excellence in Mechanical Engineering and allied areas for acquiring self-reliance through education, engagement and research

<u>MISSION</u>

➢ Department of Mechanical Engineering is established to provide students with a sound Mechanical Engineering education, advance the understanding and application of Mechanical Engineering principles to work in multicultural and multidisciplinary environment.

➢ Engage and impart knowledge to the students for innovative, high-impact and leading edge research and development of modern Mechanical Engineering science through contemporary curriculum.

➢ Maintain a collegial, supportive, and diverse environment that encourages students, faculty, and staff to achieve to the best of their abilities.

➢ Train our students by teaching them problem solving, leadership and teamwork skills, and the value of a commitment, quality and ethical behavior for their employability.

➢ Serve the community and industry through proactive knowledge exchange.

PROGRAM EDUCATIONAL OBJECTIVES

After few years of graduation, the graduates of B. Tech. (ME) Program will be:

1. Pursuing further education in Mechanical Engineering, business administration, or other disciplines.

2. In program related industry, allied industry, software industry, and able to start entrepreneurial ventures related to Mechanical Engineering.

3. Able to recognize the developing technology through life-long learning for solving problems related to Mechanical Engineering.

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of B. Tech. (ME) Program will be able to:

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. (**Engineering knowledge**)

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

3. 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. (**Design/development of solutions**)

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

5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. (**Modern tool usage**)

6. 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. (**The engineer and society**)

7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. (**Environment and sustainability**)

8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. (**Ethics**)

9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. (**Individual and team work**).

10. 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. (**Communication**)

11. 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. (**Project management and finance**)

12. 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. (**Life-long learning**)

PROGRAM SPECIFIC OUTCOMES

On successful completion of the Program, the graduates of B. Tech. (ME) Program will be able to:

PSO1. Design, develop, analyze and maintain of mechanical systems and processes by applying the concepts of material science, Manufacturing, Design and Computer aided Design & Manufacturing technologies

PSO2. Apply the principles of thermodynamics, Fluid mechanics and Heat Transfer in the thermal design of various components of thermal energy systems and assess the performance of various thermal energy systems.

PSO3. Identify, define, analyze, formulate, and solve problems related to manufacturing and service systems for optimized conditions by applying tools of Industrial Engineering for effective decision making and support purposes.

(AUTONOMOUS)

(Affiliated to J.N.T. University Anantapur, Ananthapuramu)

ACADEMIC REGULATIONS (SVEC-20)
CHOICE BASED CREDIT SYSTEM

B.Tech. Regular Four Year Degree Program
(For the batches admitted from the academic year 2020–21)

and

B.Tech. (Lateral Entry Scheme)
(For the batches admitted from the academic year 2021-22)

For pursuing four year undergraduate Degree Program B.Tech offered by Sree Vidyanikethan Engineering College under Autonomous status and herein after referred to as SVEC:

1. Applicability:

All the rules specified herein, approved by the Academic Council, shall be in force and applicable to students admitted from the academic year 2020-2021 onwards. Any reference to "College" in these rules and regulations stands for SVEC.

2. Extent:

All the rules and regulations, specified hereinafter shall be read as a whole for the purpose of interpretation and as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. It shall be ratified by the Academic Council in the forthcoming meeting. As per the requirements of statutory bodies, Principal, Sree Vidyanikethan Engineering College shall be the Chairman, Academic Council.

3. Admission:

3.1. **Admission into First Year of Four Year B.Tech. Degree Program in Engineering:**

3.1.1. **Eligibility:** A candidate seeking admission into the First Year of four year B.Tech. Degree Program should have:

Passed either Intermediate Public Examination (I.P.E.) conducted by the Board of Intermediate Education, Andhra Pradesh, with Mathematics, Physics and Chemistry as optional courses (or any equivalent examination recognized by JNTUA, Ananthapuramu) for admission as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE).

3.1.2. **Admission Procedure:** Admissions shall be made into the first year of four year B.Tech. Degree Program as per the stipulations of APSCHE, Government of Andhra Pradesh:

(a) By the Convener, EAMCET, (for Category-A Seats).

(b) By the Management (for Category-B Seats).

(c) By the Management (for 15% Supernumerary Quota) for Persons of Indian Origin (PIO)/Foreign Nationals (FN)/ Children of Indian Workers in Gulf Countries/ Overseas Citizen of India (OCI)

3.2. Admission into the Second Year of Four year B.Tech Degree Program in Engineering (Lateral Entry).

3.2.1. **Eligibility:** A candidate seeking admission into the Second Year of four year B.Tech. Degree Program (Lateral Entry) should have:

(i) Passed Diploma in Engineering in the relevant branch conducted by the Board of Technical Education, Andhra Pradesh (or equivalent Diploma recognized by JNTUA, Ananthapuramu).

(ii) Candidates qualified in ECET and admitted by the Convener, ECET. In all such cases for admission, when needed, permissions from the statutory bodies are to be obtained.

3.2.2. **Admission Procedure:** 10% of the sanctioned strength in each Program of study as lateral entry students or as stipulated by APSCHE shall be filled in by the Convener, ECET.

4. Programs of study offered leading to the award of B.Tech. Degree:

Following are the four year undergraduate Degree Programs of study offered in various branches in SVEC leading to the award of B.Tech (Bachelor of Technology) Degree:

1) Civil Engineering
2) Electrical and Electronics Engineering
3) Mechanical Engineering
4) Electronics and Communication Engineering
5) Computer Science and Engineering
6) Electronics and Instrumentation Engineering

7) Information Technology

8) Computer Science and Systems Engineering

9) Computer Science and Business Systems

10) Computer Science and Engineering (Artificial Intelligence)

11) Computer Science and Engineering (Data Science)

12) Computer Science and Engineering (Artificial Intelligence & Machine Learning)

13) Computer Science and Engineering (Internet of Things)

14) Computer Science and Engineering (Cyber Security)

15) Computer Science and Design

5. Duration of the Program:

5.1. Minimum Duration: The program shall extend over a period of four years leading to the Degree of Bachelor of Technology (B.Tech) of the JNTUA, Ananthapuramu. The four academic years shall be divided into eight semesters with two semesters per year. Each semester shall normally consist of 22 weeks having - Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), Choice Based Credit System (CBCS) and Credit Based Semester System(CBSS) as suggested by UGC and Curriculum/ Course Structure as suggested by AICTE/APSCHE are followed. Provision is made for lateral entry admission of students into the Second Year of the program in all the branches of study and they shall be required to satisfy the conditions of admissions thereto prescribed by the JNTUA, Ananthapuramu and Government of Andhra Pradesh.

5.2. Maximum Duration:

The student shall complete all the passing requirements of the B.Tech degree program within a maximum duration of 8 years (6 years for lateral entry), these durations reckoned from the commencement of the semester to which the student was first admitted to the program.

6. Structure of the Program:

Each Program of study shall consist of:

(i) HS (Humanities and Social Sciences) Courses

(ii) BS (Basic Sciences) Courses

(iii) ES (Engineering Sciences) Courses

(iv) PC (Professional Core) Courses

(v) PE (Professional Electives)

(vi) OE (Open Electives) Courses

(vii) SO (Skill Oriented) Courses

(viii) Mandatory Courses (MC)

(ix) Audit Courses (AC)

(x) Projects (PR) (Internships, Project Work)

S.No	Course Category	Course Type
1.	HS – Humanities and Social Sciences	Humanities, Social Sciences and Management.
2.	BS – Basic Sciences	Mathematics, Physics and Chemistry Courses, etc.
3.	ES – Engineering Sciences	Fundamental Engineering courses.
4.	PC – Professional Core	Core courses related to the Parent Discipline/ Branch of Engineering.
5.	PE – Professional Electives	Elective courses related to the Parent Discipline/ Branch of Engineering.
6.	OE – Open Electives	Electives from other technical and /or emerging courses
7.	SO (Skill Oriented) Courses	Basic and advanced skills related to the domain courses, soft skills course
8.	PR - Projects	Summer Internships, Internship, Project Work
9.	MC - Mandatory Courses	Induction Program, Environmental Science, Universal Human Values
10.	AC - Audit Courses	Value Added Courses.

Contact Periods:

The contact periods per week are assigned depending on the complexity and volume of the course.

7.   Credit Courses:

All Courses are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Course in a L: T: P: C (Lecture Hours: Tutorial Hours: Practical Hours: Credits) Structure, based on the following general pattern.

- **Theory Courses:** One Lecture Hour (L) per week in a semester: 01 Credit
- **Practical Courses:** One Practical Hour (P) Per week in a semester: 0.5 Credit
- **Tutorial:** One Tutorial Hour (T) Per week in a semester: 01 Credit
- **Mandatory Courses:** No **CREDIT** is awarded.
- **Audit Courses:** No **CREDIT** is awarded.

Student activities like Sports, Study Tour and Guest Lecture etc. shall not carry ANY Credits.

For Summer Internships, Internship and Project Work, where formal contact periods are not specified, credits are assigned based on the complexity of the work to be carried out.

The four year curriculum of any B. Tech Program of study shall have a total of **160** credits. However the curriculum for students admitted under lateral entry shall have a total of **121** credits.

8. Choice Based Credit System (CBCS):

Choice Based Credit System (CBCS) is introduced in line with UGC guidelines in order to promote:

- Student centred learning
- Students to learn courses of their choice
- Interdisciplinary learning

A Student has a choice of registering for courses comprising program core, professional electives, open electives, value added, Skill oriented courses etc. Besides, choice is also offered to students for registering courses to earn Minor in Engineering/Honors degree.

9. Course Enrollment and Registration

9.1. Each student, on admission shall be assigned to a Faculty Advisor (Mentor) who shall advice and counsel the student about the details of the academic program and the choice of courses considering the student's academic background and career objectives.

9.2. Each student on admission shall register for all the courses prescribed in the curriculum in the student's first and second Semesters of study. The student shall enroll for the courses with the help of the student's Faculty Advisor (Mentor). The enrollment for the courses from II B.Tech I Semester to IV B.Tech I Semester shall commence 10 days prior to the last instructional day of the preceding semester for registration process. If the student wishes, the student may drop or add courses (vide clause 8) 10 days prior to commencement of the concerned semester and complete the registration process duly authorized by the Chairman, Board of Studies of concerned department.

9.3. If any student fails to register the courses in a semester, he shall undergo the courses as per the program structure.

9.4. After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the Semester-end Examinations.

9.5. Elective courses shall be offered by a Department only if a minimum of 40 students register for that course.

10.   Break of Study from a Program (Gap Year)

10.1. A student is permitted to go on break of study for a maximum period of two years either as two breaks of one year each or a single break of two years.

10.2. In case, a student wishes to extend the gap year for one more consecutive year, he shall be permitted with the prior approval of the Principal on the recommendations of the Head of the Department prior to the beginning of the semester in which he has taken break of study.

10.3. The student shall apply for break of study in advance, in any case, not later than the last date of the first assessment period in a semester. The gap year concept is introduced for start-up (or) incubation of an idea, National/International Internships, and professional Volunteering. The application downloaded from the website and duly filled in by the student shall be submitted to the Principal through the Head of the department. A committee shall be appointed by the Principal in this regard. Based on the recommendations of the committee, Principal shall decide whether to permit the student to avail the gap year or not.

10.4. The students permitted to rejoin the program after break of study shall be governed by the Curriculum and Regulations in force at the time of rejoining.

The students rejoining in new regulations shall apply to the Principal in the prescribed format through Head of the Department, at the beginning of the readmitted semester for registering additional/equivalent courses to comply with the curriculum in-force.

10.5. The two years period of break of study shall not be counted for the maximum Period of graduation (i.e the maximum period of graduation is 10 years for Regular admitted students and 8 years for Lateral Entry admitted students availing Gap Year).

10.6. If a student has not reported to the college after completion of the approved period of break of study he is deemed to be detained in that semester. Such students are eligible for readmission into the semester when offered next.

11.   Examination System:

11.1 All components in any Program of study shall be evaluated through internal evaluation and/or an external evaluation conducted as Semester-end examination.

Sl. No.	Course	Marks	Examination and Evaluation		Scheme of examination
1.	Theory	70	Semester-end examination for 3 hours duration (External evaluation)		The examination question paper in theory courses shall be for a maximum of 70 marks. The question paper shall be of descriptive type with **FIVE EITHER/OR** type questions, **ONE EITHER/OR** type question from each unit [totally ten questions from Q. No. 1 to 10)] of which student has to answer one from each EITHER/OR type question and shall be evaluated each for 14 marks.
		30	10	Assignments (Internal evaluation)	One Assignment shall be given to the student for 10 marks during the semester.
			20	Mid-term Examination of 2 hours duration (Internal evaluation)	Two mid-term examinations each for 20 marks shall be conducted. For a total of 20 marks, 80% of better one of the two and 20% of the other one are added and finalized, any fraction shall be rounded off to the higher integer number. The examination shall be conducted and evaluated for 40 marks and scaled down to 20 marks, any fraction shall be rounded off to the higher integer number. **Mid-I:** After first spell of instruction (I & II Units). **Mid-II**: After second spell of instruction (III, IV & V Units). The question paper shall of descriptive type with two parts i.e., Part-A and Part-B. Part-A shall contain 5 short answer questions [Q. No. 1 (a) to (e)] and evaluated each for 2 marks. Part-B shall contain three EITHER/OR type questions [totally six questions from Q. No. 2 to 7)] of which student has to answer one from each EITHER/OR type question and shall be evaluated each for 10 marks. Further, in the case of Part-B of Mid-I, one EITHER/OR type question from each unit and third either or type question from both the units; and for Mid-II, one EITHER/OR type question from each unit.
2.	Laboratory	70	Semester-end Lab Examination for 3 hours duration (External evaluation)		The examination shall be conducted by the faculty member handling the laboratory (Examiner-2) and another faculty member (Examiner-1) appointed by the Chief Controller of Examinations.
		30	20	Day-to-Day evaluation for Performance in laboratory experiments and Record. (Internal evaluation)	Two laboratory examinations each for 30 marks which include Day-to-Day evaluation and Practical examination shall be evaluated by the faculty member. For a total of 30 marks 80% of better one of the two and 20% of the other one are added and finalized, any fraction shall be rounded off to the higher integer number.

Sl. No.	Course	Marks	Examination and Evaluation		Scheme of examination
			10	Practical Examination (Internal evaluation)	**Mid-I:** Shall be conducted just before FIRST mid-term theory examinations. **Mid-II:** Shall be conducted just before SECOND mid-term theory examinations.
3.	Mandatory courses	30	Internal Evaluation		Shall be evaluated as given in 11.2.1
4.	Audit Courses	-	-		As detailed in 11.2.2
5.	MOOC	100	-		The student has to submit MOOC certificate with percentage of Score earned to the Head of the Department at the end of the semester. Based on the score the equivalent Grade Point and Credits will be assigned as given in 11.3.
6.	Summer Internship	100	Semester-end evaluation		The evaluation shall be done by the Internship Evaluation Committee (IEC) at the end of the semester as given in 11.4.
7.	Internship	-	-		At the end of semester the student should submit an internship completion certificate as given in 11.5
8.	Project Work	200	100	Internal evaluation	Continuous evaluation shall be done by the Project Evaluation Committee (PEC) as given in 11.6.1
			100	Semester-end evaluation	Project Work Viva-Voce Examination shall be conducted by a Committee at the end of the semester as given in 11.6.2

11.2 Mandatory Course/ Audit Course Evaluation:

11.2.1. Mandatory Courses:

Mandatory courses carry **"ZERO"** credits. There shall be **NO Semester-end** examination. However, ATTENDANCE in Mandatory courses shall be considered while calculating aggregate attendance in a semester. The mid-term examination shall be conducted and evaluated similar to the THEORY courses. The student shall be declared to have passed the mandatory courses only when HE secures **40% marks in the internal evaluation.** If the student FAILS, a re-examination shall be conducted for FAILED candidates in the CONSECUTIVE semester. The performance of the student shall be indicated in the grade sheets "**SATISFACTORY" (or) "NOT SATISFACTORY"** as given in 14.1**.** The student should pass all the mandatory courses, for the award of B.Tech degree.

11.2.2. Audit Courses:

Audit courses carry "**ZERO**" credits. There shall be **NO mid-term** and **Semester-end examination**. However, ATTENDANCE in Audit courses shall be considered while calculating aggregate attendance in a semester. The student should study all the audit courses, and it shall be indicated in the GRADE Sheet.

11.3 Massive Open Online Course (MOOC)

MOOC is a web-based learning aimed at unlimited participation and open access.

11.3.1 A Student shall be permitted to pursue **two elective courses** under MOOC during the program of study. The duration of the MOOC shall be for a minimum period of 08 weeks.

11.3.2 The student shall confirm registration by enrolling the course within 10 days prior to the last instructional day of the current Semester of study along with regular courses.

11.3.3 The list of courses along with MOOC service providers shall be identified, approved and notified by the Chairman, BOS and Head of the Department.

11.3.4 The student has to submit MOOC certificate with percentage of Score earned to the Head of the Department at the end of the semester. Based on the score earned, the equivalent Grade Point and Credits will be assigned.

11.3.5 Attendance is not applicable for MOOC Course and also attendance will not be monitored.

11.3.6 If the student fails to submit the MOOC certificate at the end of the semester, his performance in MOOC will be shown as "Fail" in the Grade sheet. Then the student shall register for the supplementary examinations and submit the MOOC certificate.

11.4. Summer Internship

11.4.1 Students shall undergo mandatory two summer internships each with a minimum of Four weeks duration, at the end of second and third year of the Programme. The internship can be done by the students at Govt. Organizations, construction agencies, Industries, Research Centres, MNC, Academic Institutes, etc.

11.4.2 The progress of the Internship is monitored by the supervisor periodically. Evaluation of the summer internships shall be conducted by the Internship Evaluation Committee (IEC) at the end of semester. A student will be required to submit a summer internship report to the concerned department and appear for an

oral presentation before the IEC. The report and the oral presentation shall carry 40% and 60% weightage respectively.

11.4.3 If any student fails to complete summer internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the summer internship.

11.5. Internship

11.5.1 In the final semester of program of study, the student should mandatorily undergo internship for the entire semester and parallelly work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate. A student shall also be permitted to submit project report on the work carried out during the internship.

11.5.2 If any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.

11.6 Project Work:

11.6.1 Internal Evaluation: The Internal Evaluation shall be made by the Project Evaluation Committee (PEC) consisting of concerned supervisor and two senior faculty members, on the basis of TWO project reviews on the topic of the project. Each review shall be conducted for a maximum of "100" marks. For a total of 100 marks, 80% of better one of the two and 20% of the other one are added and finalized. The PEC is constituted by the Principal on the recommendations of the Head of the Department.

11.6.2 Semester-end Evaluation: The Semester-end Project Work Viva-Voce Examination shall be conducted by a Committee consisting of External examiner (nominated by the Chief Controller of Examinations), HOD and concerned Supervisor. The evaluation of project work shall be done at the end of the IV B.Tech II Semester.

Three copies of the dissertation certified in the prescribed format by the concerned Supervisor and HOD shall be submitted to the Department. One copy is to be submitted to the Chief Controller of Examinations. The examiner shall be nominated by the Chief Controller of the Examinations from the panel of SIX examiners submitted by the Department.

11.7. Eligibility to appear for the Semester-End Examination (SEE):

11.7.1. A student shall be eligible to appear for semester-end examinations if he acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the courses in a semester.

11.7.2. Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

11.7.3. Shortage of Attendance below 65% in aggregate **shall in no case be condoned.**

11.7.4. Students whose shortage of attendance is not condoned in any semester are not eligible to take their semester-end examinations of that class and their registration shall stand cancelled.

11.7.5. A student shall not be promoted to the next semester unless he satisfies the attendance requirements of the current semester, as applicable. The student may seek readmission for the semester when offered next. He shall not be allowed to register for the courses of the semester while he is in detention. A student detained due to shortage of attendance, shall have to repeat that semester when offered next.

11.7.6. A stipulated fee shall be payable to the College towards Condonation of shortage of attendance.

11.7.7. For the calculation of a student attendance in any semester, the total number of classes conducted shall be counted as scheduled in the class-work time table.

11.8.   Evaluation:

Following procedure governs the evaluation.

11.8.1. Marks for components evaluated internally by the faculty shall be submitted to the Controller of Examinations one week before the commencement of the Semester-end examinations. The marks for the internal evaluation components shall be added to the external evaluation marks secured in the Semester-end examinations, to arrive at the total marks for any course in that semester.

11.8.2. Performance in all the courses is tabulated course-wise and shall be scrutinized by the Results Committee and moderation is applied if needed and course-wise marks are finalized. Total marks obtained in each course are converted into letter grades.

11.8.3. Student-wise tabulation shall be done and individual grade Sheet shall be generated and issued to the student.

11.9.   Recounting /Revaluation/Personal Verification/ Challenging Evaluation:

Students shall be permitted to apply for **Recounting /Revaluation/Personal Verification/ Challenging Evaluation** of the Semester-end examination answer

scripts within a stipulated period after payment of the prescribed fee. After completion of the process of **Recounting /Revaluation/Personal Verification/ Challenging Evaluation**, the records are updated with changes if any, and the student shall be issued a revised grade sheet. If there are no changes, the student shall be intimated the same through a notice.

11.10. Supplementary Examination:

In addition to the regular semester-end examinations conducted, the College may also schedule and conduct supplementary examinations for all the courses of other semesters when feasible for the benefit of students. Such of the candidates writing supplementary examinations may have to write more than one examination per day.

12.   Academic Requirements for promotion/completion of regular B.Tech Program of study:

The following academic requirements have to be satisfied in addition to the attendance requirements for promotion/completion of regular B.Tech Program of study.

For students admitted into B.Tech. (Regular) Program:

12.1. A student shall be deemed to have satisfied the minimum academic requirements for each theory course, laboratory course, Internship and project work, if he secures not less than 35% of marks in the Semester-end examination and a minimum of 40% of marks in the sum total of the internal evaluation and Semester-end examination taken together.

12.2. A student shall be promoted from second year to third year of Program of study only if he fulfills the academic requirement of securing 40% credits (rounded off to lower integer number) from the following examinations (Irrespective of whether or no the candidate appears for the semester-end examinations as per the normal course of study):

a. **One** regular and **two** supplementary examinations of I B.Tech I Semester.

b. **One** regular and **one** supplementary examinations of I B.Tech II Semester.

c. **One** regular examination of II B.Tech I Semester.

12.3. A student shall be promoted from third year to fourth year of Program of study only if he fulfills the academic requirements of securing 40% credits (rounded off to lower integer number)from the following examinations (Irrespective of whether or not the candidate appears for the semester-end examinations as per the normal course of study):

a. **One** regular and **four** supplementary examinations of I B.Tech I Semester.

b. **One** regular and **three** supplementary examinations of I B.Tech II Semester.

c. **One** regular and **two** supplementary examinations of II B.Tech I Semester.

d. **One** regular and **one** supplementary examinations of II B.Tech II Semester.

e. **One** regular examination of III B.Tech I Semester.

* In case of getting detained for want of credits by sections 12.2 and 12.3 above, the student may make up the credits through supplementary examinations.

12.4. A student shall register for all the 160 credits and earn all the 160 credits. Marks obtained in all the 160 credits shall be considered for the calculation of the CLASS based on CGPA.

12.5. A student who fails to earn 160 credits as indicated in the course structure within eight academic years from the year of their admission shall forfeit his seat in B.Tech. Program and his admission stands cancelled.

For Lateral Entry Students (batches admitted from the academic year 2021-2022):

12.6. A student shall be deemed to have satisfied the minimum academic requirements for each theory course, laboratory course, Internship and project work, if he secures not less than 35% of marks in the Semester-end examination and a minimum of 40% of marks in the sum total of the internal evaluation and Semester-end examination taken together.

12.7. A student shall be promoted from third year to fourth year of Program of study only if he fulfills the academic requirements of securing 40% credits (rounded off to lower integer number) from the following examinations (Irrespective of whether or not the candidate appears for the semester-end examinations as per the normal course of study):

a. **One** regular and **Two** supplementary examinations of II B.Tech I Semester.

b. **One** regular and **One** supplementary examinations of II B.Tech II Semester.

c. **One** regular examination of III B.Tech I Semester.

Irrespective of whether or not the candidate appears for the semester-end examination as per the normal course of study and in case of getting detained for want of credits the student may make up the credits through supplementary examinations.

12.8. A student shall register for all 121 credits and earn all the 121 credits. Marks obtained in all the 121 credits shall be considered for the calculation of the CLASS based on CGPA.

12.9. A student who fails to earn 121 credits as indicated in the course structure within six academic years from the year of their   admission shall forfeit his seat in B.Tech Program and his admission stands cancelled.

13.   NCC/NSS Activities:

All students should register for NCC/NSS activities. A student will be required to participate in an activity for two hours in a week for one semester. Student shall register during Fourth or Fifth semester of the program of study. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet on the basis of participation, attendance, performance and behavior. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

14.   Minor Degree in a discipline:

The concept of Minor degree is introduced in the curriculum of all B. Tech. programs offering a Major degree. The main objective of Minor degree in a discipline is to provide additional learning opportunities for academically motivated students and it is an optional feature of the B.Tech. Program. In order to earn a Minor degree in a discipline, a student has to earn **20** extra credits (By studying Six Theory Courses) from the core courses of the minor discipline.

a. Students having a CGPA of 8.0 or above up to II B.Tech I-Semester without any backlogs shall be permitted to register for Minor degree by paying the requisite fee.

b. An SGPA and CGPA of 7.5 has to be maintained in the subsequent semesters without any backlog subjects in order to keep the Minor Degree registration live or else it shall be cancelled.

c. Students aspiring for a Minor degree must register from III B.Tech I-Semester onwards and must opt for a **Minor in a discipline other than the discipline** he is registered in.

d. A Student shall register for a Minor with **Eight** credits in III B.Tech I-Semester (**TWO** theory courses), **Six** credits in III B.Tech II-Semester (**TWO** theory courses- one from the pool of courses offered and other one through MOOC) and **Six** credits in IV B.Tech I-Semester (**TWO** theory courses- one from the pool of courses offered and other one through MOOC).

e. The evaluation pattern of the courses offered (for 16 credits) shall be similar to the regular program courses evaluation. However, the remaining 4 credits must be acquired through two MOOCs, which shall be domain specific each with 2 credits and with minimum duration of 08 weeks each.

f. The list of courses along with MOOC service providers shall be identified, approved and notified by the Chairman, BOS and Head of the Department.

g. The student has to submit MOOC certificate with percentage of Score earned to the Head of the Department at the end of the semester. Based on the score earned, the equivalent Grade Point and Credits will be assigned. Attendance is not applicable for MOOC Course and also attendance will not be monitored.

h. Minimum strength required for offering a Minor in a discipline is 40 students.

i. A student registered for Minor degree shall pass in all subjects that constitute the requirement for the Minor degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Minor degree program.

j. The Minor degree shall be mentioned in the degree certificate as Bachelor of Technology in XXX with Minor in YYY. For example, Bachelor of Technology in Computer Science & Engineering with Minor in Title of the Minor Pursued This shall also be reflected in the transcripts, along with the list of courses taken for Minor degree program with CGPA mentioned separately.

k. Separate course/class work and time table shall be arranged for the various Minor degree programs. Attendance regulations for these Minor discipline programs shall be as per regular courses.

NOTE: Interested meritorious students shall be permitted to register either for Minor degree in a discipline (or) Honors Degree in a discipline only, **but not both.**

15. Honors Degree in a discipline:

The concept of Honors degree is introduced in the curriculum for all B. Tech. programs. The main objective of Honors degree is to provide additional learning opportunities for academically motivated students in the same or allied discipline and it is an optional feature of the B. Tech. program. In order to earn Honors degree in a discipline, a student has to earn **20** extra credits (By studying SIX Theory Courses).

a. Students having a CGPA of 8.0 and above up to II B.Tech I-Semester without any backlogs shall be permitted to register for Degree with Honors by paying the requisite fee.

b. An SGPA and CGPA of 7.5 has to be maintained in the subsequent semesters without any backlog subjects in order to keep the Honors Degree registration live or else it shall be cancelled.

c. Students aspiring for a Honors degree must register from III B.Tech I-Semester onwards.

d. A Student shall register for a Honors with **Eight** credits in III B.Tech I-Semester (**TWO** theory courses), **Six** credits in III B.Tech II-Semester (**TWO** theory courses- one from the pool of courses offered and other one through MOOC) and **Six** credits in IV B.Tech I-Semester (**TWO** theory courses- one from the pool of courses offered and other one through MOOC).

e. The evaluation pattern of the courses offered (16 credits) shall be similar to the regular program courses evaluation. However, the remaining 4 credits must be acquired through two MOOCs, which shall be domain specific each with 2 credits and with minimum duration of 8 weeks.

f. The list of courses along with MOOC service providers shall be identified, approved and notified by the Chairman, BOS, and Head of the Department.

g. The student has to submit MOOC certificate with percentage of Score earned to the Head of the Department at the end of the semester. Based on the score earned, the equivalent Grade Point and Credits will be assigned.

h. Attendance is not applicable for MOOC Course and also attendance will not be monitored

i. Minimum strength required for offering a **Honors in a** discipline is 10% of the sanctioned intake.

j. A student registered for Honors degree shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree program.

k. The Honors degree shall be mentioned in the degree certificate as Bachelor of Technology (Honors) in XXX. Example, Bachelor of Technology (Honors) in Computer Science & Engineering. This shall also be reflected in the transcripts, along with the list of courses taken for Honors degree program with CGPA mentioned separately.

l. Separate course/class work and time table shall be arranged for the various Honors degree programs. Attendance regulations for these Honors discipline programs shall be as per regular courses.

NOTE: Interested meritorious students shall be permitted to register either for Minor degree in a discipline (or) Honors Degree in a discipline only, **but not both.**

16. **Transitory Regulations:**

Students who got detained for want of attendance (or) who have not fulfilled academic requirements (or) who have failed after having undergone the Program in earlier regulations (or) who have discontinued and wish to continue the Program are eligible for admission into the unfinished semester from the date of commencement of class work with the same (or) equivalent courses as and when courses are offered and they shall be in the academic regulations into which they are presently readmitted.

A regular student has to satisfy all the eligibility requirements within the maximum stipulated period of eight years and a lateral entry student within six years for the award of B.Tech Degree.

17. **Grades, Semester Grade Point Average and Cumulative Grade Point Average:**

17.1. **Grade System:** After all the components and sub-components of any course (including laboratory courses) are evaluated, the final total marks obtained shall be converted into letter grades on a "10 point scale" as described below.

% of Marks obtained	Grade	Description of Grade	Grade Points (GP)
≥90	A+	Outstanding	10
≥80 to <90	A	Excellent	9
≥70 to < 80	B	Very Good	8
≥ 60 to < 70	C	Good	7
≥ 50 to < 60	D	Fair	6
≥ 40 to < 50	E	Satisfactory	5
< 40	F	Fail	0
Absent	N	Absent	0
For Mandatory Courses			
≥40	P	Satisfactory	-
<40	I	Not Satisfactory	-
For NCC/NSS Activities			
Participated	P	Satisfactory	-
Not Participated	I	Not Satisfactory	-
For Internship			
Submission of Certificate	P	Completed	
Non-Submission of Certificate	I	Incomplete	

Pass Marks:

A student shall be declared to have passed theory course, laboratory course, and project work if he secures minimum of 35% marks (Rounded off to lower integer number) in external examination, and a minimum of 40% marks in the sum total of internal evaluation and external examination taken together. Otherwise, he shall be awarded fail grade - '**F**' in such a course irrespective of internal marks. '**F**' is considered as a fail grade indicating that the student has to pass the Semester-End Examination in that course in future and obtain a grade other than '**F**' and '**N**' for passing the course.

For the Mandatory Courses, if the student obtained 40% or more marks, then his performance shall be indicated as "P" (SATISFACTORY), otherwise the performance shall be indicated as "I" (NOT SATISFACTORY) in the grade sheet.

For the NCC/NSS Activities, if the student participate in the activities, then his performance shall be indicated as "P" (SATISFACTORY), otherwise the performance shall be indicated as "I" (NOT SATISFACTORY) in the grade sheet.

For the Internship, if the student submit Certificate, then his performance shall be indicated as "P" (COMPLETED), otherwise the performance shall be indicated as "I" (INCOMPLETE) in the grade sheet.

17.2. Semester Grade Point Average (SGPA): SGPA shall be calculated as given below on a "10 point scale" as an index of the student's performance:

$$SGPA = \frac{\sum (C \; X \; GP)}{\sum C}$$

Where "C" denotes the "credits" assigned to the courses undertaken in that semester and "GP" denotes the "grade points" earned by the student in the respective courses.

Note: SGPA is calculated only for the candidates who appeared in the semester-end regular examinations in a particular semester:

17.3. Cumulative Grade Point Average (CGPA):

The CGPA shall be calculated for a candidate who appeared in the Semester-end examination (including Regular & Supplementary) till that semester. The CGPA shall be displayed in the Grade sheet of the Regular Semester-end examinations and also in the consolidated Grade Sheet issued at the end of the program. The CGPA is computed on a 10 point scale as given below:

$$CGPA = \frac{\sum (C \; X \; GP)}{\sum C}$$

Where, C denotes the credits assigned to courses undertaken up to the end of the Program and GP denotes the grade points earned by the student in the respective courses.

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

As per AICTE regulations, conversion of CGPA into equivalent percentage as follows:

$$\text{Equivalent Percentage} = (CGPA - 0.50) \times 10$$

18. **Grade Sheet:** A grade sheet (Marks Memorandum) shall be issued to each student indicating the SGPA and CGPA, provided if he passed all the courses registered in the regular semester-end examinations.

19. **Consolidated Grade Sheet:** After successful completion of the entire Program of study, a Consolidated Grade Sheet indicating performance of all academic years shall be issued as a final record. Duplicate Consolidated Grade Sheet shall also be issued, if required, after payment of requisite fee.

20. **Award of Degree**: The Degree shall be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Ananthapuramu on the recommendations of the Chairman, Academic Council, SVEC (Autonomous).

20.1. **Eligibility:**

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

- Registered and successfully completed all the components prescribed in the Program of study to which he is admitted.

- Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of study within the stipulated time.

- Obtained CGPA greater than or equal to 4.0 (Minimum requirement for declaring as passed).

- Has NO DUES to the College, Hostel, Library etc. and to any other amenities provided by the College.

- No disciplinary action is pending against him.

20.2. **Award of Class:** Awarding of Class is based on CGPA.

Awarding of Class

CGPA Secured	Class Awarded
≥7.5	First Class with Distinction
≥6.5 and <7.5	First Class
≥5.5 and <6.5	Second Class
≥5.0 and <5.5	Pass Class

21. Additional Academic Regulations:

21.1. A student may appear for any number of supplementary examinations within the stipulated time to fulfill regulatory requirements for award of the degree.

21.2. In case of malpractice/improper conduct during the examinations, guidelines shall be followed as given in the ANNEXURE-I.

21.3. When a student is absent for any examination (Mid-term or Semester-end) he shall be awarded zero marks in that component (course) and grading shall be done accordingly.

21.4. When a component is cancelled as a penalty, he shall be awarded zero marks in that component.

22. Withholding of Results:

If the candidate has not paid dues to the College/University (or) if any case of indiscipline is pending against him, the result of the candidate shall be withheld and he shall not be allowed/promoted to the next higher semester.

23. Re-Registration for Improvement of Internal Marks:

Following are the conditions to avail the benefit of improvement of internal marks.

23.1. The candidate should have completed the 4 years of B.Tech course work and obtained examinations results from I B.Tech I Semester to IV B.Tech II semester.

23.2. Out of the courses the candidate has failed in the examinations due to internal evaluation marks secured being less than 40%, the candidate shall be given a chance for improvement of internal evaluation marks in the failed theory courses.

23.3. This provision is only for Theory courses. The candidate has to register for the chosen courses and fulfil the academic requirements (i.e. a student has to attend the classes regularly and appear for the mid-examinations and satisfy the attendance requirements to become eligible for appearing at the semester-end examinations).

23.4. For each course, the candidate has to pay a fee of Rs. 10,000/- and the amount is to be remitted in the form of D.D. in favor of the Principal, Sree Vidyanikethan Engineering College payable at Tirupati along with the requisition through the concerned Head of the Department.

23.5. In the event of availing the provision of Improvement of Internal evaluation marks, the internal evaluation marks as well as the Semester-end Examinations marks secured in the previous attempt(s) for the re-registered courses shall stand cancelled.

24. Amendments to Regulations:

The Academic Council of SVEC(Autonomous) reserves the right to revise, amend or change the Regulations, Scheme of Examinations, and / or Syllabi or any other policy relevant to the needs of the society or industrial requirements etc., with the recommendations of the concerned Board(s) of Studies.

25. General:

The words such as "he", "him", "his" and "himself" shall be understood to include all students irrespective of gender connotation.

Note: Failure to read and understand the regulations is not an excuse.

ANNEXURE-I

GUIDELINES FOR DISCIPLINARY ACTION FOR MALPRACTICES /
IMPROPER CONDUCT IN EXAMINATIONS

Rule No.	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester. The Hall Ticket of the candidate is to be cancelled.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including labs and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester. The candidate is also debarred for four consecutive semesters from class work and all Semester-end examinations, if his involvement is established. Otherwise, The candidate is debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

Rule No.	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course only.
6.	Refuses to obey the orders of the Chief Controller of Examinations/Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the Controller of Examinations or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the Controller of Examinations, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester. If the candidate physically assaults the invigilator/Controller of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in	Expulsion from the examination hall and cancellation of the performance in that course

Rule No.	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
	the examination hall.	and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred and forfeits the seat.

Note: Whenever the performance of a student is cancelled in any course(s) due to Malpractice, he has to register for Semester-end Examinations in that course(s) consequently and has to fulfill all the norms required for the award of Degree.

SVEC20 CURRICULUM

Course Structure for B.Tech. in Mechanical Engineering
(Effective from the Academic year 2020-21 onwards)

Mandatory Induction Program	03 Weeks Duration
Induction program offered before commencement of the I-Semester course work	Physical Activity
	Creative Arts
	Universal Human Values
	Literary
	Proficiency Modules
	Lectures by Eminent People
	Visits to Local Areas
	Familiarization to Department/Branch and Innovations

SREE VIDYANIKETHAN ENGINEERING COLLEGE

Sree Sainath Nagar, Tirupati – 517 102.

SVEC20 - B. Tech. (ME) Course Structure

I B.Tech. – I Semester

Sl. No.	Subject Code	Course Title	Course Category	Contact Periods per week				C	Scheme of Examination Max. Marks		
				L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	20BT1BS01	Differential Equations and Multivariable Calculus	BS	3	-	-	3	3	30	70	100
2.	20BT1BS02	Engineering Chemistry	BS	3	-	-	3	3	30	70	100
3.	20BT10201	Basic Electrical and Electronics Engineering	ES	3	-	-	3	3	30	70	100
4.	20BT10301	Material Science and Engineering	ES	3	-	-	3	3	30	70	100
5.	20BT1BS31	Engineering Chemistry Lab	BS	-	-	3	3	1.5	30	70	100
6.	20BT10331	Computer Aided Engineering Drawing	ES	-	1	4	5	3	30	70	100
7.	20BT10332	Engineering Workshop	ES	-	-	3	3	1.5	30	70	100
8.	20BT10333	Material Science and Engineering Lab	ES	-	-	3	3	1.5	30	70	100
9.	20BT1HSAC	Spoken English (Audit Course)	AC1	2	-	-	2	-	-	-	-
		Total:		**14**	**1**	**13**	**28**	**19.5**	**240**	**560**	**800**

I B.Tech. – II Semester

Sl. No.	Subject Code	Course Title	Course Category	Contact Periods per week				C	Scheme of Examination Max. Marks		
				L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	20BT2BS01	Transformation Techniques and Linear Algebra	BS	3	-	-	3	3	30	70	100
2.	20BT1BS04	Applied Physics	BS	3	-	-	3	3	30	70	100
3.	20BT1HS01	Communicative English	HS	3	-	-	3	3	30	70	100
4.	20BT20541	Programming in C and Data Structures	ES	3	-	-	3	3	30	70	100
5.	20BT20301	Basic Engineering Mechanics	ES	3	-	-	3	3	30	70	100
6.	20BT1BS33	Applied Physics Lab	BS	-	-	3	3	1.5	30	70	100
7.	20BT1HS31	Communicative English Lab	HS	-	-	3	3	1.5	30	70	100
8.	20BT20551	Programming in C and Data Structures Lab	ES	-	-	3	3	1.5	30	70	100
9.	20BT1MC01	Universal Human Values (Mandatory Course)	MC	2	-	-	2	-	30	-	30
		Total:		**17**	**-**	**09**	**26**	**19.5**	**270**	**560**	**830**

II B.Tech I–Semester

S. No.	Course Code	Course Title	L	T	P	Total	Credits (c)	Int. Marks	Ext. Marks	Total Marks
			Contact Periods per Week					**Scheme of Examination Max. Marks**		
1.	20BT3BS01	Numerical Methods, Probability and Statistics	3	-	-	3	3	30	70	100
2.	20BT30301	Engineering Thermodynamics	3	-	-	3	3	30	70	100
3.	20BT30302	Kinematics of Machinery	3	-	-	3	3	30	70	100
4.	20BT30303	Manufacturing Technology	3	-	-	3	3	30	70	100
5.	20BT30304	Strength of Materials	3	-	-	3	3	30	70	100
6.	20BT40133	Strength of Materials Lab	-	-	3	3	1.5	30	70	100
7.	20BT30331	Computer Aided Machine Drawing	-	-	3	3	1.5	30	70	100
8.	20BT30332	Manufacturing Technology Lab	-	-	3	3	1.5	30	70	100
9.	20BT3HS31	Soft Skills Lab	-	1	2	3	2	30	70	100
		Total					**21.5**	**270**	**630**	**900**
10.	20BT3MC01	Environmental Science	2	-	-	2	-	30	-	30

II B.Tech II–Semester

S. No.	Course Code	Course Title	L	T	P	Total	Credits (C)	Int. Marks	Ext. Marks	Total Marks
			Contact Periods per Week					**Scheme of Examination Max. Marks**		
1.	20BT40301	Dynamics of Machinery	3	-	-	3	3	30	70	100
2.	20BT40302	Engineering Metrology and Machine Tools	3	-	-	3	3	30	70	100
3.	20BT40303	Fluid Mechanics and Machines	3	-	-	3	3	30	70	100
4.	20BT40304	Thermal Engineering-I	3	-	-	3	3	30	70	100
5.	**Open Elective-1**		3	-	-	3	3	30	70	100
6.	20BT30132	Fluid Mechanics and Hydraulic Machinery Lab	-	-	3	3	1.5	30	70	100
7.	20BT40331	Engineering Metrology Lab	-	-	3	3	1.5	30	70	100
8.	20BT40332	Machine Tools Lab	-	-	3	3	1.5	30	70	100
9.	20BT40333	MATLAB for Mechanical Engineers Lab	-	1	2	3	2	30	70	100
		Total					**21.5**	**270**	**630**	**900**
10.	20BT315AC	Design Thinking	2	-	-	2	-	-	-	-

III B.Tech I–Semester

S. No.	Course Code	Course Title	L	T	P	Total	Credits (C)	Int. Marks	Ext. Marks	Total Marks
1.	20BT50301	Design of Machine Elements	3	-	-	3	3	30	70	100
2.	20BT50302	Operations Research	3	-	-	3	3	30	70	100
3.	20BT50303	Thermal Engineering-II	3	-	-	3	3	30	70	100
4.	**Professional Elective- 1**		3	-	-	3	3	30	70	100
	20BT50304	Automobile Engineering								
	20BT50305	Compressible Fluid Flow								
	20BT50306	Engineering Metallurgy								
	20BT50307	Statistical Inference and Modeling								
	20BT50308	Tool Design								
	20BT50309	Tribology								
5.	**Open Elective-2**		3	-	-	3	3	30	70	100
6.	20BT50331	Design and Dynamics Lab	-	-	3	3	1.5	30	70	100
7.	20BT50332	Thermal Engineering Lab	-	-	3	3	1.5	30	70	100
8.	20BT51551	Internet of Things Lab		1	2	3	2	30	70	100
9.	20BT50333	Summer Internship-I	-	-	-	-	1.5	-	100	100
		Total					**21.5**	**240**	**660**	**900**
10.	20BT503AC	Foundations of Entrepreneurship	2	-	-	2	-	-	-	-
11.	20BT4NS01	NCC/NSS Activities	-	-	-	-	-	-	-	-

III B.Tech II–Semester

S. No.	Course Code	Course Title	Contact Periods per Week				Credits (C)	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	20BT60301	Computer Aided Design and Manufacturing	3	-	-	3	3	30	70	100
2.	20BT60302	Heat Transfer	3	-	-	3	3	30	70	100
3.	20BT60303	Industrial Engineering and Management	3	-	-	3	3	30	70	100
4.	**Professional Elective-2**		3	-	-	3	3	30	70	100
	20BT60304	Casting and Welding Technology								
	20BT60305	Composite Materials								
	20BT60306	Design of Transmission systems								
	20BT60307	Gas Turbines and Jet Propulsion								
	20BT60308	Internal Combustion Engines								
	20BT60309	Quality Management and Reliability Engineering								
5.	**Professional Elective-3**		3	-	-	3	3	30	70	100
	20BT60310	Automotive Fuels and Combustion								
	20BT60311	Design of Pressure Vessels and Piping Systems								
	20BT60312	Mechanical Behavior of Materials								
	20BT60313	Non-Traditional machining processes								
	20BT60314	Optimization Techniques								
	20BT60315	Refrigeration and Air Conditioning								
6.	**Inter disciplinary Elective-1**		3	-	-	3	3	30	70	100
7.	20BT60316	Artificial Intelligence and Robotics								
	20BT60317	Automotive Electronics								
	20BT60318	Industrial Automation and Control Systems								
	20BT60319	Machinery Fault Diagnosis and Signal Processing								
	20BT60320	Non-Conventional Energy Sources								
	20BT60321	Programmable logic controller in Automation								
8.	20BT60331	Computer Aided Design and Manufacturing Lab	-	-	3	3	1.5	30	70	100
9.	20BT60332	Heat Transfer Lab	-	-	3	3	1.5	30	70	100
10.	20BT60333	Simulation and Analysis Lab		1	2	3	2	30	70	100
		Total					23	270	630	900
11.	20BT5MC01	Professional Ethics	2	-	-	2	-	30	-	30

IV B.Tech I–Semester

S. No.	Course Code	Course Title	Contact Periods per Week				Credits (C)	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	20BT5HS02	Principles of Business Economics and Accountancy	3	-	-	3	3	30	70	100
2.	20BT70301	Operations Management	3	-	-	3	3	30	70	100
3.	**Professional Elective-4**		3	-	-	3	3	30	70	100
	20BT70302	Computational Fluid Dynamics								
	20BT70303	Finite Element Method								
	20BT70304	Material Processing Techniques								
	20BT70305	Power Plant Engineering								
	20BT70306	Supply Chain Management								
	20BT70307	Sustainable Manufacturing								
4.	**Professional Elective-5**		3	-	-	3	3	30	70	100
	20BT70308	Cryogenics								
	20BT70309	Design of Automotive components								
	20BT70310	Hybrid and Electric Vehicles								
	20BT70311	Project Management								
	20BT70312	Rapid Prototyping								
	20BT70313	Surface Engineering								
5.	**Inter disciplinary Elective-2**		3	-	-	3	3	30	70	100
	20BT60410	Microelectromechanical Systems								
	20BT70314	Hydraulics and Pneumatics								
	20BT70315	Industrial Internet of Things								
	20BT70316	Instrumentation and Control systems								
	20BT70317	Mechatronics								
	20BT70318	Soft Computing Techniques in Mechanical Engineering								
6.	20BT70331	Industrial Automation and Robotics Lab	-	-	3	3	1.5	30	70	100
7.	20BT70332	Manufacturing systems and Operations Management Lab	-	-	3	3	1.5	30	70	100
8.	20BT70333	Heating, Ventilation and Air Conditioning Lab		1	2	3	2	30	70	100
9.	20BT70334	Summer Internship-II					1.5	-	100	100
		Total					**21.5**	**240**	**660**	**900**
10.	20BT703AC	3D Printing and Design	2	-	-	2	-	-	-	-

IV B.Tech II–Semester

S. No.	Course Code	Course Title	Contact Periods per Week				Credits (C)	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	20BT80331	Project Work	-	-	-	-	12	100	100	200
2.	20BT80332	Internship	-	-	-	-	-	-	-	-
		Total	-	-	-	-	12	100	100	200

LIST OF COURSES FOR

OPEN ELECTIVE–1 AND OPEN ELECTIVE-2

Course Code	Open Elective -1	Course Code	Open Elective -2
20BT4BS01	Material Science	20BT4HS01	Banking and Insurance
20BT4HS02	Business Communication and Career Skills	20BT4HS03	Cost Accounting and Financial Management
20BT4HS04	Entrepreneurship for Micro, Small and Medium Enterprises	20BT4HS05	Gender and Environment
20BT4HS06	German Language	20BT4HS07	Indian Economy
20BT4HS08	Indian History	20BT4HS09	Life Skills
20BT4HS10	Personality Development	20BT4HS11	Indian Tradition and Culture
20BT4HS12	Women Empowerment	20BT4HS13	Constitution of India
20BT40205	Reliability and Safety Engineering	20BT50106	Disaster Mitigation and Management
20BT40105	Environmental Pollution and Control	20BT50107	Sustainable Engineering
20BT40106	Planning for Sustainable Development	20BT50108	Contract Laws and Regulations
20BT40107	Rural Technology	20BT50310	Global Strategy and Technology
20BT40305	Human Resource Management	20BT50311	Management Science
20BT50506	Ethical Hacking	20BT40502	Cyber Laws and Security
20BT51205	AI in Healthcare	20BT50206	Intellectual Property Rights
20BT51501	Bioinformatics	20BT50406	Green Technologies

I B. Tech. - I Semester

(20BT1BS01) DIFFERENTIAL EQUATIONS AND MULTIVARIABLE CALCULUS

(Common to All Branches)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE REQUISITE: -

COURSE DESCRIPTION:

Ordinary Differential Equations; Partial Differential Equations; Multivariable Calculus (Differentiation); Multivariable Calculus (Integration); Multivariable Calculus (Vector Calculus).

COURSE OUTCOMES:

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

CO1. Solve the higher order linear differential equations and identify solutions by analytical methods related to various engineering problems involving electrical circuits.

CO2. Formulate and solve partial differential equations for engineering problems.

CO3. Determine maxima and minima of functions of two variables and analyze their behaviour at extreme values.

CO4. Evaluate and apply multiple integrals to determine areas of plane curves.

CO5. Identify solenoidal and irrotational vector fields and apply vector integral theorems in evaluating areas and volumes.

DETAILED SYLLABUS

UNIT I: ORDINARY DIFFERENTIAL EQUATIONS   (9 Periods)

Ordinary Differential Equation: Order and Degree of Differential Equation; Second and higher order linear differential equations with constant coefficients: Non-Homogeneous equations with R.H.S terms of the type e^{ax}, $\sin ax$, $\cos ax$, polynomials in x, $e^{ax}V(x)$ and $xV(x)$; method of variation of parameters; Equations reducible to linear differential equations with constant coefficients: Cauchy's homogeneous and Legendre's linear equations; Applications to L-C-R Circuit problems.

UNIT II: PARTIAL DIFFERENTIAL EQUATIONS   (9 Periods)

Formation of PDE, solutions of first order linear PDEs, Solution to homogenous and non-homogenous linear partial differential equations of second and higher order by complimentary function and particular integral method, method of Separation of variables in Cartesian coordinates.

UNIT III: MULTIVARIABLE CALCULUS (DIFFERENTIATION)   (9 Periods)

Partial derivatives, Chain rule, Total derivative, Jacobian, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.

UNIT IV: MULTIVARIABLE CALCULUS (INTEGRATION)   **(9 Periods)**

Evaluation of Double integrals (Cartesian and polar coordinates), Change of order of integration (Cartesian form only); Evaluation of Triple integrals; Change of variables: double integration from Cartesian to polar coordinates, Triple integration from Cartesian to spherical polar coordinates; Areas enclosed by plane curves.

UNIT V: MULTIVARIABLE CALCULUS (VECTOR CALCULUS)   **(9 Periods)**

Vector Differentiation: Scalar and Vector fields: Gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector field, irrotational vector, Laplacian operator. **Vector Integration:** Line integral - circulation-work done, Surface integral and Volume integral; Vector integral theorems: Theorems of Green, Gauss and Stokes (without proofs)-Problems related to theorems.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M. V. S. S. N. Prasad, *Engineering Mathematics, vol-1*, S. Chand and Company, 13th edition, 2014.

2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.

REFERENCE BOOKS:

1. Dennis G. Zill and Warren S. Wright, *Advanced Engineering Mathematics*, Jones and Bartlett, 6th edition, 2011.

2. R. K. Jain and S. R. K. Iyengar, *Advanced Engineering Mathematics*, Alpha Science International Ltd., 6th edition, 2017.

3. Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 9th edition, 2006.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	-	-	-	-			
CO2	3	3	-	-	1	-	-	-	-	-	-	-			
CO3	2	3	-	-	1	-	-	-	-	-	-	-			
CO4	2	3	-	-	1	-	-	-	-	-	-	-			
CO5	3	2	-	-	1	-	-	-	-	-	-	-			
Average	2.60	2.60	-	-	1	-	-	-	-	-	-	-			
Correlation level	3	3	-	-	1	-	-	-	-	-	-	-			

Correlation Levels: 3– High   2 - Medium   1– Low

I B. Tech. – I Semester

(20BT1BS02) ENGINEERING CHEMISTRY

(Common to CE, ME, CSE, CSSE, IT, CSE(IOT), CS&D and CSE(CS))

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE REQUISITE: -

COURSE DESCRIPTION:

Water Treatment; Atomic Structure and Bonding Theories; Electrochemistry and Applications; Corrosion; Instrumental Methods and Applications; Fuel chemistry and Lubricants.

COURSE OUTCOMES:

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

CO1. Analyze and solve problems associated with hardness of water, boiler troubles and address the societal, health and safety issues related to quality of water.

CO2. Apply the basic knowledge of quantum mechanical approach to atomic structure and bonding theories to identify shapes of different molecules.

CO3. Apply the basic knowledge of corrosion phenomenon to identify solutions for control of corrosion and demonstrate competency in the basic concepts of electrochemical cells.

CO4. Demonstrate the basic knowledge of instrumental methods and their applications in the structural analysis of materials.

CO5. Apply the basic knowledge of fuel chemistry and lubricants to identify the quality of fuels and lubricants.

DETAILED SYLLABUS:

UNIT I: WATER TREATMENT   **(10 periods)**

Introduction, types of water, Impurities in water and their consequences. Hardness of water, units of hardness, disadvantages of hardness, measurement of hardness by EDTA method, numerical problems on measurement of hardness of water; Boiler troubles; softening of water– Ion exchange process, zeolite process, desalination of brackish water by reverse osmosis, specifications of potable water as per WHO and BIS standards. Fluoride in ground water: Effects on human health, defluoridation method – Nalgonda method; merits and demerits of various defluoridation methods.

UNIT II: ATOMIC STRUCTURE AND BONDING THEORIES   **(9 periods)**

Quantum-mechanical model of atom, Schrodinger wave equation, significance of Ψ and Ψ^2, applications to particle in a box; Molecular orbital theory – bonding in homo and hetero nuclear diatomic molecules – energy level diagrams of N_2, O_2, NO and CO; Π-molecular orbitals of butadiene and benzene; VSEPR theory and molecular shapes.

UNIT III: ELECTROCHEMISTRY AND APPLICATIONS   (9 periods)

Introduction, Electrode potential, Nernst equation, reference electrode-Calomel electrode, electrochemical cell; Battery– Leclanche cell, lithium ion batteries; Fuel cells- Hydrogen-oxygen fuel cell, Solid-oxide fuel cell.

Corrosion: Introduction, Definition, types of corrosion- wet (galvanic corrosion, concentration cell corrosion) and dry corrosion, Factors influencing corrosion, control of corrosion- sacrificial anodic protection, Impressed current cathodic protection, electroplating method (Nickel).

UNIT IV: INSTRUMENTAL METHODS AND APPLICATIONS   (9 periods)

Introduction to spectroscopy–types of energy present in molecules, types of spectra, UV-Vis spectroscopy – principle (Beer-lamberts Law), types of electronic transitions, chromophore, auxochrome, Bathochromic shift, Hypsochromic shift, Instrumentation of UV-Vis spectrophotometer, applications; Infrared spectroscopy – principle, types of vibrational modes, group frequencies, Instrumentation of IR spectrophotometer, applications; principle and applications of physicochemical methods (SEM, TEM, X-ray diffraction).

UNIT V: FUEL CHEMISTRY AND LUBRICANTS   (8 Periods)

Fuel chemistry: Types of fuels, calorific value, numerical problems based on calorific value; Liquid fuels - cracking of oils (Thermal and Fixed-bed catalytic cracking), knocking and anti-knock agents, Octane and Cetane values, Synthetic petrol: Fischer-Tropsch method and Bergius process.

Lubricants: Definition, functions of lubricants, mechanism of lubrication, classification of lubricants and their applications, properties of lubricants – viscosity and viscosity index , flash and fire points, cloud and pour points, Aniline points, neutralization number and mechanical strength.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. P. C. Jain & Monika Jain*, Engineering Chemistry*, DhanpatRai Publishing Company (P) Ltd, New Delhi, 16th edition, 2013.

2. K.N. Jayaveera, G.V. Subba Reddy and C. Ramachandriah, Engineering Chemistry,Mc.Graw Hill Publishers, New Delhi.

REFERENCE BOOKS:

1. J. D. Lee, *Concise Inorganic Chemistry*, Oxford University Press, 5th edition 2010.

2. Skoog and West, *Principles of Instrumental Analysis*, Thomson, 6th edition, 2007.

3. Peter Atkins, Julio de Paula and James Keelar, *Atkins' Physical Chemistry*, Oxford University Press, 10th edition, 2010.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	2	1	-	-	-	-	-			
CO2	3	1	-	-	-	-	-	-	-	-	-	-			
CO3	3	1	-	-	-	1	-	-	-	-	-	-			
CO4	3	-	-	-	1	-	-	-	-	-	-	-			
CO5	3	1	-	-	-	1	-	-	-	-	-	-			
Average	3	1.2			1	1.3	1								
Correlation level	3	1			1	1	1								

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

I B. Tech. – I Semester

(20BT10201) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to ME, EEE, ECE, EIE, CSE, CSSE, IT, CSE(AI), CSE(DS), CSE(AI&ML), CSE(IOT), CS&D and CSE(CS))

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Principles of Electrical Systems; AC & DC Machines; Semiconductor Devices and Op-Amps.

COURSE OUTCOMES:

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

CO1. Analyze electrical circuits by applying the conceptual knowledge of circuit concepts.

CO2. Demonstrate knowledge on various generation technologies, protection devices, safety procedures and BEE standards.

CO3. Demonstrate knowledge on characteristics and applications of transformers and AC machines.

CO4. Demonstrate knowledge on characteristics and applications of diode, BJT and Op-amps.

DETAILED SYLLABUS:

UNIT I: PRINCIPLES OF ELECTRICAL SYSTEMS-I   (9 Periods)

Basic electrical sources: DC-Battery, AC sources–Single loop generator; Single phase and three phase supply; Electrical circuit elements (R, L and C), Ohm's law, Kirchhoff's laws, Representation of sinusoidal waveforms, peak and RMS values, phasor representation, reactive power, apparent power, real power, energy and power factor.

UNIT II: PRINCIPLES OF ELECTRICAL SYSTEMS-II   (9 Periods)

Significance of Power factor and power factor correction, most economical power factor. Typical layout of electrical grid; Typical layout and operation of Hydro, Thermal and Solar Power Plants; Fuse, circuit breaker (MCB, MCCB, RCCB, ELCB), relay (elementary treatment); Inverter and UPS. Energy Efficiency (Star rating) standards by BEE.

UNIT III: TRANSFORMERS AND MACHINES   (10 Periods)

Construction and working of a single phase transformer, EMF Equation; Construction, working and applications of Permanent Magnet DC Motor, Brushless DC Motor, three phase induction motor; construction, working and applications of stepper motor, resistor start & capacitor start and run single phase induction motor.

UNIT IV: SEMICONDUCTOR DEVICES   (9 Periods)

PN Junction diode, Characteristics, applications - half wave and full wave rectifier. Zener diode, characteristics, application – Regulator. BJT - operation, configurations, characteristics.

UNIT V: OP-AMPS   **(8 Periods)**

Operational Amplifier: Block diagram of Op-Amp, equivalent circuit, Op-Amp AC and DC Characteristics, Inverting and Non-Inverting modes. Applications - Adder, Comparator, Integrator and Differentiator.

                                                                        Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Ashfaq Hussain*, Fundamentals of Electrical Engineering,* Dhanpatrai & Co. (P) Ltd., 3rd edition, New Delhi, 2009.

2. R. L. Boylestad and Louis Nashelsky, *Electronics Devices and Circuits*, PHI, 11th edition, 2009.

REFERENCE BOOKS:

1. M.S. Naidu, S. Kamakshaiah, *Introduction to Electrical Engineering,*Tata McGraw-Hill Education, New Delhi, 2007.

2. D. Roy Chowdhury, *Linear Integrated Circuits*, New Age International Pvt. Ltd., 4th edition, 2011.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-			
CO2	3	-	-	-	-	-	1	1	-	-	-	-			
CO3	3	-	-	-	-	1	-	-	-	-	-	-			
CO4	3	1	-	-	-	1	-	-	-	-	-	-			
Average	3	1	1	-	-	1	-	-	-	-	-	-			
Correlation level	3	1	1	-	-	1	-	-	-	-	-	-			

Correlation Levels: 3– High   2 - Medium   1– Low

I B. Tech. - I Semester

(20BT10301) MATERIAL SCIENCE AND ENGINEERING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Engineering Chemistry

COURSE DESCRIPTION:

Materials Structure and Constitution of Alloys; Heat treatment of steels; Properties of ferrous materials and its alloys; Properties of non-ferrous materials and its alloys; Properties and applications of Ceramics, Polymers and Composite materials.

COURSE OUTCOMES:

After successful completion of the course, the student will be able to:

CO1. Analyze the structural, constitutional characteristics of alloys and calculate atomic packing factor of different structures.

CO2. Analyze the properties of materials and enhance the same through heat treatment processes.

CO3. Demonstrate knowledge of ferrous materials and its alloys for engineering applications.

CO4. Demonstrate knowledge of Non-ferrous materials and its alloys for engineering applications.

CO5. Demonstrate knowledge of Ceramics, Polymers, and Composite materials for suitable engineering applications.

DETAILED SYLLABUS:

UNIT I: MATERIALS STRUCTURE AND CONSTITUTION OF ALLOYS   (10 periods)

Materials Structure: Space lattice, Unit cells and Metallic crystal structures (SC, BCC, FCC and HCP), Crystal defects: Point, Line, Interstitial and Volume, Primary and secondary bonding in materials.

Constitution of Alloys: Necessity of Alloying, Gibbs's phase and Hume Rothery rule, Iron-Iron-carbide diagram and its microstructural aspects.

UNIT II: HEAT TREATMENT OF STEELS   (9 periods)

Annealing, Normalizing, Tempering, Carburization and Hardening- Austempering, Martempering, Carburizing, Nitriding, Cyaniding, Carbo-Nitriding, Flame and Induction Hardening, Vacuum and Plasma Hardening, Time-Temperature-Transformation Diagrams and Continuous Cooling Transformation Diagrams.

UNIT III: FERROUS MATERIALS AND ALLOYS   (9 periods)

Steels: Structure, properties, classifications and applications of plain steels, Specifications of steels, Structure, properties, classifications and applications of low alloy steels, Hadfield manganese steels, Stainless steel and Tool steels.

Cast iron: Structure, properties and applications of Gray cast iron, White cast iron, Malleable cast iron, Nodular cast iron and Alloy cast iron.

UNIT IV: NON-FERROUS MATERIALS AND ALLOYS **(6 periods)**

Structure, properties and applications of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Nickel and its alloys, Magnesium and its alloys, Refractory and Precious metals.

UNIT V: CERAMICS, POLYMERS AND COMPOSITES MATERIALS **(11 p***eriods***)**

Ceramics: Classifications, Properties and Applications, Glass-ceramics, Polymers: Classification, Properties and Applications, Polymerization Reaction, Composites: Classifications, Properties and Applications of Polymer matrix composites, Ceramic matrix composites, Metal matrix composites and Nanocomposites*.*

Total Periods: *45*

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. V. Raghavan, Materials Science & Engineering, Prentice Hall of India, 5th edition, 2004.

2. R. Balasubramaniam, Callister's Materials Science & Engineering, John Wiley and sons, 2nd edition, 2014.

REFERENCE BOOKS:

1. Sidney H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill, 2nd edition, 1997.

2. George E Dieter, Mechanical Metallurgy, Tata McGraw Hill, 3rd edition, 2013.

3. Kodigre V D, Material Science and Metallurgy, Everest Publishing House, 31st edition, 2011.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1							1			1		
CO2	3	3	1							1			1		
CO3	3	1											1		
CO4	3	1											1		
CO5	3	1											1		
Average	3	1.8	1							1			1		
Correlation level	3	2	1							1			1		

Correlation Levels: **3– High** **2 - Medium** **1– Low**

I B.Tech. - I Semester

(20BT1BS31) ENGINEERING CHEMISTRY LABORATORY

(Common to CE, ME, CSE, CSSE, IT, CSE(IOT), CS&D and CSE(CS))

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE REQUISITE: -

COURSE DESCRIPTION:

Estimation of hardness ground water sample, alkalinity, dissolved oxygen of water samples, Iron, residual chlorine in drinking water and Strength of an acid in Pb-Acid battery by volumetric methods; Instrumental methods like conductivity meter, potentiometer, PH meter and colorimeter; Measurement of viscosity of lubricants; and Determination of the influence of pH on metallic corrosion.

COURSE OUTCOMES:

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

CO1. Apply analytical skills for the quantitative estimation of materials through volumetric methods of analysis and address the societal, health issues related to quality of water.

CO2. Develop analytical skills for the quantitative estimation of materials through instrumental methods of analysis.

CO3. Work independently and in teams to solve problems with effective communication.

List of Experiments

A minimum of any **Ten** experiments are to be conducted among the following:

1. Determination of hardness of ground water sample
2. Determination of alkalinity of Water sample
3. Estimation of Dissolved Oxygen in water by Winkler's method.
4. Estimation Fe (II) by Dichrometry
5. Estimation of residual chlorine in drinking water
6. Conductometric titration of strong acid Vs strong base
7. Estimation of Ferrous ion by Potentiometry
8. Determination of percentage of Iron in Cement sample by colorimetry
9. Determination of strength of acid by pH metric method
10. Determination of Viscosity of liquids by Ostwald's viscometer
11. Determination of Strength of an acid in Pb-Acid battery
12. Determination of the influence of pH on metallic corrosion

TEXTBOOK:

1. Engineering Chemistry lab Manual (SVEC-20)

REFERENCE BOOKS:

1. K. Mukkanti, *Practical Engineering Chemistry*, BS Publications, 2013.

2. K.N. Jayaveera, K.B. Chandra Sekhar, *Chemistry laboratory manual*, S.M. Enterprises Limited, 2013.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	2	1	-	-	-	-	-			
CO2	3	3	-	-	2	-	-	-	-	-	-	-			
CO3	-	-	-	-	-	-	-	2	2	2	-	-			
Average	3	3			2	2	1	2	2	2					
Correlation level	3	3			2	2	1	2	2	2					

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT10331) COMPUTER AIDED ENGINEERING DRAWING

(Common to CE, ME, EEE, ECE, EIE, CSE(IOT) and CS&D)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	1	4	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Engineering drawing conventions; Importance of engineering drawing; fundamental concepts of sketching; computer aided drafting and different types of projections of geometric entities (both 2D and 3D) through computer aided drafting packages.

COURSE OUTCOMES:

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

CO1: Apply the principles of engineering drawing, Methods and CAD tools to draw the Geometries, Curves and Orthographic projections used to communicate in engineering field.

CO2: Develop lateral surfaces of solids and draw Isometric views of given objects for engineering communication using principles of engineering drawing and CAD tools.

CO3: Work independently or in teams to solve problems with effective communication

DETAILED SYLLABUS:

INTRODUCTION TO ENGINEERING GRAPHICS AND DESIGN

Principles, significance -Conventions in drawing-lettering - BIS conventions-Dimensioning principles and conventional representations.

Exercises:

1. Practice exercise on Basic Lettering and Dimensioning
2. Practice exercise on Conventional representations

Introduction to AutoCAD: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions.

Exercises:

3. Practice exercise using basic drawing commands
4. Practice exercise using editing commands

CONICS, CURVES, PROJECTION OF POINTS, LINES AND PLANES

Conics & Special Curves: Conic sections including the rectangular hyperbola- eccentricity method only; Cycloid, Epicycloid and Hypocycloid, Involutes.

Exercises:

    5. Practice exercises on Ellipse, Parabola, Hyperbola and Rectangular Hyperbola

    6. Practice exercises on Cycloid, Epicycloid, Hypocycloid and Involutes

PROJECTION OF POINTS, LINES AND PLANES

Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line, Projections of regular plane surfaces.

Exercises:

    7. Practice exercises on Projection of points

    8. Practice exercises on projection of lines inclined to one plane

    9. Practice exercises on projection of lines inclined to both planes

    10. Practice exercises on Projections of regular plane surfaces

PROJECTION OF SOLIDS AND SECTION OF SOLIDS

Projection of solids: Projection of regular solids inclined to one plane.

Sections of solids: Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone, True shapes of the sections.

Exercises:

    11. Practice exercises on Projections of regular solids

    12. Practice exercises on Sections of solids

DEVELOPMENT OF SURFACES

Development of surfaces: Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts.

Exercises:

    13. Practice exercises on Development of surfaces of right regular solids

ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS

Orthographic Projections: Systems of projections, conventions and application to orthographic projections.

Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views: lines, planes, simple solids.

Exercises:

    14. Practice exercises on Orthographic Projections

    15. Practice exercises on Isometric Projections

TEXTBOOKS:

1. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, *Engineering Graphics with AutoCAD*, PHI Learning Private Limited, New Delhi, Revised edition, 2010.

2. N. D. Bhatt and V. M. Panchal, *Engineering Drawing*, Charotar Publishing House, Gujarat, 51st edition, 2013.

REFERENCE BOOKS/LABORATORY MANUALS:

1. Sham Tickoo, *AutoCAD 2013 for Engineers and Designers*, Dreamtech Press, 2013.

2. M. H. Annaiah & Rajashekar Patil, *Computer Aided Engineering Drawing*, New Age International Publishers, 4th edition, 2012.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	1	-	-	-	-	-	-	3		
CO2	3	3	2	1	3	1	-	-	-	-	-	-	3		
CO3	-	-	-	-	-	-	-	-	3	3	-	-	3		
Average	3	3	2	1	3	1	-	-	3	3	-	-	3		
Correlation level	3	3	2	1	3	1			3	3			3		

Correlation Levels: 3– High   2 - Medium   1– Low

I B. Tech. – I Semester

(20BT10332) ENGINEERING WORKSHOP

(Common to CE, ME, EEE, ECE, EIE, CSE(IOT) and CS&D)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		-	-	3	1.5

PRE-REQUISITES: --

COURSE DESCRIPTION: Knowledge on various workshop hand and power tools; hands on experience in different manufacturing trades such as fitting, carpentry, sheet metal forming and foundry; Demonstration on dismantling and assembling of various two wheeler parts, power tools in machining and metal joining, basics of plumbing and working of 3D printer.

COURSE OUTCOMES:

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

CO1: Design and model various basic prototypes in the trade of fitting such as square/half round mating, V- mating and dovetail mating from the given MS workpieces using fitting tools.

CO2: Develop different prototypes in the carpentry trade such as cross lap joint, dovetail / bridle joints and Mortise and Tenon joint using carpentry tools.

CO3: Design and model different prototypes in the sheet metal forming trade such as rectangular tray, square vessel/cylinder, Funnel as per the dimensions using sheet metal forming tools.

CO4: Develop sand mold using single piece pattern and split piece pattern in the foundry trade using foundry tools.

CO5: Develop electric circuits for series and stair case connections.

CO6: Demonstrate the knowledge on power tools, plumbing operation, 3D printing technology involved in different engineering applications.

CO7: Work independently or in teams to solve problems with effective communication

DETAILED SYLLABUS:

FITTING: Conduct a detailed study on various aspects in fitting trade which includes the details of fitting operations, safety precautions, types of tools, tool holders, miscellaneous tools, care and maintenance of hand tools, marking and measurement tool, and finishing tool.

Exercises :

1. Make a square/half round mating from the given MS workpieces
2. Make a V- mating from the given MS workpieces

CARPENTRY: Conduct a detailed study on various aspects in carpentry trade which includes the details of types of wood, carpentry tools, wood working techniques, types of joints, safety precautions, and care and maintenance of tools.

Exercises:

    3.   Prepare a cross lap joint

    4.   Prepare dovetail / bridle joints

SHEET METAL FORMING: Conduct a detailed study on various aspects in sheet metal forming which includes the details of sheet materials, hand tools, sheet metal fabrication, and safety and precautions

Exercises:

    5.   Fabricate a rectangular tray as per the dimensions

    6.   Fabricate square vessel/cylinder as per the dimensions

FOUNDRY: Conduct a detailed study on various aspects in foundry which includes the details of moulding sand, properties of moulding sand, types of patterns and pattern, materials, foundry tools, and safety and precautions

Exercises:

    7.   Prepare a sand mold, using the given single piece pattern (stepped pulley/cube)

    8.   Prepare a sand mold, using the given split piece pattern (pipe bent/dumbbell)

ELECTRICAL WIRING: Prepare electrical wiring with associated devices such as switches, distribution boards, sockets, and light fittings in a structure considering safety standards for design and installation.

Exercises:

    9.   Prepare electrical circuits with Series.

    10.   Prepare electrical circuits with Stair case connections.

DEMONSTRATION:

    11.   Demonstrate the usage of power tools.

    12.   Demonstrate the plumbing operation and identify the essential tool and materials required for plumbing.

    13.   Demonstrate the working of 3D printer

Note: Student shall perform any **Twelve Exercises**

REFERENCE BOOKS/LABORATORY MANUALS:

1. P. Kannaiah and K. L. Narayana, *Workshop Manual*, SciTech Publishers, 2009.

2. K. Venkata Reddy, *Workshop Practice Manual*, BS Publications, 2008.

3. V. Ramesh Babu, *Engineering Workshop Practice*, V R B Publishers Private Limited, 2009.

ADDITIONAL LEARNING RESOURCES:

1. R. K. Jain, *Production Technology*, Khanna Publishers, 17th edition, 2012.

2. Kalpakjian, Serope, *Manufacturing Engineering and Technology*, Pearson Education, 7th edition, 2014.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1		1							3		
CO2	3	3	3	1		1							3		
CO3	3	3	3	1		1							3		
CO4	3	3	3	1		1							3		
CO5	3	3	3	1		1							3		
CO6	3	1	1	1	1	1							3		
CO7									3	3			3		
Average	3	2.6	2.6	1	1	1			3	3			3		
Correlation level	3	3	3	1	11	1			3	3			3		

Correlation Levels: **3– High** **2 - Medium** **1– Low**

(20BT10333) MATERIAL SCIENCE AND ENGINEERING LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

Intermediate Physics, Intermediate Chemistry

COURSE DESCRIPTION:

Characterization of microstructures of steels, cast irons and non-ferrous metals; heat treatment procedures; data acquisition and recording; grain size analysis; phase segmentation; non-destructive tests.

COURSE OUTCOMES:

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

CO1.   Analyze metallographic study of various metals using tools & software.

CO2.   Determine the mechanical properties of heat treated materials using tools & equipment.

CO3.   Apply non-destructive methods to identify and analyze the metal defects.

CO4.   Work individually or in a team to solve problems with effective communication.

LIST OF EXPERIMENTS:

(**Note:** Student shall perform minimum of **Twelve** experiments.)

1. Study of metallurgical instruments & microscope

2. a) Preparation of specimen using cold setting die

  b) Preparation of specimen using hydraulic press

3. Preparation and study of the microstructure of cast irons

4. Preparation and study of the microstructure of carbon steels

5. Preparation and study of the microstructure of Non-Ferrous Alloys

6. Study of the microstructures of heat treated steels

7. Measurement of hardness of heat treated and untreated steels

8. Determination of hardenability of steel by Jominey End Quench Test

9. Determination of grain size, and phase distribution of specimens (any four

  materials) by Material Plus software

10. Experiment on Ultrasonic flaw detection

11. Experiment on Magnetic particle inspection

12. Experiment on Die-penetration

13. Study on Eddy current testing

REFERENCE BOOKS / LAB MANUALS:

1. Material Science and Engineering Lab Manual (SVEC-20)

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1									3		
CO2	3	3	2	1									3		
CO3	3	3	2	1									3		
CO4									3	3			3		
Average	3	3	2	1					3	3			3		
Correlation level	3	3	2	1					3	3			3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

I B.Tech. - I Semester

(20BT1HSAC) SPOKEN ENGLISH

(Common to CE, ME, EEE, ECE, EIE, CSE(IOT) and CS&D)

(Audit Course)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	2	-	-	-

PRE-REQUISITES: -

COURSE DESCRIPTION:

Grammar; Functional English; Paragraph writing; Letter writing and Email writing.

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge of grammar and vocabulary in writing effective formal letters and e-mails.

CO2. Communicate effectively by applying appropriate speaking and writing techniques by examining and applying functional English.

DETAILED SYLLABUS

UNIT I: GRAMMAR **(6 periods)**

Active voice and Passive voice – Auxiliary modals - Question Forms: Wh-word, Embedded, Yes/No - Disjunctive/Tags - Spotting Errors

UNIT II: FUNCTIONAL ENGLISH **(6 periods)**

Vocabulary Building: (Vegetables, groceries, fruits, Parts of human body, relations) Greetings - Introduction - Self and others - Story telling - Speaking Activities

UNIT III: PARAGRAPH WRITING **(6 periods)**

Topic sentence - cohesion and coherence - Unity - adequate development - Introduction to types - Compare-Contrast - Problem & Solution, Cause & Effect, Classification & Illustrative.

UNIT IV: LETTER WRITING **(6 periods)**

Components of an Effective Letter - Communication in everyday life - Personal Correspondence, Internal Communication - Career and Employment Letters

UNIT V: EMAIL WRITING **(6 periods)**

Do's & Don'ts - Tips for email effectiveness - Email Jargon - Sample Emails

Total Periods: 30

TEXTBOOKS:

1. L. Adinarayana and V. Prakasam, *Spoken English*, Neelkamal Publications Pvt. Ltd., New Delhi, 2008

2. Ram Bhasker Raju, *The Complete Book on Spoken English*, Goutham Buddha Publications, Hyderabad, 2002.

REFERENCE BOOKS :

1. Sabina Pillai, Spoken English for my World, Oxford University Press, New Delhi, 2016.

2. K. R. Lakshminarayanan, Speak in English, Scitech Publications, Chennai, 2009.

ADDITIONAL LEARNING RESOURCES

- https://www.britishcouncil.in/programmes/english-partnerships/state/skillsprojects/AP-English-Skills.

- https://www.fluentu.com/blog/english/websites-to-learn-english/

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			1					1					
CO2	2	3			1					2					
Average	**2.5**	**2**			**1**					**1.5**					
Correlation level	**3**	**2**			**1**					**2**					

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

I B. Tech. - II semester

(20BT2BS01) TRANSFORMATION TECHNIQUES AND LINEAR ALGEBRA

(Common to All Branches)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITE: -

COURSE DESCRIPTION:

Fourier Series and Fourier Transforms; Laplace Transforms; Inverse Laplace Transforms; Linear Algebra-I (Matrices); Linear Algebra-II (Vector Spaces).

COURSE OUTCOMES:

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

CO1. Construct the Fourier series for periodic functions and demonstrate the use of Fourier series and Fourier transform to connect the frequency and time domain systems.

CO2. Solve initial and boundary value problems in engineering fields through Laplace Transform techniques.

CO3. Apply the matrix theory in solving system of linear equations and determine the Eigen values and Eigen vectors.

CO4. Demonstrate the knowledge of Linear Transformations to intelligent systems.

DETAILED SYLLABUS:

UNIT I: FOURIER SERIES AND FOURIER TRANSFORMS   (9 Periods)

Fourier series: Determination of Fourier coefficients, Euler's formulae, convergence of Fourier series (Dirichlet's conditions), Fourier series in $(0, 2\pi), (-\pi, \pi)$; Fourier series of even and odd functions; Half-range Fourier sine and cosine expansions in $(0, \pi)$; Fourier integral theorem (statement only), Fourier sine and cosine integrals; Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier transforms.

UNIT II: LAPLACE TRANSFORMS   (9 Periods)

Definition of Laplace transforms, existence conditions, Laplace transforms of standard functions, Properties of Laplace transforms (without proofs), Laplace transforms of derivatives, Laplace transforms of integrals, multiplication by t^n, division by t, Laplace transforms of periodic functions, Laplace transforms of unit step function and unit impulse function.

UNIT III: INVERSE LAPLACE TRANSFORMS   (9 Periods)

Inverse Laplace transforms by different methods; Convolution theorem (without proof), inverse Laplace transforms by convolution theorem; Applications of Laplace transforms to ordinary differential equations of first and second order with constant coefficients.

UNIT- IV: LINEAR ALGEBRA-I (MATRICES)   (9 Periods)

Rank of a matrix: echelon form; Linear systems of equations: solving system of Homogeneous and Non-Homogeneous equations; Eigen values and Eigen vectors of a

matrix and properties (without proofs), Diagonalization of a matrix by orthogonal transformation.

UNIT- V: LINEAR ALGEBRA-II (VECTOR SPACES)   (9 Periods)

Vector spaces, Linear dependence and independence of vectors, basis, dimension, Linear transformations (maps), range and kernel of a linear map, rank and nullity, inverse of a linear transformation, rank-nullity theorem (without proof).

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M. V. S. S. N. Prasad, Engineering Mathematics-II, S. Chand & Company, 10th edition, 2016.

2. B. S. Grewal, Higher Engineering Mathematics, Khanna publishers, 44th edition, 2017.

3. David Poole, Linear Algebra: A Modern Introduction, Brooks/Cole, 2nd edition, 2005.

REFERENCE BOOKS:

1. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw hill, 1st edition, 2017.

2. V. Krishna Murthy, Mainra and Arora: An Introduction to Linear Algebra, Affiliated East-West Press, 1993.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	1	-	-	-	-	-	-	-			
CO2	3	3	-	-	1	-	-	-	-	-	-	-			
CO3	3	2	-	-	1	-	-	-	-	-	-	-			
CO4	3	2	-	-	1	-	-	-	-	-	-	-			
Average	3	2.5	-	-	1	-	-	-	-	-	-	-			
Correlation level	3	3	-	-	1	-	-	-	-	-	-	-			

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT1BS04) APPLIED PHYSICS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Fiber optics; Acoustics; Ultrasonics; Kinematics; Kinetics; Thermal Physics and Modern Engineering Materials.

COURSE OUTCOMES:

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

CO1. Understand the electromagnetic wave propagation in various types of Optical Fibers.

CO2. Apply the basic knowledge of acoustics and ultrasonics to provide solutions for various engineering problems.

CO3. Analyze and solve the problems associated with kinetics and kinematics.

CO4. Acquire the basic knowledge in several heat transfer mechanisms and heat conduction through the compound media.

CO5. Demonstrate the knowledge on characteristics and applications of modern engineering materials.

DETAILED SYLLABUS:

UNIT I: FIBER OPTICS   (8 periods)

Introduction, structure of an optical fiber, total internal reflection, acceptance angle, acceptance cone and numerical aperture, modes of propagation, classification of optical fibers, V-number (qualitative), fabrication of optical fiber by double crucible technique, applications of optical fibers, sensors (temperature, displacement, liquid level detector).

UNIT II: ACOUSTICS AND ULTRASONICS   (9 periods)

Acoustics - Introduction, classification of sound, sound intensity level (decibel), reverberation, reverberation time, Sabine's formula (qualitative), absorption coefficient and its determination, , factors affecting acoustics and their remedies, basic requirements of an acoustically good hall.

Ultrasonics - Introduction to ultrasonic waves, production of ultrasonic waves by magnetostriction method, piezoelectric method, detection of ultrasonics (qualitative), industrial applications (ultrasonic welding, ultrasonic soldering and ultrasonic drilling).

UNIT III: KINEMATICS AND KINETICS   (10 periods)

Kinematics of particles – Introduction, Rectilinear motion (displacement-time curve, velocity-time curve, acceleration-time curve), curvilinear motion (velocity and angle of projection, equation of trajectory path, horizontal range) - inclined projection (equation of trajectory, maximum height, time of flight of projectile, horizontal range, angle of projection).

Kinetics - Bodies in rectilinear translation, kinetics of bodies rotating about fixed axis, work, energy, power, work-energy equation for translation.

UNIT IV: THERMAL PHYSICS   (8 periods)

Introduction, modes of heat transfer (conduction, convection and radiation), coefficient of thermal conductivity, rectilinear flow of heat along a uniform bar, thermal conductivity of bad conductor (Lee's disc method), heat conduction through compound media (materials in series and parallel).

UNIT-V: MODERN ENGINEERING MATERIALS   (10 periods)

Metallic glasses - Introduction, preparation of metallic glasses by RF sputtering technique, properties (structural, thermodynamic, mechanical, electrical, chemical and optical), applications of metallic glasses.

Shape memory alloys (SMA) – Introduction, shape memory effect and its types, characteristics of SMA, properties of NiTi alloy, applications of SMA.

Composites - Introduction, types and applications.

Total periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. M. N. Avadhanulu, P. G. Kshirsagar, T. V. S. Arun Murthy, A *Textbook of Engineering Physics*, S. Chand Publications, 11th edition, 2019.

2. S. S. Bhavikatti and K. G. Rajashekarappa, *Engineering Mechanics*, New Age International Publishers, 2nd edition, 2015.

REFERENCE BOOKS:

1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Learning, 2012.

2. Brij Lal and N. Subrahmanyam, *Heat and Thermodynamics,* S. Chand and Company Ltd., 1995.

3. William D. Callister, Jr. David, G. Rethwisch, *Material Science and Engineering*, 9th Edition, Wiley 2013.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-			
CO2	3	2	-	-	-	-	-	-	-	-	-	-			
CO3	3	2	-	-	-	-	-	-	-	-	-	-			
CO4	3	2	-	-	-	-	-	-	-	-	-	-			
CO5	3	2	-	-	-					-	-				
Average	3	2	-	-	-	-	-	-	-	-	-	-			
Correlation level	3	2	-	-	-	-	-	-	-	-	-	-			

3. **Correlation Levels:**   **3– High**   **2 - Medium**   **1– Low**

I B. Tech. - II Semester

(20BT1HS01) COMMUNICATIVE ENGLISH

(Common to CE, ME, EEE, ECE, EIE, CSE(IOT) and CS&D)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Introduction to Communication; Active Listening; Effective Speaking; Reading and Technical Writing.

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge of English language, examining and applying the aspects of Process of communication, Paralinguistic features, Skimming, Scanning, and Elements of style in writing.

CO2. Analyze the modes and techniques of listening, speaking, reading, writing and apply them appropriately to communicate effectively with the engineering community and society.

CO3. Apply reading and writing techniques in preparing documents by examining SQ3R Technique, Writer's Block, and Précis Writing.

CO4. Communicate effectively in Conferences, Symposia, Seminars and in formal and real time situations by applying appropriate speaking techniques learnt by examining different communication styles used in similar contexts.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO COMMUNICATION   **(9 periods)**

Introduction – Language as a Tool of Communication – Communicative Skills (Listening, Speaking, Reading and Writing) – Effective Communication – Modes of Communication – Barriers to Communication (classification)

UNIT II - **ACTIVE LISTENING**   **(9 periods)**

Introduction – Traits of a Good Listener – Listening Modes – Types of Listening – Barriers to Effective Listening – Listening for General Content and Specific Information

UNIT III: EFFECTIVE SPEAKING   **(9 periods)**

Introduction – Achieving Confidence, Clarity and Fluency – Paralinguistic Features – Barriers to Speaking – Types of Speaking – Conferences; significance, planning and preparation and procedure – Symposia and Seminars - Persuasive Speaking

UNIT IV: READING   **(9 periods)**

Introduction – Reading and Interpretation – Intensive and Extensive Reading – Critical Reading – Techniques for Good Comprehension – SQ3R Reading Technique – Study Skills

UNIT V: TECHNICAL WRITING   (9 periods)

Introduction – Language – Elements of Style – Techniques for Good Technical Writing – Paragraphs Construction – Essays: types, Steps to Essay Writing and Checklist – Précis Writing

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXTBOOKS:

1. Meenakshi Raman & Sangeetha Sharma, *Technical Communication*, Oxford University Press, New Delhi, 2012.

2. Ashraf Rizvi, *Effective Technical Communication*, McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2018.

REFERENCE BOOKS:

1. Sanjay Kumar & Pushp Lata, *Communication Skills*, Oxford University Press, New Delhi, 2013.

2. Rajendra Pal and J. S. Korlahalli, *Essentials of Business Communication*, Sultan Chand and Son, New Delhi, 2010.

ADDITIONAL LEARNING RESOURCES

1. https://www.skillsyouneed.com/ips/active-listening.html: A useful summary of what active listening skills are.

2. https://en.wikipedia.org/wiki/Active_listening: Wikipedia entry about active listening.

3. https://www.forbes.com/sites/womensmedia/2012/11/09/10-steps-to-effective-listening/#4b27a2503891: Ten steps to Active Listening (by Forbes magazine).

4. https://goo.gl/t1Uqrt: 20 tips for organizing a conference.

5. https://goo.gl/kPMr9u: 10 important issues for speakers at a conference.

6. https://goo/gl/C5bDvv: Wikihow guide to organizing a conference.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-		-	-	-	-	-	-	-			
CO2	1	3	-	-	-		-	-	-	-		-			
CO3	1	1	-	-	2	-	-	-	-	-	-	-			
CO4	1	1	-	-	2	-	-	-	-	3	-	1			
Average	1.2	1.6			2					3		1			
Correlation level	1	2			2					3		1			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

I B. Tech. – II Semester

(20BT20541) PROGRAMMING IN C AND DATA STRUCTURES

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

A Course on Basic Mathematics

COURSE DESCRIPTION:

Algorithms; Flowcharts; Introduction to C language; Operators and expressions; Input and output functions; Control statements; Arrays; Strings; Functions; Pointers; User-defined data types; Linked lists; Overview of data structures; Stack; Queue; Searching algorithms; Sorting algorithms.

COURSE OUTCOMES:

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

CO1. Develop flowcharts, algorithms for given problems.

CO2. Design algorithmic solutions by analyzing programming problems and using appropriate C language constructs.

CO3. Apply linear data structures such as arrays, linked lists, stacks, queues for efficient data organization and manipulation.

CO4. Select appropriate techniques for searching and sorting problems.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO C PROGRAMMING   (8 periods)

Introduction to Algorithms and Flowcharts: What is an algorithm, Different ways of stating algorithms, Key features of algorithm, What are variables, Subroutines, Flowcharts, Strategy for designing algorithms, Tracing an algorithm to depict logic, Specification for converting algorithms into programs.

Basis of C Programming: Introduction, Structure of a C program, Concept of a variable, Data types in C, Program statement, Declaration, How does the computer store data in memory, Tokens, Operators and expressions, Expressions revisited, Type conversion in C.

UNIT II - INPUT AND OUTPUT, CONTROL STATEMENTS   (9 periods)

Input and Output: Basic screen and keyboard I/O in C, Non-formatted input and output, Formatted input and output functions.

Control Statements: Specifying test condition for selection and iteration, Writing test expression, Conditional execution and selection, Iteration and repetitive execution, goto statement, Special control statements, Nested loops.

UNIT III: ARRAYS AND STRINGS, FUNCTIONS   (10 periods)

Arrays and Strings: One-dimensional array – Declaration, Initialization, Manipulation; Multi-dimensional arrays – Declaration, Initialization, Manipulation; Strings – Declaration, Initialization, String input/output, Character manipulation, String manipulation; Arrays of strings – Declaration, Initialization, Manipulation.

Functions: Concept of function, Using functions, Call by value mechanism, Working with functions, Passing arrays to functions, Scope and extent, Storage classes, Recursion.

UNIT IV – POINTERS, USER-DEFINED DATA TYPES, LINKED LISTS   (10 periods)

Pointers in C: Understanding memory addresses, Address operator (&), Pointer, Arrays and pointers, Pointers and strings, Pointer arithmetic, Pointers to pointers, Array of pointers, Pointers to an array, Two-dimensional arrays and pointers, Dynamic memory allocation.

User-Defined Data Types: Structures - Declaration, Initialization, Accessing members, Arrays of structures, Arrays within structure, Structures and pointers, Structures and functions; Enumeration types.

Linked Lists: Single linked lists – Definition, Representation, Operations, Inserting a node, Deleting a node; Applications of linked lists, Disadvantages of linked lists, Array versus linked list revisited.

UNIT V – DATA STRUCTURES   (8 periods)

Basic Data Structures: Overview of data structures, Stack – Definition, Array representation, Implementation of stack operations using arrays; Queue - Definition, Array representation, Implementation of queue operations using array.

Searching and Sorting: Linear Search, Binary Search, Bubble sort, Selection sort.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Pradip Dey and Manas Ghosh, *Programming in C,* Oxford University Press, 2018.

2. Debasis Samanta, *Classic Data Structures,* 2nd Edition, PHI Learning, 2009.

REFERENCE BOOKS:

1. Byron S Gottfried and Jitender Kumar Chhabra, *Programming with C*, 4th Edition, McGraw Hill Education, 2019.

2. Yashavant Kanetkar, *Let Us C,* 17th Edition, BPB Publications, 2020.

ADDITIONAL LEARNING RESOURCES:

*   E. Balagurusamy, *Programming in C*, 7th Edition, McGraw Hill, 2014.

*   R. G. Dromey, *How to Solve it by Computer*, Pearson Education, 2007.

*   https://nptel.ac.in/courses/106/104/106104128/

*   https://nptel.ac.in/courses/106/103/106103069/

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2													
CO2	3	3	3												
CO3	3	3	3	2											
CO4	2	3	3	2											
Average	2.7	2.7	3	2											
Correlation level	3	3	3	2											

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT20301) BASIC ENGINEERING MECHANICS

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES: -

Applied Physics

COURSE DESCRIPTION:

Statics of Particles and Rigid Bodies; Support Reactions; Analysis of Perfect Frames; Friction; Centroid, Centre of Gravity and Moment of Inertia; kinetics and Vibrations

COURSE OUTCOMES:

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

CO1. Analyze the equilibrium of forces in static particles, rigid bodies, and effect of friction by applying the principles of Engineering Mechanics, and solve the problems..

CO2. Analyze composite areas and bodies to find centroid, centre of gravity and moment of inertia.

CO3. Apply D'Alembert's Principle for analyzing the kinetics of rigid bodies.

CO4. Apply the basic principles of Simple Harmonic Motion and vibrations to solve problems in mechanical systems

DETAILED SYLLABUS:

UNIT – I: STATICS OF PARTICLES   (9 Periods)

Basic concepts, System of units, System of concurrent coplanar forces in plane, Resultant of forces, Laws of mechanics, Parallelogram and triangular law of forces, Equilibrium of forces, Lami's theorem, Vectorial representation of forces, Vector operations of forces –addition, subtraction, dot product, cross product of vectors, principle of transmissibility.

UNIT – II: STATICS OF RIGID BODIES   (9 Periods)

Moment of a force, Varignon's theorem, Moment of a couple, Vectorial representation of moments and couples, Coplanar non-concurrent forces, Equilibrium of rigid bodies, Types of supports and loads, Types of frames, Perfect frame analysis, Method of joints, Method of sections, Principle of virtual work.

UNIT – III: FRICTION   (9 Periods)

Frictional force, Types of friction, Laws of friction, Co-efficient of friction, Angle of friction, Angle of repose, Cone of friction, Applications: Body on horizontal/inclined plane, Two bodies in contact, Ladder friction, Wedge friction.

UNIT–IV: CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA

(9 Periods)

Centroids of simple and composite areas, centre of gravity of bodies, Theorems of Pappus and Guldinus, Parallel axis and perpendicular axis theorems, Moment of Inertia of Composite areas, Radius of gyration – Section modulus, Mass Moment of Inertia of simple and composite masses.

UNIT–V: KINETICS AND MECHANICAL VIBRATIONS   (9 Periods)
Kinetics of Rigid Bodies:

Introduction, Problems on D'Alembert's principle, Impulse-momentum equation, Kinetics of circular motion, Rotation.

Mechanical Vibrations:

Definitions, Concepts – Simple Harmonic Motion – Free vibrations – Simple, compound and Tortional pendulum – Numerical problems.

Total Periods: *45*

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. S. S. Bhavikatti and K. G. Rajashekarappa, *Engineering Mechanics*, New Age International (P) Ltd., 3rd Edition, 2009.

2. A. K. Tayal, *Engineering Mechanics Statics and Dynamics*, Umesh Publications, Delhi, 14th edition, 2011.

REFERENCE BOOKS:

1. S. Rajasekaran and G. Sankarasubramanian, *Engineering Mechanics – Statics and Dynamics*, Vikas Publishing House Pvt. Ltd., 3rd Edition, 2009.

2. Arthur P. Boresi and Richard J. Schmidt, *Engineering Mechanics - Statics and Dynamics, Cengage Learning*, 1st Edition, Indian Edition, 2008.

3. K. Vijaya Kumar Reddy and J. Suresh Kumar, *Singer's Engineering Mechanics - Statics and Dynamics*, BS Publications, 3rd Edition, 2010.

4. S. Timoshenko, D. H. Young and J. V. Rao, *Engineering Mechanics*, Tata McGraw-Hill Education Pvt. Ltd., Revised 4th Edition, Special Indian Edition, 2007.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1									3		
CO2	3	3	2	1									3		
CO3	3	3	2	1									3		
CO4	3	3	2	1									3		
Average	3	3	2	1									3		
Correlation level	3	3	2	1									3		

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT1BS33) APPLIED PHYSICS LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE REQUISITE: -

COURSE DESCRIPTION:

Determination of acceleration due to gravity using Compound Pendulum; Moment of inertia of a Flywheel; rectangular body using Bifilar Pendulum; Rigidity Modulus of a wire using Torsional Pendulum and frequency of electrically vibrating tuning fork; Thermal conductivity of a bad conductor (Lee's disc method); Seebeck Effect using Thermocouple; Verification of Newton's Law of Cooling for any two liquids; Characteristics of Optical fiber; Experimental determination of carrier concentration and energy gap of a material by varying temperatures and Determination of spring constant of springs using Coupled Oscillator.

COURSE OUTCOMES:

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

CO1. Demonstrate the experimental procedures to compute the frequency of a tuning fork, hall coefficient, energy gap, moment of inertia, rigidity modulus and thermal conductivity of materials.

CO2. Apply skills to plot various characteristic curves of an optical Fiber and also determine thermal conductivity, thermo emf and energy gap.

CO3. Work independently and in teams to solve problems with effective communication.

List of Experiments:

A minimum of **Ten** experiments are to be conducted among the following:

1. Determination of moment of inertia of a bar and acceleration due to gravity - Compound Pendulum.
2. Moment of inertia of a Flywheel.
3. Bifilar Pendulum - Moment of inertia of a rectangular body.
4. Melde's Experiment – Determine the frequency of electrically driven tuning fork.
5. Determination of thermal conductivity of a bad conductor (Lee's disc method).
6. Estimate the acceptance angle of an optical fiber.
7. Verification of Newton's Law of Cooling for any two liquids.
8. Determination of number of charge carriers per unit volume and hall coefficients of a given material using Hall Effect.
9. Rigidity Modulus of a material of a wire - Torsional Pendulum
10. Thermocouple - Seebeck Effect.
11. Determine the energy gap of a material by varying temperatures.
12. Determination of spring constant of springs using Coupled Oscillator.

TEXTBOOK:

1. Applied Physics Lab Manuel (SVEC-20)

REFERENCES:

1. Balasubramanian S, Srinivasan M.N and Ranganathan, *A Textbook of Practical Physics,* R. Sultan Chand & Sons, 2017.

2. https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=354&cnt=1

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-			
CO2	3	3	-	-	-	-	-	-	-	-	-	-			
CO3	-	-	-	-	-	-	-	2	2	2	-	-			
Average	3	3						2	2	2					
Correlation level	3	3						2	2	2					

Correlation Levels: 3– High   2 - Medium   1– Low

I B.Tech. - II Semester

(20BT1HS31) COMMUNICATIVE ENGLISH LAB

(Common to CE, ME, EEE, ECE, EIE, CSE(IOT) and CS&D)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE REQUISITE: -

COURSE DESCRIPTION:

Just a Minute, Elocution/Impromptu; Phonetics; Vocabulary Building; Grammar; Giving Directions; Role Plays; Public Speaking; Letter Writing; Describing Objects; Listening Comprehension; Information Transfer and Reading Comprehension.

COURSE OUTCOMES:

After successful completion of this course, students will be able to:

CO1. Demonstrate knowledge of Phonetics by examining and applying sounds of English through Phonetics.

CO2. Analyze sentence structures by applying and demonstrating knowledge of Vocabulary and Grammar.

CO3. Apply appropriate listening and reading skills by analyzing the context, and demonstrate through listening comprehension and reading comprehension.

CO4. Function effectively as an individual and as a member in diverse teams examining and applying speaking skills in Just A Minute and Role Play.

CO5. Communicate effectively applying appropriate writing and speaking techniques by examining and demonstrating knowledge through Describing Objects, Information Transfer and Letter Writing in formal and real time situations.

*First ten exercises are mandatory among the following:

List of Exercises:

1. Just a Minute, Elocution/Impromptu

Steps to be followed – Useful tips – Dos & Don'ts – Preparation – Examples

2. Phonetics

 Sounds of English – Consonants – Vowels – Speech Organs – Phonetic Transcription – Word Accent – Basics of Intonation

3. Vocabulary Building

Prefixes & Suffixes – Synonyms & Antonyms – Phrasal verbs – Idioms – One word substitutes – Words often confused

4. Grammar

Tenses –Nouns – Word order and error correction

5. Giving Directions

Useful phrases – Sample conversations - Exercises

6. Role Plays

Useful tips – Dos & Don'ts – Exercises – Role Plays for practice

7. Public Speaking

Stage presence – Voice control – Body Language – Rehearsals – Audience – Delivery - Dos & Don'ts – Project Submission

8. Letter Writing

Introduction – Objective – Formats – Types – Exercises

9. Describing Objects

Jargon – Useful Phrases – Do's & Don'ts – Exercises

10. Listening Comprehension

Introduction – Types of listening – Practice – Benefits of listening – Exercises

11. Information Transfer

Tables – Pie Charts – Venn Diagrams – Graphs – Flow Charts – Steps to be followed – Exercises

12. Reading Comprehension

Introduction – Types of reading – Inferring – Critical analysis – Exercises

TEXTBOOK:

1. Communicative English Lab, SVEC

REFERENCE BOOKS:

1. D. Sudha Rani, *A Manual for English Language Laboratories*, Pearson, Noida, 2010.

2. Nira Kumar, English *Language Laboratories*, PHI Learning Pvt. Ltd., New Delhi, 2011.

SUGGESTED SOFTWARES:

1. SoftX
2. Speech Solutions
3. English Pronunciation Dictionary by Daniel Jones
4. Learning to Speak English 8.1, The Learning Company – 4 CDs.
5. Mastering English: Grammar, Punctuation and Composition.
6. English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
7. Dorling Kindersley Series of Grammar.
8. Language in Use 1, 2 & 3
9. Cambridge Advanced Learner's Dictionary - 3rd Edition
10. Centronix – Phonetics
11. Let's Talk English, Regional Institute of English South India.

ADDITIONAL LEARNING RESOURCES

1. https://goo.gl/IjE45p: Amazon India site – with thousands of different product descriptions
2. https://goo.gl/3ozeO6: 15 ways to calm your nerves before giving a presentation.
3. https://goo.gl/p20ttk: useful site for more language about introducing yourself.
4. https://goo.glsvMHZ1: information and advice about describing line graphs
5. https://goo.gl/NqFJuc: an informative presentation about using line graphs

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-		--	-	-	-	-	-	-			
CO2	2	3	-	-	-	-	-	-	-	-	-	-			
CO3	1	1	-	-	1	-					-	-			
CO4	1	1	-		2				1			-			
CO5	1	2	-		2					3		1			
Average	1.8	1.7			1.2				1	3		1			
Correlation level	2	2			1				1	3		1			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

I B. Tech. – II Semester

(20BT20551) PROGRAMMING IN C AND DATA STRUCTURES LAB

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

A course on "Programming in C and Data Structures"

COURSE DESCRIPTION:

Hands on practice in developing and executing simple programs using C Programming constructs – Control statements, Arrays, Strings, Functions, Pointers, Structures, Single linked lists, Stack, Queue, Searching and Sorting.

COURSE OUTCOMES:

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

CO1. Design algorithmic solutions by analyzing programming problems and using appropriate C language constructs.

CO2. Implement linear data structures such as arrays, linked lists, stacks, queues for efficient data organization and manipulation.

CO3. Select appropriate techniques for searching and sorting problems.

CO4. Work independently and communicate effectively in oral and written forms.

LIST OF EXERCISES:

1. a) Let a and b are two integer variables whose values are 10 and 13 respectively. Write a program to evaluate the following arithmetic expressions.
   i) a + b   ii) a–b   iii) a * b   iv) a/b   v) a % b

   b) Write a program to evaluate the following algebraic expressions after reading necessary values from keyword.
   i) $(ax + b)/(ax – b)$
   ii) $2.5 \log x + \cos 32^0 + | x^2 + y^2 |$
   iii) $x^5 + 10 x^4 + 8$ and $x^3 + 4 x + 2$
   iv) ae^{kt}

2. a) Mr. Gupta deposited Rs.1000 in a bank. The bank gives simple interest at the rate of 15% per annum. Write a program to determine the amount in Mr. Gupta's account at the end of 5 years. (Use the formula I = PTR / 100)

   b) A cashier has currency notes of denominations Rs.10, Rs. 50 and Rs. 100. If the amount to be withdrawn is input in hundreds, find the total number of notes of each denomination the cashier will have to give to the withdrawer.

   c) In a town, the percentage of men is 52. The percentage of total literacy is 48. If total percentage of literate men is 35 of the total population; write a program to find the total number of illiterate men and women if the population of the town is 8000.

3. a) Write a program that prints the given three integers in ascending order using if - else.

   b) Write a program to calculate commission for the input value of sales amount. Commission is calculated as per the following rules:
       i) Commission is NIL for sales amount Rs. 5000.
       ii) Commission is 2% for sales when sales amount is >Rs. 5000 and<=Rs. 10000.
       iii) Commission is 5% for sales amount >Rs. 10000.

   c) If cost price and selling price of an item is input through the keyboard, write a program to determine whether the seller has made profit or incurred loss. Also determine how much profit or loss he incurred in percentage.

4. a) An insurance company calculates premium as follows:
       i) If a person's health is excellent and the person is between 25 and 35 years of age and lives in a city and is a male then premium is Rs.4 per thousand and the policy amount cannot exceed Rs.2 lakhs.
       ii) If a person satisfies all the above conditions and is female then the premium is Rs.3 per thousand and the policy amount cannot exceed Rs.1 lakh.
       iii) If a person's health is poor and the person is between 25 and 35 years of age and lives in a village and is a male then premium is Rs.6 per thousand and the policy cannot exceed Rs. 10000.
       iv) In all other cases the person is not insured.
       Write a program to determine whether the person should be insured or not, his/her premium rate and maximum amount for which he/she can be insured.

   b) Write a program, which takes two integer operands and one operator as input from the user, performs the operation and then prints the result. (Consider the operators +, -, *, /, %. Use switch statement)

5. a) Write a program to find the sum of individual digits of a positive integer.

   b) A Fibonacci sequence is defined as follows: The first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a program to generate the first N terms of the sequence.

6. a) Write a program to find the largest and smallest number in a given list of integers.

   b) Write a program to perform addition of two matrices.

   c) Write a program to determine whether the given string is palindrome or not.

7. a) Write a program using functions to perform the following operations:
       i) To convert a given decimal number into binary number
       ii) To convert a given binary number into decimal number

   b) Write a program using functions insert a sub-string in main string at a specified position.

8. a) Write a C program to print the elements of an array in reverse order using pointers.

   b) Write a program to accept the elements of the structure as: Employee-name, Basic pay. Display the same structure along with the DA, CCA and Gross salary for 5 employees.
       Note: DA=51% of Basic pay, CCA=Rs.100 consolidated.

9. A college has N number of students and the following details of all the students are maintained – register number, name, branch, phone number. Write a program to store the details of the students using a singly linked list. Develop functions to perform the following operations on the data.
   i) Insert new student's details
   ii) Display the details of the students
   iii) Delete a given student's information

10. a) Develop a menu driven program to perform the following operations on a stack of integers (Array implementation of stack with maximum size MAX)
    i) Push an element
    ii) Pop an element
    iii) Display the status
    iv) Demonstrate overflow and underflow situations

    b) Develop a menu driven program to perform the following operations on a queue of characters (Array implementation of queue with maximum size MAX).
    i) Insert an element
    ii) Delete an element
    iii) Display the status
    iv) Demonstrate overflow and underflow situations

11. Store register numbers of students who attended placement training program in a random order in an array. Write a function to search whether a student has attended placement training program or not using
    a) Linear Search
    b) Binary Search

12. Given marks of N number of students in mathematics subject, write a program to display the marks of students in ascending order using
    a) Bubble Sort
    b) Selection Sort

TEXTBOOKS:

1. Pradip Dey and Manas Ghosh, *Programming in C*, Oxford University Press, 2018.

2. Debasis Samanta, *Classic Data Structures*, 2nd Edition, PHI Learning, 2009.

REFERENCE BOOKS:

1. Byron S Gottfried and Jitender Kumar Chhabra, *Programming with C*, 4th Edition, McGraw Hill Education, 2019.

2. Yashavant Kanetkar, *Let Us C*, 17th Edition, BPB Publications, 2020.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3												
CO2	3	3	3	2											
CO3	2	3	3	2											
CO4									3	3					
Average	2.6	3	3	2					3	3					
Correlation level	3	3	3	2					3	3					

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT1MC01) UNIVERSAL HUMAN VALUES

(Mandatory Course)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	-	-	2	-	-	-

PRE-REQUISITES: -

COURSE DESCRIPTION:

Process for Value Education; Harmony in the Human Being - Harmony in Myself!; Harmony in Family and Society- Human Relationship; Harmony in the Nature and Existence – Coexistence; Implications of Holistic Understanding of Harmony on Professional Ethics.

COURSE OUTCOMES:

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

CO1. Understand Values and skills for sustained happiness and prosperity.

CO2. Analyse realistic implications of a Holistic understanding of ethical human conduct, trustful and mutually fulfilling human behaviour.

CO3. Apply holistic approach in personal life and profession through a positive understanding of the Human reality and existence.

DETAILED SYLLABUS:

UNIT I: VALUE EDUCATION   **(6 Periods)**

Human Values-Introduction; Self-Exploration - Natural Acceptance; Human Aspirations-Right understanding- the current scenario: understanding and living in harmony.

UNIT II: HUMAN BEING AND SELF   **(6 Periods)**

Understanding human being - I' and the material 'Body'; needs of Self ('I') and 'Body'- happiness and physical facility; Body as an instrument of 'I' - characteristics and activities of 'I' and harmony in 'I'; harmony of I with the Body.

UNIT III: FAMILY, THE SOCIETY AND THE NATIONS   **(6 Periods)**

Values in human relationship (nine universal values) - foundational values of relationship; Difference between intention and competence; Difference between respect and differentiation; harmony in the society; Universal harmonious order in society.

UNIT IV: HARMONY WITH THE NATURE   **(6 Periods)**

Harmony in the Nature; Interconnectedness and mutual fulfilment - the four orders of nature - Recyclability and Self-regulation; Existence as Co-existence; Holistic perception of harmony and existence.

UNIT V: HARMONY WITH PROFESSIONAL ETHICS   **(6 Periods)**

Acceptance of human values; Ethical Human Conduct; Basis for Humanistic Education; Competence in professional ethics; Case studies: Holistic technologies, Management Models and Production Systems; Socially and ecologically responsible engineers, technologists and managers - enriching institutions and organizations.

Total Periods: 30

TEXTBOOKS:

1. R R Gaur, R Sangal, G P Bagaria, *Human Values and Professional Ethics*, Excel Books, New Delhi, 2010

REFERENCE BOOKS:

1. JeevanVidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					3	2	-							
CO2	3					3	3	-							
CO3	3					3	3	2							
Average	2.6					3	2.6	2							
Correlation level	3					3	3	2							

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT3BS01) **NUMERICAL METHODS, PROBABILITY AND STATISTICS**

(Common to CE, ME, CSE, CSSE, IT, CSE (AI), CSE (DS) and CSBS)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	--	--	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Numerical solutions of equations; interpolation; numerical differentiation and integration; random variables; mathematical expectations; probability distributions; test of hypothesis.

COURSE OUTCOMES:

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

CO1. Provide solutions for equations, derivatives and integrals through numerical methods for the given data.

CO2. Identify the types of random variables and determine their probabilities & mathematical expectation.

CO3. Apply the concept of probability distributions to solve engineering problems.

CO4. Analyze the hypothesis by applying statistical testing methods.

DETAILED SYLLABUS

UNIT I: NUMERICAL SOLUTIONS OF EQUATIONS AND INTERPOLATION

(8 Periods)

Solutions of algebraic and transcendental equations: Regula-falsi method, Newton-Raphson method; Interpolation: Forward and backward differences, interpolation using Newton's forward and backward difference formulae, Lagrange's interpolation formula, partial fractions using Lagrange's interpolation formula.

UNIT II: NUMERICAL DIFFERENTIATION AND INTEGRATION   (9 Periods)

Numerical differentiation using Newton's forward and backward interpolation formulae; Numerical integration using Simpson's $1/3^{rd}$ and $3/8^{th}$ rules; Numerical solutions of first order ordinary differential equations using Taylor's series method, fourth order Runge-Kutta method.

UNIT III: RANDOM VARIABLES AND MATHEMATICAL EXPECTATIONS   (8 Periods)

Random Variables: Discrete and continuous random variables, distribution function of random variable, properties, probability mass function, probability density function; mathematical expectation, properties of mathematical expectation, mean and variance.

UNIT IV: PROBABILITY DISTRIBUTIONS   (9 Periods)

Discrete probability distributions: Binomial, Poisson- mean, variance, standard deviation (without derivations); Continuous probability distributions: Normal, uniform and exponential distributions- mean, variance, standard deviation (without derivations), area under the normal curve.

UNIT V: TEST OF HYPOTHESIS   (11 Periods)

Population and sample, parameter and statistic, null and alternative hypothesis, Type I and Type II errors, level of Significance, critical region, degrees of freedom; Large sample test: Tests of significance for proportions and means; Small sample test: Student's t-test- single mean, difference of means; F-test for equality of population variance; Chi-Square test for independence of attributes.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M. V. S. S. N. Prasad, *Mathematical Methods,* S. Chand & Company, 5th edition, 2016.

2. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M. V. S. S. N. Prasad, *Probability and Statistics,* S. Chand & Company, 5th edition, 2016.

REFERENCE BOOKS:

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th edition, 2017.

2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, *Numerical Methods*, S. Chand and Company, 2nd edition, Reprint 2012.

3. S. C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons Publications, 11th edition, 2012.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	-	-	-	-			
CO2	3	2	-	-	-	-	-	-	-	-	-	-			
CO3	3	2	-	-	1	-	-	-	-	-	-	-			
CO4	2	3	-	1	1	-	-	-	-	-	-	-			
Average	2.75	2.25	-	1	1	-	-	-	-	-	-	-			
Correlation level	3	3	-	1	1	-	-	-	-	-	-	-			

Correlation Levels: 3– High   2 - Medium   1– Low

II B. Tech. - I Semester

(20BT30301) ENGINEERING THERMODYNAMICS

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Courses on Applied Physics and Engineering Chemistry.

COURSE DESCRIPTION:

Thermodynamic system; Energy interactions; Heat and work Transfer in flow and non- flow systems; Laws of thermodynamics; Reversible and irreversible processes; Entropy; Equation of state; Pure substance; Thermodynamic Relations; Gases and gas mixtures and Gas power cycles.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1: Analyze thermodynamic systems using thermodynamic laws and estimate the thermodynamic properties during energy interactions in engineering application.

CO2: Calculate the properties of steam using PVT diagrams, H-S diagrams and steam tables considering steam power plant.

CO3: Determine the properties of ideal gases, real gases and gas mixtures using gas laws, volumetric analysis and gravimetric analysis for engineering applications.

CO4: Analyze the air stand cycles using P-V and T-S diagrams used in power generation systems and estimate the performance characteristics it.

DETAILED SYLLABUS:

UNIT I: **BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS** **(9 periods)**

Microscopic and macroscopic point of view, Thermodynamic systems, Control volume, Thermodynamic properties, Processes, Cycle, Homogeneous and Heterogeneous systems, Thermodynamic equilibrium, Quasi-static process, Work transfer and Heat transfer, Point and path function, Zeroth law of thermodynamics.

First Law of Thermodynamics: First law for a closed system undergoing a cycle, change of state, Limitations of first Law, Perpetual motion machine (PMM1) of first kind, Energy a property of system, First law applied to a flow process - steady flow energy equation (SFEE).

UNIT II: SECOND LAW OF THERMODYNAMICS **(9 periods)**

Second Law of Thermodynamics: Energy reservoir, Kelvin Planck and Clausius statements of second law and their equivalence, PMM of second kind, Heat engine, Refrigerator, Heat pump, Reversibility and Irreversibility, Carnot cycle, Carnot's theorem, Absolute thermodynamics temperature scale.

Entropy and Availability: Introduction, Clausius theorem, Clausius inequality, Entropy as a property, Principle of entropy increase and applications, Third law of thermodynamics. Availability and irreversibility, Available Energy, Maximum Work in a Reversible Process, Availability in Non - Flow and Flow Processes.

UNIT III: PURE SUBSTANCE AND THERMODYNAMIC RELATIONS   (9 periods)

Properties of pure substances: Introduction, P-V, P-T and T-S Diagrams for a Pure Substance, Quality and Dryness Fraction, Use of Steam Tables and Mollier Chart for thermodynamic properties.

Thermodynamic Relations: T-dS relations, Helmholtz and Gibbs functions, Gibbs relations, Maxwell relations, Joule-Thomson coefficient, coefficient of volume expansion

UNIT IV: PROPERTIES OF GASES AND GAS MIXTURES   (9 periods)

Properties of gases: Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties-Compressibility factor-.Principle of Corresponding states.

Properties of gas mixtures: Ideal gas, equation of state, Mole Fraction, Mass fraction, Gravimetric and volumetric Analysis, Dalton's Law of partial pressure, Equivalent Gas constant and Molecular Internal Energy, Enthalpy, Specific Heats and Entropy of Mixture of perfect Gases and Vapour.

UNIT V: POWER CYCLES   (9 periods)

Otto cycle, Diesel cycle and Dual cycle; Comparison of Otto, Diesel and Dual cycles - Description and representation on P–V and T-S diagram, Stirling cycle, Ericsson cycle, Joule cycle representation on P–V and T-S diagram.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. P. K. Nag, *Engineering Thermodynamics*, TMH, 6th Edition, 2017.

2. Chatttopadhyay, *Engineering Thermodynamics*, Oxford Publishers, 2nd edition, 2016.

REFERENCE BOOKS:

1. Yunus Cengel & Boles, *Thermodynamics–An Engineering Approach*, TMH, 8th Edition, 2015

2. Dr.R.Yadav, *Fundamentals of Engineering Thermodynamics*, Central publishing House, 7th Edition, 2004.

Note: Steam Tables with Mollier Chart shall be supplied during examination.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1		1								3	
CO2	3	3	2	1		1				1				3	
CO3	3	3	2	1		1								3	
CO4	3	3	2	1		1				1				3	
Average	3	3	2	1		1				1				3	
Correlation level	3	3	2	1		1				1				3	

Correlation Levels: 3– High   2 - Medium   1– Low

II B. Tech. - I Semester

(20BT30302) KINEMATICS OF MACHINERY

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Courses on Basic Engineering Mechanics and Computer Aided Engineering Drawing.

COURSE DESCRIPTION:

Basic concepts and description of various plane mechanisms; Calculation of Displacement; Velocity and acceleration of simple plane mechanisms; Straight line mechanisms; Steering mechanisms; Hooke's joint; Concepts of Gears and Gear trains; Preparation of cam profiles.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Calculate degrees of freedom of kinematic pairs, kinematic chains and its inversions used in machines for engineering applications.

CO2. Demonstrate the knowledge on straight line motion mechanisms for exact straight line motion and approximate straight line motion conditions.

CO3. Analyze steering gear mechanisms for correct steering and Hookes joints for uniform velocity ratios.

CO4: Analyze the gears to avoid interference and gear trains to find the velocity and number of teeth of its components.

CO5. Draw the profile of the cam based on follower motons and calculate the velocity and acceleration of the follower.

CO6: Analyze planar mechanisms for displacement, velocity and acceleration of different Points of it using relative velocity and Instantaneous center methods.

DETAILED SYLLABUS:

UNIT I: **MECHANISMS AND MACHINES**   **(8 Periods)**

Elements or Links, Classification- Rigid, Flexible and Fluid link; Types of kinematic pairs- Sliding, Turning, Rolling, Screw and Spherical pairs, Lower and Higher pairs, Closed and Open pairs; Constrained motions- Completely, Partially or successfully and incompletely constrained motion; Kinematic chain, Types of joints- Binary, Ternary and Quaternary joints; Number of Degrees of Freedom, Kutzbach and Grubler's Criteria, Inversions of plane mechanisms- Quadric cycle, Single slider and Double slider crank chains.

UNIT II: STRAIGHT LINE, STEERING GEAR MECHANISMS AND HOOKE'S JOINT

(10 periods)

Pantograph, Exact Straight Line Motion Mechanisms- Peaucellier, Hart and Scott Russell's mechanism; Approximate Straight Line Motion Mechanisms- Modified Scott Russell's mechanism, Watt's, Grasshopper, Tchebicheff's and Robert mechanisms; Steering mechanisms, Condition for correct steering, Davis Steering gear and Ackerman steering gear mechanisms, Single and double Hooke's joints.

UNIT III: GEARS AND GEAR TRAINS   (11 Periods)

Friction wheels and toothed gears, Types, Law of gearing, Sliding velocity of teeth, Forms of teeth- Cycloidal, Involute profiles; Expressions for path of contact and arc of contact, Contact ratio, Phenomena of interference, Condition for minimum number of teeth to avoid interference, Gear trains - Simple, Compound, Reverted and Epicyclic gear train; Compound Epicyclic Gear Train (sun and planet wheel), Differential gearbox for automobile.

UNIT IV: CAMS   (8 Periods)

Introduction to cams and followers, Types, Terminology, Types of follower motion, Cam profile- For uniform velocity, SHM, Cycloidal and Uniform acceleration- and retardation of Knife edge, Roller followers (axis of follower passes through the axis of camshaft and offset), Maximum velocity and maximum acceleration during outward and return stroke.

UNIT V: VELOCITY AND ACCELERATION ANALYSIS OF MECHANISMS   (8 Periods)

Instantaneous center of rotation, Centrode and Axode, Relative motion between two bodies, Kennedy theorem (Three centers in line), Instantaneous center method to determine angular

velocity of links and linear velocity of point, Relative velocity method to determine velocity and acceleration diagrams for four bar mechanism, Slider-crank mechanism and its inversions, Coriolis component of acceleration.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. S. S. Rattan, *Theory of Machines and Mechanisms*, Tata McGraw Hill Education, 4th Edition, 2016.
2. R.S. Khurmi, *Theory of machines,* S.Chand Publications, 14th Revised Edition, 2012

REFERENCE BOOKS:

1. Ballaney. P. L., *Theory of Machines and Mechanisms*, Khanna Publishers, 2005
2. Joseph Edward Shigley and John Joseph Uicker,Jr., *Theory of Machines and Mechanisms*, MGH, 4th Edition, New York, August 2013.
3. Bevan T, *Theory of Machines*, CBS Publishers and Distributors, New Delhi, 2002.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1		1							3		
CO2	3	2	1	1		1				1			3		
CO3	3	3	1	1		1							3		
CO4	3	3	1	1		1							3		
CO5	3	3	1	1		1				1			3		
CO6	3	3	1	1		1				1			3		
Average	3	2.8	1	1		1				1			3		
Correlation level	3	3	1	1		1				1			3		

Correlation Levels: 3– High   2 - Medium   1– Low

II B. Tech. - I Semester

(20BT30303) MANUFACTURING TECHNOLOGY

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Course on Material Science and Engineering

COURSE DESCRIPTION:

Introduction to manufacturing processes; casting, welding, cutting of metals, metalworking processes, forging processes, extrusion of metals, Sheet Metal Operations and Plastic Processing.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Design the gating system using the knowledge of foundry.

CO2. Demonstrate the knowledge on casting process, cast defects and operational procedures required in manufacturing the cast part.

CO3. Demonstrate the operational and procedural steps required in sheet metal process for manufacturing of sheet metal parts.

CO4. Demonstrate knowledge on welding processes required for weld parts.

CO5. Demonstrate knowledge on plastic processing and its sequences operations required for manufacturing a plastic product.

DETAILED SYLLABUS

UNIT I: FOUNDRY   (9 Periods)

Introduction, Sand mould making procedure, Types of Patterns, Pattern Materials, Pattern Allowances, Gates and Risers, Design of Gating systems, Properties of Moulding Sand, Testing of Moulding Sand, Moulding Machines, Cores - Types of Cores and Applications, Melting furnaces: Blast and Cupola Furnaces.

UNIT II: SPECIAL CASTING PROCESSES   (9 Periods)

Introduction, Special Casting Processes – Shell Moulding, Carbon Dioxide Moulding, Casting, Precision Investment Casting, Permanent Mould Casting, Full Mould Casting, Die Casting, Centrifugal casting, Continuous Casting, Cleaning and Finishing of Castings - Inspection and Testing of Castings, Casting Defects.

UNIT III: METAL FORMING PROCESSES AND SHEET METAL OPERATIONS

(9 Periods)

Metal forming processes: Introduction, Hot Working and Cold Working, Forging, Extrusion – Direct, Indirect and Tube Extrusion; Rolling – Types of Rolling Mills; Drawing –Rod, Wire and Tube Drawing.

Sheet Metal Operations: Shearing operations, Types of dies - Progressive Die, Compound Die and Combination Die, Special sheet metal forming processes – Explosive Forming, Magnetic Pulse Forming, Electro-Hydraulic Forming.

UNIT IV: METAL WELDING PROCESSES   **(9 Periods)**

Introduction, Classification of Welding Processes - Arc Welding, TIG Welding, MIG Welding, Submerged Arc Welding; Gas Welding Process – Types of Flames; Resistance Welding – Spot Welding, Seam Welding; Thermit Welding, Electron Beam Welding, Laser Beam Welding, Ultrasonic Welding, Welding Defects - Causes and Remedies; Destructive and Nondestructive Testing of Welds, Soldering and Brazing.

UNIT V: PLASTIC PROCESSING   **(9 Periods)**

Introduction, Plastics – Properties of Plastics, Additives in Plastics; Types of Plastics-Thermoforming Plastics, Thermosetting Plastics; Injection Moulding, Blow Moulding, Compression Moulding, Transfer Moulding, Extrusion Process, Calendering, Casting of Plastics, Plastic Product Design

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. P.N.Rao, *Manufacturing Technology*, Vol.1, TMH, 4th Edition, 2013

2. Kalpakjian, Serope, *Manufacturing Engineering and Technology*, Pearson Education, 7th Edition, 2014.

3. Hazra Choudary S.K. and Hazra Choudary A.K., *Elements of Workshop Technology*, Vol I, Media Promoters, 12th Edition, 2007.

REFERENCE BOOKS:

1. R.K.Jain, *Production Technology*, Khanna Publishers, 17th Edition, 2010.

2. Rosenthal, *Principles of Metal Castings*, McGraw-Hill Professional Publishing, 3rdEdition, 2013.

3. MikellP.Groover, Fundamentals *of Modern Manufacturing, Materials, Processes and Systems*, John Wiley and Sons, 9th Edition,2007.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1			1	1						3		
CO2	3	1				1	1						3		
CO3	3	1				1							3		
CO4	3	1				1	1						3		
CO5	3	1				1	1						3		
Average	3	1.4	1			1	1						3		
Correlation level	3	1	1			1	1						3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

II B. Tech. - I Semester

(20BT30304) STRENGTH OF MATERIALS

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Course on Basic Engineering Mechanics.

COURSE DESCRIPTION:

Analysis of stresses and strains of mechanical and structural components; Shear force and Bending moment of beams; Bending and Torsional stresses and Deflection beams.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Calculate stresses, strains and elastic constants of structural member subjected to external loading.

CO2. Draw shear force and bending momentum diagrams for beams and articulate stresses in beam structure under transverse loading.

CO3. Estimate the torsional shear stress and deflection on circular shafts subjected torsion and find principal stresses from mohr's circle diagram.

CO4. Analyze deflections of cantilever and simply supported beams using Double Integration method and Macaulay's method

DETAILED SYLLABUS:

UNIT I: SIMPLE STRESSES AND STRAINS   (8 Periods)

Types of Stresses, Strains, Hooke's law, Stress–Strain diagram, Working Stress, Factor of safety, Lateral strain, Poisson's ratio, Volumetric strain, Elastic Moduli and relationship between them, Bars of Varying section, Composite bars, Temperature stresses, Strain energy.

UNIT II: SHEAR FORCE AND BENDING MOMENT   (10 Periods)

 Concept of shear force and bending moment, S.F and B.M. diagrams for cantilever, Simply supported, Overhanging beams subjected to Point loads, Uniformly distributed loads, Uniformly varying loads and combination of these loads, Point of contra flexure.

UNIT III: BENDING AND SHEAR STRESSES   (10 Periods)

Theory of simple bending, Bending equation, Determination of flexural stresses for simple cases, Section modulus, Shear stress formula, Shear stress distribution across various beams & sections - Rectangular, Circular, Triangular, I, T sections.

UNIT IV: TORSION   (8 Periods)

Theory of pure torsion, Torsion Equation, Torsional moment of resistance, Polar section modulus; Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

Mohr's circle: Principal stresses and Mohr's circle for Biaxial Stresses – like stresses and unlike stresses; Mohr's circle for Complex Stresses.

UNIT - V: DEFLECTION OF BEAMS   **(9 Periods)**

Relationship between curvature, slope and deflection, Slope and deflection of cantilever and simply supported beams by Double Integration method and Macaulay's method

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. S.Ramamrutham, R.Narayanan, *Strength of Materials*, Dhanpat Rai Publications, 14th Edition, 2011.

2. Ferdinand L. Singer & Andrew, *Strength of Materials*" Addison Wesley publisher, 4th Edition, 1990.

REFERENCE BOOKS:

1. James M.Gere, Stephen Timoshenko, *Mechanics of Materials*, CBS Publications, 2nd Edition, 2004.

2. Beer, ýJohnston & Dewolf, *Mechanics of Materials*, Tata McGraw-Hill Education, 3rd Edition, 2004.

3. R.K.Rajput, *Strength of materials*, S. Chand Publications, Revised Edition, 2006.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	1									3		
CO2	3	3	2	1						1			3		
CO3	3	3	2	1						1			3		
CO4	3	3	2	1									3		
Average	**3**	**3**	**2**	**1**						**1**			**3**		
Correlation level	**3**	**3**	**2**	**1**						**1**			**3**		

    Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

II B. Tech. - I Semester

(20BT40133) STRENGTH OF MATERIALS LAB

(Common to CE and ME)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

Course on Mechanics of Solids/Strength of Materials.

COURSE DESCRIPTION:

Tests on strength of materials**:** Tension test; Compression test; Bending test; Shear test; Torsion test; Hardness test; Verification of Maxwell reciprocal theorem.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Evaluate the strength of materials such as steel, timber, metal using appropriate tools/techniques to solve complex problems in accordance with codal provisions ensuring safety.

CO2. Evaluate the load-deflection behavior for the materials used in beams and springs using appropriate tools/techniques to solve complex problems in accordance with codal provisions ensuring safety.

CO3. Perform material testing individually or in a team besides communicating effectively in written, oral and graphical forms on strength of materials.

LIST OF EXPERIMENTS:

1. Tension test on mild steel/HYSD bar

2. Compression test on wood/bricks/mild steel

3. Compression test on coiled spring

4. Tension test on coiled spring

5. Bending test on carriage spring

6. Brinell and Rockwell hardness tests

7. Charpy and Izod impact tests

8. Shear test on mild steel

9. Bending test on simply supported beam

10. Bending test on cantilever beam

11. Bending test on fixed beam

12. Bending test on continuous beam

13. Bending test on overhanging beam

14. Verification of Maxwell's reciprocal theorem

15. Torsion test on mild steel

Note: Minimum 12 experiments shall be conducted.

REFERENCE BOOKS/LABORATORY MANUALS:

SVEC 20 *Strength of Materials Lab Manual*.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		1	3	1		2							
CO2	2	3		1	3	1		2							
CO3									3	3					
Average	2	3		1	3	1		2	3	3					
Correlation level	2	3		1	3	1		2	3	3					

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT30331) COMPUTER AIDED MACHINE DRAWING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

A Course on Computer Aided Engineering Drawing.

COURSE DESCRIPTION:

Principles of machine drawing; Sectional views; Tolerances; Thread profiles; Bolted joints; Locking arrangements for nuts; Foundation bolts; Keys; Assembling and Disassembling; Part drawing.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to: .

CO1: Develop suitable drawing views of machine elements and simple parts using CAD software.

CO2: Draw assembled views for the part drawings with suitable tolerances using conventions and CAD software.

CO3: Work independently and Communicate about the assembly and part drawings through the computer aided drawings.

SYLLABUS:

1. **Exercises on machine drawing conventions using drafting software.**

   (Any three exercises)

   a) Conventional representation of materials.

   b) Conventional representation of machine components.

   c) Conventional representation sectional views.

   d) Conventional representation of limits, Fits and tolerances-form and positional tolerances and machining symbols.

   e) Conventional representation of dimensioning on the drawings.

2. **Exercises on drawing of machine elements and simple parts using drafting software.** (Any three exercises)

   a) Types of thread profiles-Square, Metric, ACME, Worm.

   b) Bolted joints-Hexagonal bolt and nut, Square bolt and nut.

   c) Locking arrangements for nuts-Locking by split pin, castle nut.

   d) Foundation bolts- Eye, Bent and Rag foundation bolts.

   e) Keys-Saddle key, Sunk key, Woodruff key, Kennedy key.

   f) Riveted joints-Single riveted lap joints, Butt joints with single cover straps(Chain and zigzag using snap head riveters).

3. **Assembly drawings.**

   Drawing of assembled views for the part drawings of the following, using conventions and easy drawing proportions. Representation of limits, fits and tolerances on assembly drawings. (Any three assembly drawings represented with dimensional and geometric tolerances)

   a) Stuffing box

   b) Pipe vice

   c) Eccentric

   d) Screw jack

4. **Part drawings.**

   Preparation of part drawing representing limits fits and tolerances and surface finish indications (Below mentioned part drawings ONLY).

   a) Petrol Engine connecting rod

   b) Single tool post

   c) Plummer block

   Note: Minimum 12 experiments shall be conducted.

REFERENCE BOOKS/LABORATORY MANUALS:

SVEC 20 *Computer Aided Machine Drawing Manual*.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	1									
CO2	3	3	2	1	3	1									
CO3									3	3					
Average	3	3	2	1	3	1			3	3					
Correlation level	3	3	2	1	3	1			3	3					

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

II B. Tech. - I Semester

(20BT30332) **MANUFACTURING TECHNOLOGY LAB**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

Course on Material Science and Engineering

COURSE DESCRIPTION:

Provides skill on sand testing; Pattern making; Mould preparation; Metal casting; Mechanical press working; Welding; Sheet metal works; Plastic moulding; Manufacturing of composites.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Develop cast components using sand/die/stir casting process considering societal and safety issues.

CO2. Develop welding joints using given welding process for the given design requirements considering societal and safety issues and simulate the welding process.

CO3. Develop sheet metal components with metal forming techniques using fly press and hydraulic press machines considering safety and societal issues.

CO4. Develop different components using plastic molding based on the given design requirements considering societal and safety issues.

CO5. Work independently or in teams to solve problems with effective communication

List of Experiments:

1. Determination of grain fineness number of sand using Sieve Shaker.

2. Determination of moisture content, clay content, permeability of moulding sand.

3. Preparation of green sand moulding arrangement and metal casing of solid pattern.

4. Preparation of green sand moulding arrangement and metal casing of split pattern.

5. Design and making a solid pattern using wood turn lathe.

6. Manufacturing of composites by using Stir-Casting.

7. Simulation of welding.

8. Development of Lap joint and butt joint using arc welding process.

9. Development of Lap joint and butt joint using gas welding process.

10. Development of Lap joint by TIG and MIG welding process.

11. Development of Lap joint by spot welding process.

12. Blanking and Piercing operations using fly press machine.

13. Deep drawing and Extrusion operations using hydraulic press.

14. Producing a component using injection moulding machine.

15. Producing a component using blow moulding machine.

Note: Minimum 12 experiments shall be conducted.

REFERENCE BOOKS/LABORATORY MANUALS:

SVEC20 Manufacturing Technology Lab Manual

Software used: Simulation software for welding

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1		1	1						3		
CO2	3	3	2	1	1	1	1						3		
CO3	3	3	2	1		1							3		
CO4	3	3	2	1		1	1						3		
CO5									3	3					
Average	**3**	**3**	**2**	**1**	**1**	**1**	**1**		**3**	**3**			**3**		
Correlation level	**3**	**3**	**2**	**1**	**1**	**1**	**1**		**3**	**3**			**3**		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

II B. Tech. - I Semester

(20BT3HS31) **SOFT SKILLS LAB**

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		-	1	2	2

PRE-REQUISITES: -

COURSE DESCRIPTION:

Body Language; Assertiveness; Goal Setting; Thinking Skills; Team Building; Conflict Management; Technical Report Writing; Résumé Writing; Group Discussions; Interview Skills; Interpersonal Skills; Etiquette.

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge of career skills by examining and applying the styles and strategies of Goal Setting, Thinking Skills, and Etiquettes.

CO2. Analyze the limitations and possibilities of favourable situations by applying the skills of Body Language and demonstrate through Assertiveness, and Interpersonal Skills.

CO3. Apply appropriate soft skills by analyzing the problem situations that arise in professional career through demonstrating remedies in Conflict Management.

CO4. Demonstrate ability to function effectively as an individual and as a member in diverse teams examining and applying soft skills in Interviews, Group Discussion and Team Building.

CO5. Apply appropriate speaking and writing techniques in preparing documents and to communicate effectively by examining and demonstrating knowledge in Technical Report Writing and Résumé Writing.

List of Exercises:

*First TEN exercises are mandatory among the following:

1. **Body Language**

   Types of Body Language – Parts of Body – Facial Expressions – Eye Contact Insights – Good Posture

2. **Assertiveness**

   Communications Styles – Benefits – Being Unassertive – Role Playing

3. **Goal Setting**

   Seven Steps of Goal Setting – Self Motivation – Personal Goal Setting – Setting Career Goals

4. **Thinking Skills**

   Positive Thinking – Creative Thinking – Lateral Thinking – Logical Thinking – Intitutive Thinking

5. **Team Building**

   Learning Activities – Management Essentials – Team Building Scenarios

6. **Conflict Management**

   Ways of Resolving Conflict – Personality Types and Conflict – Conflict Resolution Process – Team Conflict

7. **Technical Report Writing**

   Objectives – Formats – Writing Styles

8. **Résumé Writing**

   Structure and Presentation – Planning – Defining Career Objectives – Projecting One's Strengths and Skills – Cover Letter – Formats and Styles

9. **Group Discussions**

   Types of GD – Dos and Don'ts – Dynamics of GD – Intervention – Summarization Techniques

10. **Interview Skills**

    Planning – Opening Strategies – Answering Strategies – Tele Conferencing – Video Conferencing

11. **Interpersonal Skills**

    Starting a Conversation – Responding to a Conversation – Conversation Examples – Body Language – Role Play

12. **Etiquette**

    Basic Social Etiquette – Telephone Etiquette – Dinning Etiquette – Conference Etiquette

TEXTBOOKS:
1. Soft Skills Lab Manual, SVEC.

REFERENCE BOOKS:
1. R. C. Sharma & Krishna Mohan, *Business Correspondence and Report Writing*, Tata McGraw-Hill Publishing Company Limited, 3rd edition, New Delhi, 2012.

SUGGESTED SOFTWARES:
1. KVAN SOLUTIONS
2. Learning to Speak English 8.1, The Learning Company – 4 CDs.
3. English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
4. Language in Use 1, 2 & 3.
5. Cambridge Advanced Learner's Dictionary - 3rd Edition.
6. Let's Talk English, Regional Institute of English South India.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	1	-	-	-	-	1	-	-			
CO2	3	2	-	-	1	-	-	-	-	3	-	-			
CO3	2	2	-	-	3	-	-	-	-	1	3	-			
CO4	2	2	-	-	2	-	-	-	3	2	-	-			
CO5	1	1	-	-	2	-	-	-	-	3	-	-			
Average	2.2	1.8	-	-	1.8	-	-	-	3	2	3	-			
Correlation level	2	2	-	-	2	-	-	-	3	2	3	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT3MC01) **ENVIRONMENTAL SCIENCE**
(Mandatory Course)
(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	-	30	2	-	-	-

PRE-REQUISITES: -

COURSE DESCRIPTION:
Natural resources; Ecosystems; Biodiversity; Environment pollution and control; Social issues and environment; Human population and environment.

COURSE OUTCOMES:
After successful completion of this course, the students will be able to:

CO1. Analyze natural resources to solve complex environmental problems and natural resource management considering society, environment and sustainability.

CO2. Analyze ecosystems and biodiversity to solve complex environmental problems by following environmental ethics considering society, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze various types of pollution and their control measures to solve environmental problems through appropriate tools and techniques following latest developments considering society, ethics, environment and sustainability.

CO4. Analyze social issues and its impact on environment, environmental acts to solve complex environmental problems considering society, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze human population and its impact on environment to solve complex environmental problems through team work and using appropriate tools and techniques considering ethics, society, environment and sustainability.

DETAILED SYLLABUS:

UNIT I: NATURAL RESOURCES   (07 periods)
Multidisciplinary nature of environment; Natural Resources: Renewable and non-renewable resources; Forest, Water, Mineral, Food and Energy resources -Causes, Effects, Remedies, Case studies; Role of an individual in conservation of natural resource and equitable use of resources for sustainable lifestyles.

UNIT II: ECOSYSTEMS AND BIODIVERSITY   (07 periods)
Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem - Producers, Consumers, Decomposers; Food chains, Food webs, Ecological pyramids – Types; Characteristic features, Structure and functions of forest ecosystem, Desert ecosystem, Aquatic ecosystem.
Biodiversity: Concept and value of biodiversity, Role of biodiversity in addressing new millennium challenges, Hot spots of biodiversity, Threats to biodiversity, Man-wild life conflicts, Endemic, Endangered and extinct species of India, Conservation of biodiversity – In-situ and ex-situ.

UNIT III: ENVIRONMENTAL POLLUTION AND CONTROL   (06 periods)
Causes, Adverse effects and control measures of pollution - Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, Nuclear pollution, Solid waste management – Urban waste, industrial waste; Latest developments in pollution control, Hazards and disaster management – Floods, Earthquakes, Tsunamis, Case studies.

UNIT IV: SOCIAL ISSUES AND THE ENVIRONMENT   **(06 periods)**
Sustainable development, Urban problems related to energy, Environmental ethics –Issues, Solutions; Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and case studies, Wasteland reclamation, Consumerism and waste products, Concept of green technologies, Environment justice: National Green Tribunal and its importance; Environment protection act, Air act, Water act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation, Public environmental awareness.

UNIT V: HUMAN POPULATION AND THE ENVIRONMENT   **(04 periods)**
Population growth, Population characteristics and variation among nations, Population explosion, Family welfare programme, Environment and human health, Human rights, Value education, HIV/AIDS, Women and child welfare, Role of information technology in environment and human health; Case studies - Field Work/Assignment/Seminar on Environmental assets – Water bodies/Forest/Grassland/Hill/Mountain.

                                                            Total Periods: 30

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:
1. Anubha Kaushik and Kaushik, C. P., *Perspectives in Environmental Studies*, New Age International (P) Ltd. Publications, 6th Edition, 2018.
2. Erach Barucha, *Environmental Studies,* Orient Blackswan, 3rd Edition, 2021.

REFERENCE BOOKS:
1. Cunningham, W. P. and Cunningham, M. A., *Principles of Environmental Science*, Tata McGraw-Hill Publishing Company, New Delhi, 8th Edition, 2016.
2. Benny Joseph, *Environmental Studies*, Tata McGraw-Hill, 2nd Edition, 2009.
3. Anji Reddy, M., *Text Book of Environmental Science and Technology*, BS Publications, Revised Edition, 2014.
4. Rajagopalan, R., *Environmental Studies*, Oxford University Press, 3rd Edition, 2015.

ADDITIONAL LEARNING RESOURCES:
1. Chauhan, B. S., *Environmental Studies*, University Science Press, 2nd Edition, 2018.
2. Botkin, D. B. and Keller, E. A., *Environmental Science: Earth as a Living Planet*, John Wiley & Sons, 9th International Student Edition, 2014.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	2	-	1	1	-	-	-	1	-			
CO2	3	3	-	2	-	1	1	1	-	1	-	-			
CO3	3	3	-	2	1	1	1	1	-	-	-	1			
CO4	3	3	-	3	-	1	1	1	-	1	-	-			
CO5	3	3	-	2	1	1	1	1	1	-	-	-			
Average	3	3	-	2.2	1	1	1	1	1	1	1	1			
Correlation level	3	3	-	2	1	1	1	1	1	1	1	1			

      Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

II B. Tech. – II Semester

(20BT40301) DYNAMICS OF MACHINERY

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Courses on Basic Engineering Mechanics & Kinematics of Machinery.

COURSE DESCRIPTION:

Force analysis; Clutches, brakes and dynamometers; Gyroscopic couple, Turning moment diagrams, flywheel design; Analysis and balancing of shaking forces in machines; Governors; Vibrations, single degree, Multi degrees of freedom vibrations, spring mass systems; transmissibility of forces, Dunkerley's method, Rayleigh's method; Whirling of shafts; isolation of systems.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1.   Analyze the mechanism, clutches, brakes and dynamometers for the forces acting on it during its operation and calculate the forces involved in it.

CO2.   Determine the effect of gyroscopic couple on transport vehicles for stabilization.

CO3.   Analyze turning moment diagram for fluctuations of energy and flywheel for controlling the speed variations in machines.

CO4.   Analyze the governors and calculate the forces acting on it during its operation.

CO5.   Analyze the unbalanced forces of masses in engines using analytical and graphical methods.

CO6.   Calculate the frequency of vibration in beams and rotating shafts.

UNIT I: FORCE ANALYSIS, CLUTCHES, BRAKES AND DYNAMOMETER

(10 Periods)

STATIC AND DYNAMIC ANALYSIS: Static force analysis of four bar mechanism and slider crank mechanism by principle of superposition; Dynamic force analysis: Four-bar mechanism

Clutches: Friction clutches- Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch;

Brakes and Dynamometers: Simple block brakes-Single block, Pivoted block, Double block; simple Band brake, Differential Band Brake, Band and Block Brake, internal expanding brake. Dynamometers–absorption and transmission types.

UNIT II: GYROSCOPE & TURNING MOMENT DIAGRAMS   (9 Periods)

Gyroscope: Gyroscopic couple, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships; Turning moment diagrams and Fly wheels: Turning moment diagrams for steam engine, IC Engine and multi cylinder engine, Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design, Fly wheels for Punching machines.

UNIT III: GOVERNORS: (8 Periods)

Introduction to Governors, Watt, Porter and Proell governors; spring loaded governors – Hartnell and Hartung governors with auxiliary springs; Sensitiveness, isochronism and hunting; Effort and power of a governor.

UNIT IV: BALANCING OF MASSES: (9 Periods)

Balancing of Rotating Masses - Single and several masses in Single and multiple planes; Balancing of Reciprocating Masses - Primary and complete balancing of reciprocating parts of an engine, Analytical and graphical methods, Unbalanced forces and couples –V Engine balancing, Multi cylinder inline engine balancing and radial engine balancing.

UNIT V: VIBRATIONS: (9 Periods)

Classification, Free and forced vibration of single degree of freedom system, Role of damping, whirling of shafts and critical speeds, Simple problems on free, forced and damped vibrations, Vibration Isolation & Transmissibility, Transverse vibrations of beams with concentrated and distributed loads, Dunkerly's method, Rayleigh's method, Torsional vibrations - two and three rotor systems.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. S.S.Rattan, *Theory of Machines and Mechanisms*, Tata McGraw Hill Publishers, 4th Edition, 2016.

2. R.S Khurmi, *Theory of Machines*, S.Chand Publications, 14th Revised Edition, 2012.

REFERENCE BOOKS:

1. Joseph Edward Shigley and John Joseph Uicker, Jr. *Theory of Machines and Mechanisms*, Second Edition, MGH, New York.

2. Ballaney P L, Theory of Machines and Mechanisms, Khanna Publishers, New Delhi,2005

3. Bevan T, *Theory of Machines*, CBS Publishers and Distributors, NewDelhi, Third Edition,2002.

4. J.S. Rao and R.V. Dukkipati, *Mechanism and Machine Theory*, New age International, Second Edition, 2007.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1		1							3		
CO2	3	3	1	1		1							3		
CO3	3	3	1	1		1							3		
CO4	3	3	1	1		1							3		
CO5	3	3	1	1		1							3		
CO6	3	3	1	1		1							**3**		
Average	**3**	**3**	1	1		1							**3**		
Correlation level	**3**	**3**	**1**	**1**		**1**							**3**		

Correlation Levels: **3– High** **2 - Medium** **1– Low**

II B. Tech. – II Semester

(20BT40302) ENGINEERING METROLOGY AND MACHINE TOOLS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Manufacturing Technology, Applied Physics, Computer Aided Machine Drawing

COURSE DESCRIPTION:

Theory of Metal Cutting; Geometry of Cutting Tools; Merchants Force Diagram; Lathe Machine-Principle of Operation; Tools; Multi spindle lathes; shaping; slotting and planning machines; drilling; boring; jig boring; milling machine Specifications; grinding; lapping; honing; Limits, Fits and Tolerances; Limit Gauges and Gauge Design; Comparators; Linear Measurement; Measurement of Angles and Tapers; Flatness Measurement, Surface Roughness Measurement;

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the mechanics of metal cutting to estimate cutting forces and machining parameters.

CO2. Demonstrate the basic structure, mechanism and operations of lathe, drilling and boring machines.

CO3. Demonstrate the basic structure, mechanism and operations of milling and grinding machines.

CO4. Apply limits, fits and tolerances for limit gauges and dimensional measurements for quality products.

CO5. Analyze surfaces, screw threads and gears with suitable instruments and methods for their quality.

DETAILED SYLLABUS:

UNIT I: MECHANICS OF METAL CUTTING   (9 Periods)

Introduction, Elements of metal cutting, H A Z , Geometry of single point tools, Chip formation and types of chips; Mechanics of orthogonal cutting, Shear angle, Velocity relationship, shear strain; Merchant's force diagram, Cutting forces, cutting speeds, Feed, Depth of cut, tool life, tool failure, coolants, Machinability, tool materials.

UNIT II: LATHE, DRILLING AND BORING MACHINES   (9 Periods)

Engine lathe, Principle of working, types of lathes, specifications of lathe, Taper turning methods, Lathe work and tool holding devices, Capstan and Turret lathes, Drilling and Boring Machines, Principles of working, specifications, Types, operations performed, Twist drills, Types of Boring machines and applications; Shaping, slotting and planning machines –Principles of working, Specifications, Operations performed.

UNIT III: MILLING AND GRINDING MACHINES   (9 Periods)

Milling Machines: Principle of working, Types of milling machines, Methods of indexing.

Grinding Machines: Theory of grinding – Classification of grinding machines, Types of abrasives, bonds, Selection of a grinding wheel. Lapping, honing and broaching, Tapping, Reaming Operations; Introduction to Non-traditional machining.

UNIT IV: LIMITS, FITS AND TOLERANCES   (9 Periods)

Limits, fits and tolerances: Unilateral and bilateral tolerance system, hole and shaft basis system; Interchangeability and selective assembly; Limit Gauges- Taylor's principle, GO and NO-GO gauges

Linear and Angular Measurement: Slip gauges; Measurement of angles- Bevel protractor, and Sine bar; Measurement of flat surfaces, Surface plates, Optical flat and Auto collimator.

UNIT V: SURFACE AND SCREW THREAD MEASUREMENTS   (9 Periods)

Surface Roughness Measurement: Roughness, Waviness, Methods of measurement of surface finish -CLA, RMS, Rz Values, Talysurf.

Screw thread and Gear measurement: Introduction to Screw threads, Errors in Screw threads, Measurement of Pitch diameter by three wire method; Gear measurement – Nomenclature, Measurement of gear elements by Parkinson gear tester.

Comparators: Introduction to comparator, Characteristics, Classification of comparators.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Hazra Choudary S.K. and Hazra Choudary A.K., *Elements of Workshop Technology*, Vol II, Media Promoters, 12th Edition, 2007.

2. M. Mahajan, *Engineering Metrology*, DhanpatRai and Co., 2nd edition, 2013

3. A.B. Chattopadhyay, *Machining and Machine Tools*, Wiley, 2nd Edition, 2017.

4. N.V Raghavendra, L.Krishnamurthy, *Engineering Metrology and Measurements*, Oxford University Publisher, 2013.

REFERENCE BOOKS:

1. H.M.T. (Hindustan Machine Tools), *Production Technology*, Tata Megrawhill Education, 2013.

2. Vijay K Jain, *Advanced machining processes*, Allied publishers, 2012.

3. R.K. Jain, *Production Technology*, Khanna Publishers, 17th Edition, 2012.

4. Thomas G. Beckwith, Roy D. Maragoni, John H. Lienhard V, *Mechanical Measurements*, Pearson Education International Publishers, 6th edition, 2013 .

5. Anand K Bewoor, Vinay A Kulkarni, *Metrology & Measurement*, McGraw Hill, 1st Edition, 2013.

6. B .C.Nakra& K .K .Choudhary, Instrumentation , Measurement & Analysis, Tata Mcgraw Hill, 6th edition, 2011.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1										3		
CO2	3	1											3		
CO3	3	1											3		
CO4	3	1	1										3		
CO5	3	3	1										3		
Average	3	1.8	1										3		
Correlation level	3	2	1										3		

Correlation Levels: 3– High   2 - Medium   1– Low

II B. Tech. – II Semester

(20BT40303) FLUID MECHANICS AND MACHINES

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

A course on Engineering Mechanics.

COURSE DESCRIPTION:

Properties of Fluids; Pressure Measurements; Types of flow; One-dimensional steady flow energy & momentum Equations; Flow measurements; Fluid flow; Impact of jets on stationary & moving plate; Hydraulic turbines & Pumps Components and its performance.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Calculate the properties of fluids using the principles of fluid properties.

CO2. Apply the principles of fluid kinematics and dynamics and determine the flow properties of the fluid.

CO3. Calculate the loss of energy in fluid flows using the principles of fluid flows.

CO4. Evaluate the hydrodynamic force acting on jets and the performance of Hydraulic turbines under various loading and head conditions.

CO5. Evaluate the performance pumps under various head conditions and analyze its performance characteristics curves.

DETAILED SYLLABUS:

UNIT I: PROPERTIES OF FLUIDS AND PRESSURE MEASUREMENT   (9 periods)

Properties of Fluids: Dimensions and units, Physical properties of fluids - Density, Specific weight, Specific volume, Specific gravity, Viscosity, Surface tension, Capillarity, Buoyancy, Vapor pressure and its influence on fluid motion, Bulk modulus, compressibility; Types of fluids.

Pressure Measurement: Absolute Pressure, Gauge Pressure, Atmospheric Pressure, Vacuum Pressure, Manometers types - Piezometer, U-tube, Single column manometer and Differential manometers.

UNIT II: FLUID KINEMATICS AND DYNAMICS   (9 periods)

Kinematics: Classification of flow, the continuity equation for three dimensional flow (Cartesian coordinate only), Types of flow lines - stream, streak and path lines.

Dynamics: Equations of motion- Euler's and Bernoulli's equations, Application of Bernoulli's equations, Momentum equation and its application to pipe bend, moment of momentum equations.

Measurement of Flow: Venturimeter, Orifice meter, Rotameter and Pitot tube.

UNIT III: FLUID FLOWS   (9periods)

Flow Over Flat Plate: Boundary Layer- Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer; submerged objects – drag and lift.

Flow Through Pipes: Reynold's experiment, Darcy Weisbach equation, Chezy's equation, Minor losses in pipes, Equivalent pipe, Pipes in series and pipes in parallel, Total energy line and Hydraulic Gradient Line.

UNIT IV: IMPACT OF JETS AND HYDRAULIC TURBINES   (9 periods)

Impact of Jets: Force exerted on stationary and moving plates- vertical, inclined and curved, Velocity diagrams, Work done and Efficiency.

Hydraulic turbines: Classification of turbines -Impulse, Reaction turbines; Pelton wheel, Francis turbine, Kaplan turbine – Construction, Working principle, velocity triangles and work done, Efficiencies; Draft tube theory, Types of draft tubes; Performance of hydraulic turbines -Geometric similarity, Specific speed, Unit quantities, Characteristic curves, Governing of turbines, Water hammer, Cavitation.

UNIT V: HYDRAULIC PUMPS   (9 periods)

Centrifugal pumps: Classification, Single stage Centrifugal pump - Working Principle, Work done and Efficiencies; Multi stage Centrifugal pump, Pumps in series, Pumps in parallel, Characteristic curves, Specific speed.

Reciprocating pumps: Construction and Working Principle of single acting, Double acting reciprocating pumps, Discharge, Work done, Slip, Indicator diagrams, Air vessels.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. R.K. Rajput, *Fluid Mechanics and Hydraulic Machines*, S. Chand, 4th Edition, 2013.

2. Modi and Seth, *Fluid Mechanics and Hydraulic Machinery*, Standard book house, 17th Edition, 2011.

REFERENCE BOOKS:

1. R.K. Bansal, *Fluid Mechanics and Hydraulic Machinery*, Laxmi publications, 9th Edition, 2017.

2. K Subramanya, Fluid *Mechanics and hydraulic machines*, Mc Graw Hill Education, 2nd Edition, 2011.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1										3	
CO2	3	3	1	1										3	
CO3	3	3	1	1										3	
CO4	3	3	1	1										3	
CO5	3	3	1	1										3	
Average	3	3	1	1										3	
Correlation level	3	3	1	1										3	

Correlation Levels: 3– High   2 - Medium   1– Low

II B. Tech. – II Semester

(20BT40304) THERMAL ENGINEERING – I

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

A course on Engineering Thermodynamics.

COURSE DESCRIPTION:

Introduction to Internal Combustion (IC) engines; Components and working of 2-stroke and 4-stroke engines; Combustion phenomena in spark ignition and compression ignition engines; Performance parameters of an internal combustion engine; Gas turbines; Jet propulsions and Rocket propulsions; Reciprocating compressors; Rotary compressors; Concept of steam power cycles.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1: Analyze the combustion process in IC engines and calculate the Performance parameters of IC Engines under various testing conditions.

CO2: Analyze the gas turbines and jet propulsions using PV and TS diagrams and solve problems on it.

CO3: Calculate the performance parameters of air compressors using principles of air compressors.

CO4: Analyze the steam power cycles using PV and TS diagrams and calculate the thermal efficiencies of these cycles.

DETAILED SYLLABUS:

UNIT I: INTERNAL COMBUSTION ENGINES (10 Periods)

Introduction, Classification of IC Engines, Engine components, Working of two stroke and four IC engines, Valve and port timing diagrams; Air-fuel and actual cycles; Combustion in Spark Ignition (SI) Engines **-** Stages of combustion in SI engines, Factors influencing the flame speed, Phenomenon of knock in SI engines; Combustion in Compression Ignition (CI) Engines **-** Stages of combustion in CI engines, Factor affecting delay period; Phenomenon of knock in C.I engine, comparison of knock in SI and CI engines.

UNIT II: PERFORMANCE OF INTERNAL COMBUSTION ENGINES (9 Periods)

Performance parameters - Brake power, indicated power, Friction power, Mean effective pressure, Specific fuel consumption, Engine efficiencies, Performance calculations, Heat balance sheet; Measurement of brake power; Measurement of indicated power; Measurement of Friction power - Willian's line method, Morse test, motoring test and retardation test; Air and fuel measurement.

UNIT III: GAS TURBINES AND JET PROPULSIONS (9 Periods)

Gas Turbines: Classification of Gas Turbines, Components of simple gas turbine plant-Ideal Gas Turbine Cycle and its deviations with actual cycle; Turbine Work and Efficiency of Simple Gas Turbine Cycle, Condition for Optimum Pressure Ratio, Methods to improve Turbine Work - Inter cooling and Reheating; Methods to improve efficiency -Regeneration.

Jet Propulsion: Introduction, Classification of Jet Propulsion devices, Working of Air breathing engines- Turbojet Engine, Turbo Prop Engine, Ram Jet Engine and Pulse Jet Engine; Introduction to Rocket Engine.

UNIT IV: AIR COMPRESSORS   (9 Periods)

Introduction, Classification, Reciprocating Compressors - Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors; Rotary compressor - Working principles of Roots blower, Vane type Blower, Centrifugal Compressor, Axial Flow Compressors.

UNIT V: STEAM POWER CYCLES   (8 Periods)

Carnot Cycle, Rankine Cycle-Schematic Layout, Thermodynamic Analysis; Effect of operating variables on the performance, Reheating and Regeneration, Modified Rankine Cycle; Low temperature power cycles, Binary vapour cycle and Cogeneration.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. R.K.Rajput, *Thermal Engineering*, Laxmi Publication, 9th Edition,2013.

2. V.Ganesan,*I.C.Engines*,TMH,3rdEdition,2010

REFERENCE BOOKS:

1. M.L. Mathur & R. P. Sharma, *Internal combustion engines*, Dhanpat Rai & Sons, 8thEdition, 2014.

2. R. S. Khurmi & J.S. Gupta, *Thermal Engineering*, S.Chand, 15th Edition, 2015.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1										3	
CO2	3	3	1	1										3	
CO3	3	3	1	1										3	
CO4	3	3	1	1										3	
Average	3	3	1	1										3	
Correlation level	3	3	1	1										3	

3. **Correlation Levels: 3– High   2 - Medium   1– Low**

II B. Tech. – II Semester

(20BT4BS01) MATERIAL SCIENCE

(Open Elective-1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Introduction to material science and engineering; properties, processing and applications of composite materials; smart materials; nano and biomimetic materials; emerging materials.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1.   Demonstrate the basic knowledge on different materials.

CO2.   Analyze the structure and properties of various composites used in commercial aircraft, marine grade sandwich and wind turbine blades using different methods.

CO3.   Demonstrate the basic properties of piezoelectric, magneto-rheostatic, electro-rheostatic, and shape memory alloys used for different applications.

CO4.   Analyze the properties of nano materials for NEMS & biomimetic materials for dolphin sound wave technology and apply Lithographic technique for deposition of nanomaterials.

CO5.   Demonstrate the processing and properties of functionally graded materials for nanoelectronic and optoelectronic applications.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO MATERIAL SCIENCE AND ENGINEERING   (7 Periods)

Introduction - material science and engineering, engineering materials and advanced materials, modern materials needs, processing and properties of metals, polymers and ceramics (Qualitative).

UNIT II: COMPOSITE MATERIALS   (10 Periods)

Composite materials – classification based on matrix phase and dispersed phase – functions of matrix phase and dispersed phase – polymer matrix composites and structural composites – applications (commercial aircraft, marine grade sandwich and wind turbine blades), basic composite manufacturing methods: prepeg-up process, wet lay –up (hand lay –up) process - advantages and limitations of composites.

UNIT III: SMART MATERIALS   (08 Periods)

Smart materials – piezoelectric, magneto-rheostatic (MR) and electro-rheostatic (ER) materials - shape memory alloys (SMA): characteristics, preparation of SMA, applications in different fields, advances in smart materials.

UNIT IV: NANO AND BIOMIMETIC MATERIALS   (10 Periods)

Nanomaterials: Low dimensional structures and energy quantization, Fabrication of nano materials: Lithographic technique using photons, properties of nano materials (metallic,

semiconducting and magnetic) and applications (renewable energy and nano electro-mechanical systems (NEMS).

Biomimetic materials – Introduction- classification and their applications of biomimetic materials (Lotus effect, Dolphin sound wave technology and viper as a model in its defence)

UNIT V: EMERGING MATERIALS   (10 Periods)

Functionally graded materials (FGM): Types, properties, processing and potential applications, functionally graded fiber cement: mixture design, processing and as structural material, Functionally Graded Nanoelectronic, Optoelectronic and Thermoelectric Materials (Qualitative) and its applications.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. K M Gupta, *Engineering Materials – Research, Applications and Advances*, CRC press (Taylor & Francis group), 2015.

2. William D Callister, David G Rethwisch, *Materials Science and Engineering*, Wiley, 9th edition, 2014.

REFERENCE BOOKS:

1. Sulabha K Kulkarni*, Nanotechnology: Principles and practices*, Springer, 9th edition, 2014.

2. Charles P. Poole and Frank J. Owens, *Introduction to Nanotechnology*, Wiley-Interscience, May 2003.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-			
CO2	3	3	-	-	2	3	-	-	-	-	-	-			
CO3	3	-	-	-	-	2	-	-	-	-	-	-			
CO4	3	-	-	-	-	3	-	-	-	-	-	-			
CO5	3	-	-	-	-	2	-	-	-	-	-	-			
Average	3	3	-	-	2	2.5	-	-	-	-	-	-			
Correlation level	3	3	-	-	2	3	-	-	-	-	-	-			

Correlation Levels: 3– High   2 - Medium   1– Low

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II B. Tech. – II Semester

(20BT4HS02) BUSINESS COMMUNICATION AND CAREER SKILLS

(Open Elective-1)

(Common to CE, ME, EEE, ECE and EIE)

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Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: –

COURSE DESCRIPTION:

Nature and Scope of Communication, Corporate Communication, Writing Business Messages & Documents, Careers & Résumés, and Interviews.

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge of professional communication by analyzing and applying the styles and strategies of business communication in Communication Networks, Interpersonal, and Informal communication.

CO2. Analyze the limitations of communication by applying and demonstrating corporate and cross-cultural communication strategies effectively in a business context and Crisis Management situations.

CO3. Apply appropriate strategies and techniques in writing business messages, business letters, and résumé for effective professional communication and career building.

CO4. Demonstrate appropriate communication techniques and answering strategies by analyzing the expectations during presentations and interviews.

DETAILED SYLLABUS:

UNIT I: NATURE AND SCOPE OF COMMUNICATION (9 Periods)

Introduction – Communication Basics – Functions of Communication – Communication Networks – Interpersonal Communication – Informal Communication – Communication Barriers – Roles of a Manager.

UNIT II: CORPORATE COMMUNICATION (9 Periods)

Introduction – Corporate Communication – Cross-Cultural Communication; Concept & Styles – Corporate Communication Strategy – Corporate Citizenship – Crisis Communication: Case Study.

UNIT III: WRITING BUSINESS MESSAGES & DOCUMENTS (9 Periods)

Introduction – Importance of Written Business Communication – Types of Business Messages – Five Main Stages of Writing Business Messages – Business Letter Writing – Kinds of Business Letters – Common Components of Business Letters – Strategies for Writing the Body of a Letter.

UNIT IV: CAREERS AND RÉSUMÉS (9 Periods)

Introduction – Career Building – Résumé Formats: Traditional, Electronic and Video Résumé – Sending Résumés – Follow-up Letters – Business Presentations and Speeches: Planning - Structuring – Organizing – Delivery.

UNIT–V: INTERVIEWS (9 Periods)

Introduction – General Preparation for an Interview – Success in an Interview – Important Non-verbal Aspects – Types of Interviews – Styles of Interviewing – Types of Interviewing – Online Recruitment Process.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Meenakshi Raman, and Prakash Singh, *Business Communication*, Oxford University Press, New Delhi, 2nd edition, 2012.

2. Neera Jain, and Sharma Mukherji, *Effective Business Communication*, Tata Mc Graw–Hill Education, Pvt. Ltd., New Delhi, 2012.

REFERENCE BOOKS:

1. Courtland L. Bovee et al., *Business Communication Today*, Pearson, New Delhi, 2011.

2. Krizan, *Effective Business Communication*, Cengage Learning, New Delhi, 2010.

ADDITIONAL LEARNING RESOURCES

1. http://www.career.vt.edu/interviewing/TelephoneInterviews.html

2. http://job-search-search.com/interviewing/behavioral_interviews

3. https://goo.gl/laEHOY (dealing with complaints)

4. http://www.adm.uwaterloo.ca/infocecs/CRC/manual/resumes.html

5. https://goo.gl/FEMGXS

6. http://www.resumania.com/arcindex.html

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	2	-	-	-	-	3	-	-			
CO2	1	2	-	-	2	-	-	-	-	3	1	-			
CO3	1	-	-	-	2	-	-	-	-	3	-	-			
CO4	1	2	-	-	2	-	-	-	-	3	-	-			
Average	1.5	1.66	-	-	2	-	-	-	-	3	-	-			
Correlation level	1	2	-	-	2	-	-	-	-	3	1	-			

Correlation Levels: **3– High** **2 - Medium** **1– Low**

II B. Tech. – II Semester

(20BT4HS04) ENTREPRENEURSHIP FOR MICRO, SMALL AND MEDIUM ENTERPRISES

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE REQUISITE: --

COURSE DESCRIPTIONS:

Introduction to entrepreneurship; Idea generation and formulation of business plans; Micro small and medium enterprises; Institutional finance; Women & rural entrepreneurship.

COURSE OUTCOMES:

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

CO1.   Demonstrate the concepts of Entrepreneurship and Entrepreneur.

CO2.   Analyze the Ideas and Business Plans for promoting entrepreneurships and start-ups.

CO3.   Demonstrate the environment of Micro, Small and Medium Enterprises.

CO4.   Analyze the various sources of Institutional Finance for promoting entrepreneurship.

CO5.   Demonstrate the encouragement for Women and Rural Entrepreneurship.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO ENTREPRENEURSHIP   (9 Periods)

Introduction to Entrepreneurship - Concept of Entrepreneurship – Growth of Entrepreneurship in India **-** Factors affecting entrepreneurship growth - Characteristics of an Entrepreneur – Functions of Entrepreneur – Types of Entrepreneurs – Distinction between an Entrepreneur and a manager.

UNIT II: IDEA GENERATION AND FORMULATION OF BUSINESS PLANS

(9 Periods)

Sources of Ideas – Methods of idea generation – Steps in Setting up of a Small Business Enterprise – Concepts of Business Plan – Significance – Formulation of Business Plan – Common Errors in the Formulation of Business Plan – The role of incubation centers for promoting entrepreneurships and start-ups.

UNIT III: MICRO SMALL AND MEDIUM ENTERPRISES   (9 Periods)

Meaning and Definition of Micro, Small and Medium Enterprises – Essential Features – Scope and Objectives of Micro Small and Medium Enterprises – relationship between Micro and Macro Enterprises- Problems of Micro Small and Medium Enterprises.

UNIT IV: INSTITUTIONAL FINANCE   (9 Periods)

Institutional Finance **–** Need – Scope - Services - Various Institutions offering Institutional support: – Small Industries Development of Bank of India (SIDBI), State Industrial

Development Corporations (SIDC) – Small Industries Development Organization (SIDO) – Small Industries Service Institutes (SISIs) – State Financial Corporation (SFC) - National Institute of Entrepreneurship and Small Business Development (NIESBUD) – Micro Units Development and Refinance Agency Bank (MUDRA).

UNIT V: WOMEN & RURAL ENTREPRENEURSHIP   **(9 Periods)**

Concept of Women entrepreneurs - Functions of Women entrepreneurs - Growth of women entrepreneurship in India - Challenges of Women entrepreneurs - Programmes for supporting women entrepreneurship – **Rural Entrepreneurship:** – Meaning, Need for Rural entrepreneurship, Problems of rural entrepreneurship, Role of NGOs, Role of Bharatiya Mahila Bank for encouraging Women Entrepreneurs – Micro Finance & Self Help Groups (Basic Concepts).

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Dr.S.S.Khanka*, Entrepreneurial Development*, S. Chand and Company Ltd, Revised edition, 2012.

2. MadhurimaLall & ShikhaSahai, *Entrepreneurship*, Excel Books India, 4th edition, 2014.

REFERENCE BOOKS:

1. Nandan, H., *Fundamentals of Entrepreneurship*, PHI Learning Pvt. Ltd., New Delhi, 3rd edition, 2013.

2. Bholanath Dutta, *Entrepreneurship Management* – Text and Cases, Excel Books, 3rd edition, 2015.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-			
CO2	-	3	-	-	-	-	-	-	-	-	2	-			
CO3	3	2	-	-	-	-	-	-	-	2	-	-			
CO4	-	3	-	-	-	-	-	-	-	-	2	-			
CO5	3	-	-	-	-	-	-	-	-	-	2	-			
Average	3	2.66	-	-	-	-	-	-	-	2	2	-			
Correlation level	3	3	-	-	-	-	-	-	-	2	2	-			

    3. **Correlation Levels:**   **3– High**   **2 - Medium**   **1– Low**

II B. Tech. – II Semester

(20BT4HS06) GERMAN LANGUAGE (Deutsch alsFremdsprache)

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Oral communication; Basic grammar; Basic writing; Berufsdeutcsch (Business German)

COURSE OUTCOMES:

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

CO1. Demonstrate basic knowledge of German language and the verb conjugation.

CO2. Comprehend and apply the knowledge of vocabulary and phrases in day-to-day real-life conversation.

CO3. Apply the various sentence structures by examining the rules of grammar in speaking and writing.

CO4. Analyze and apply the various verb structure of English and German language effectively in professional writing

DETAILED SYLLABUS:

UNIT I: INTRODUCTION   (9 Periods)

Introduction - German alphabets, numbers, days in a week, names of months, seasons. Grammar: Nouns –(i)Nominative case and (ii) Nominative personal pronouns, simple sentence, Verb Conjugation 1st and 2nd type, verb Conjugation 3rd type, 'Wh' questions (simple sentences) Nominative (definite and indefinite) Articles

UNIT II: CITY AND FOOD   (9 Periods)

In the city: naming places and buildings, means of transport, basic directions. Food: drink, groceries and meals. Apartments: rooms, furniture, colours.

Grammar: Nouns-articles negation–(kein and nicht); imperative and the accusative case; Nominative Possessive Pronouns.

UNIT III: DAY TO DAY CONVERSATIONS   (9 Periods)

Everyday life, telling time, making appointments, leisure activities, and celebrations. Different types of professions, Health and the body, Holiday and weather, Clothes and Dresses.

UNIT IV: BASIC GRAMMAR   (9 Periods)

Grammar: Possessive articles, Prepositions (am, um, von. bis); Modal verbs, Separable verbs, the accusative, past tense of 'to have' and 'to be', the imperative sentences, dative case, perfect tense.

UNIT V: BASIC WRITING **(9 Periods)**

Translation from English to German and German to English, Contacts, Writing letters and Email Writing.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tana Sieber, *NetzwerkDeutsch als Fremdsprache, Kursbuch A1*, Goyal Publishers and Distributors Pvt. Ltd. 2015.

2. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tana Sieber, *Netzwerk Deutsch als Fremdsprache, Arbeitsbuch A1*, Goyal Publishers and Distributors Pvt. Ltd. 2015.

Web link:

- https://learngerman.dw.com/en/beginners/c-36519789

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	2	-	-			
CO2	3	-	-	-	-	-	-	-	-	2	-	-			
CO3	3	-	-	-	-	-	-	-	-	2	-	-			
CO4	3	-	-	-	-	-	-	-	-	2	-	-			
Average	3	-	-	-	-	-	-	-	-	2	-	-			
Correlation level	3	-	-	-	-	-	-	-	-	2	-	-			

Correlation Levels: **3– High** **2 - Medium** **1– Low**

II B. Tech. – II Semester

(20BT4HS08) INDIAN HISTORY

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-RQUISITES: --

CORSE DESCRIPTION:

Introduction; Ancient India; Classical and Medieval era; Modern India; India after independence.

COURSE OUTCOMES:

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

CO1. Demonstrate contextual knowledge in evolution of ancient and medieval Indian History and acquire awareness on societal and cultural transformation.

CO2. Analyze the situations before and after Independence and assess the societal reforms implemented in India after Independence.

CO3. Practice culture transformations and appreciate its influence to adapt themselves in global scenario.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO INDIAN HISTORY (8 Periods)

Elements of Indian History; History Sources: Archaeology, Numismatics, Epigraphy & Archival research; Methods used in History; History & historiography; sociological concepts-structure, system, organization, social institutions, Culture and social stratification (caste, class, gender, power), State& Civil Society.

UNIT II: ANCIENT INDIA (9 Periods)

Mohenjo-Daro civilization; Harappa civilization; Mauryan Empire.

UNIT III: CLASSICAL & MEDIEVAL ERA (12 Periods)

Classic Era (200 BC - 1200 AD); Hindu - Islamic Era (1200 - 1800 AD).

UNIT IV: MODERN INDIA (6 Periods)

Age of Colonialism (17th - 19th centuries); First war of Indian Independence; Freedom Struggle (1857-1947)

UNIT V: INDIA AFTER INDEPENDENCE (1947 -) (10 Periods)

The Evolution of the Constitution and Main Provisions; Consolidation of India as a Nation; Politics in the States; Indian economy; Modernization and globalization, Secularism and communalism, Nature of development, Processes of social exclusion and inclusion, Changing Nature of work and organization.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOK:

1. K. Krishna Reddy, *Indian History,* Tata McGraw-Hill, 21st reprint, 2017.

REFERENCE BOOKS:

1. Guha, Ramachandra, *India after Gandhi*, Pan Macmillan, 2007.
2. Romila Thapar, *Early India*, Penguin India, New Delhi 2002.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	-	-	-	-	-	-			
CO2	1	2	-	-	-	1	-	-	-	-	-	-			
CO3	1	1	-	-	-	2	-	-	-	-	-	-			
Average	1.3	1	-	-	-	1.3	-	-	-	-	-	-			
Correlation level	1	1	-	-	-	1	-	-	-	-	-	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

II B. Tech. – II Semester

(20BT4HS10) PERSONALITY DEVELOPMENT

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Personalities and Leadership Qualities; Self Esteem and self Development; Attitude; Communication Relationship; Critical Work Skills and Ethics.

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge of leadership qualities by examining and applying personality traits.

CO2. Analyze and apply the proven techniques to build self-esteem and self-confidence.

CO3. Analyze the limitations of attitudes by demonstrating how experiences and circumstances impact attitudes.

CO4. Analyze the role of communication in relationships, qualities of a team player and leadership styles.

CO5. Apply appropriate techniques in solving problems by examining and demonstrating time management, stress management and anger management.

DETAILED SYLLABUS:

UNIT I: PERSONALITIES AND LEADERSHIP QUALITIES **(9 Periods)**

Introduction: Different Personalities -Personality Analysis -Freudian Analysis - Vedantic Concept: Swamy Vivekananda -Personality Begets - Types - Leadership Qualities - Decision Making- Case Studies: Personalities.

UNIT II: SELF ESTEEM AND SELF DEVELOPMENT **(9 Periods)**

Know Yourself: Self Image - Positive Self-Esteem - Turn Failure into Success - Be Sensitive to Feedback - Build Self-Confidence - Self Actualization - Set Goals - Action Plans - Accountability - Behavior Modification - Mentoring - Learning - Counseling -Challenge yourself with Aptitude Tests and Internships.

UNIT III: ATTITUDE **(9 Periods)**

Importance - Difference between Behavior and Attitude - Changing Negative Attitude- Impact of Attitudes on others - Unproductive Attitudes -Assess your Behaviour.

UNIT IV: COMMUNICATIONRELATIONSHIP **(9 Periods)**

Introduction - Positive and Negative Traits - Grapevine Communication - Open Communication; Team Player - Leadership styles -Performance Evaluations - Electronic Communication; Text Messaging - Voicemail - E-Mail

UNIT V: CRITICAL WORK SKILLS AND ETHICS   **(9 Periods)**

Time Management - Balancing Life and Work - Stress Management - Anger Management - Making Decisions and Solving Problems - Developing Creativity - Ethics and Self-Righteousness - Being Judgmental in the Real World - Striving for Integrity.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Barun K. Mitra, *Personality Development and Soft Skills,* Oxford University Press, 2011.

2. Harold R. Wallace and L. Ann Masters, *Personal Development for Life and Work*, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011. (6th Indian Reprint 2015)

REFERENCE BOOKS:

1. K. Alex, *Soft Skills*, S. Chand & Company Ltd, New Delhi, 2nd Revised Edition 2011.

2. Stephen P. Robbins and Timothy A. Judge*, Organizational Behaviour*, Prentice Hall, Delhi, 16th edition 2014.

ADDITIONAL LEARNING RESOURCES

o https://www.universalclass.com/.../the-process-of-perso...

o https://www.ncbi.nlm.nih.gov/pubmed/25545842

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	3	-	-	-	-	1	-	-			
CO2	1	3	-	-	3	-	-	-	-	1	-	-			
CO3	1	2	-	-	3	-	-	-	-	2	-	-			
CO4	1	2	-	-	1	-	-	-	2	3	-	-			
CO5	1	1	-	-	2	-	-	-	-	3	-	-			
Average	1.4	1.8	-	-	2.4	-	-	-	2	2	-	-			
Correlation level	1	2	-	-	3	-	-	-	2	2	-	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

II B. Tech. – II Semester

(20BT4HS12) WOMEN EMPOWERMENT

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	–	–	3

PRE–REQUISITES: --

COURSE DESCRIPTION:

Concept & Framework, Status of Women, Women's Right to work, International Women's Decade, and Women Entrepreneurship.

COURSE OUTCOMES:

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

CO1. Demonstrate the knowledge of the characteristics and achievements of empowered women and women's empowerment techniques by analyzing women's legal and political status.

CO2. Apply the knowledge of women's rights by analyzing various societal issues and obstacles in different fields, including science and technology.

CO3. Demonstrate the knowledge of significance of women's participation in policy debates, National conferences, and common forums for equality and development by identifying and analyzing issues.

CO4. Analyze the concept of women's entrepreneurship, government schemes, and entrepreneurial challenges and opportunities.

DETAILED SYLLABUS:

UNIT I: CONCEPT & FRAMEWORK   (9 Periods)

Introduction– Empowered Women's Characteristics – Achievements of Women's Empowerment **Concept of Empowerment:** Meaning & Concept – Generalizations about Empowerment – Empowerment Propositions – Choices women can make for empowerment – Women's participation in decision making, development process & in Governance. **Framework for Empowerment** – Five levels of equality – Tenets of Empowerment– Elements – Phases and aspects – Techniques – Categories and Models – Approaches.

UNIT II: STATUS OF WOMEN   (9 Periods)

Legal Status: Present Scenario – Call for Social change – Significant trends – Legal & Schemes – Personal Law – Joint Family – Criminal Law – Shift towards Dowry – Deterrent Punishment – Criminal Law (II Amendment) – Discrimination in Employment.

Political Status: Present Scenario – Political Participation & its Nature – Socio–economic Characteristics – Political Mobilization: Mass Media – Campaign Exposure – Group Orientation – Awareness of issues and participation – Progress & Future Thrust.

UNIT III: WOMEN'S RIGHT TO WORK   (9 Periods)

Introduction – Present Scenario – Changes in Policy & Programme – National Plan of Action– Women's Cells and Bureau – Increase in work participation rate – Discrimination in labour market – Women in unorganized sector – Issues and Obstacles– Women in Education –

Women in Science & Technology – **Case Study:** Linking Education to Women's Access to resources.

UNIT IV: WOMEN'S PARTICIPATORY DEVELOPMENT   (9 Periods)

Dynamics of social change – conscious participation – Information Explosion – Organized Articulation – National Conference – Common Forums – Participatory Development – New Issues Identified – Role of other Institutions.

UNIT V: WOMEN ENTREPRENEURSHIP   (9 Periods)

Introduction – Definition – Concept – Traits of women Entrepreneurs – Role of women Entrepreneurs in India – Reasons of Women Entrepreneurship – Government schemes & Financial Institutions to develop Women Entrepreneurs – Key policy recommendations – Project Planning – Suggestions and measures to strengthen women entrepreneurship – Growth & Future challenges – Training and Opportunities – **Case Study:** Training Women as Hand–pump Mechanics– **Case Study** : Literacy for Empowering Craftswomen

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. SahaySushama. *Women and Empowerment.* Discovery Publishing House, New Delhi. 2013.

2. NayakSarojini, Jeevan Nair. *Women's Empowerment in India*. Pointer Publishers, Jaipur. 2017.

REFERENCE BOOKS:

1. Baluchamy. S. *Women's Empowerment of Women*. Pointer Publishers, Jaipur. 2010.

2. Khobragade Grishma. *Women's Empowerment: Challenges and Strategies Empowering Indian Women*, Booksclinic Publishing, Chhattisgarh. 2020.

3. https://www.economicsdiscussion.net/entrepreneurship/women–entrepreneurs–in–india

4. https://www.businessmanagementideas.com/entrepreneurship–2/women–entrepreneurs

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	1	3	-	1	–	–	-	-			
CO2	3	1	-	-	-	2	-	-	-	–	-	-			
CO3	3	1	-	-	-	2	-	-	-	3	-	-			
CO4	3	1	-	-	-	-	-	-	-	-	2	-			
Average	3	1	-	-	1	2.3	-	1	–	3	2	-			
Correlation level	3	1	-	-	1	3	-	1	–	3	2	-			

5. **Correlation Levels:**   3– High   2 - Medium   1– Low

II B. Tech. – II Semester

(20BT40205) RELIABILITY AND SAFETY ENGINEERING

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Differential Equations and Multi-Variable Calculus, and Transformation Techniques and Linear Algebra.

COURSE DESCRIPTION:

Fundamentals of reliability engineering; Network modelling and reliability evaluation; Markov chain and Markov processes; basics of safety concepts and safety techniques and applications.

COURSE OUTCOMES:

After successful completion of this course, student will be able to:

CO1. Develop mathematical model of a network to evaluate the parameters for assessing the reliability of a system.

CO2. Analyze the time dependent/independent characteristics of a repairable system and frequency durations techniques to assess reliability.

CO3. Understand various safety management, policy, and planning strategies for personal and industrial safety.

CO4. Understand various safety and hazard identification techniques and follow appropriate safety measures in industry and society.

DETAILED SYLLABUS:

UNIT I: FUNDAMENTALS OF RELIABILITY ENGINEERING   (9 periods)

Random variables, probability concepts, rules for probabilities of events. Probability density and distribution functions. Binomial distribution - Expected value and standard deviation for binomial distribution. Reliability functions, $f(t)$, $F(t)$, $h(t)$ - Relationship between these functions, Exponential density and distribution functions, expected value and standard deviation of exponential distribution. Measures of reliability - MTTF, MTTR, MTBF. Bathtub curve.

UNIT II: NETWORK MODELING AND RELIABILITY EVALUATION   (9 periods)

Basic concepts - Evaluation of network reliability/unreliability, series systems, parallel systems, series - Parallel configuration systems. Redundant systems and its types. Evaluation of network Reliability / Unreliability using conditional probability method, tie-set and cut-set based approach, complete event tree and reduced event tree methods.

UNIT III: MARKOV CHAIN AND MARKOV PROCESSES   (9 periods)

Basic concepts, stochastic transitional Probability matrix, time dependent probability evaluation, Limiting State Probability evaluation, Absorbing states. Modelling concepts – State space diagrams, time dependent reliability evaluation of single component repairable model, two component repairable model. Frequency and duration techniques.

UNIT IV: BASICS OF SAFETY CONCEPTS   (9 periods)

Introduction, goals, need for safety, history of safety movement - evolution of modern safety concept, general concepts of safety management. Planning for safety- productivity, quality and safety, line and staff functions, budgeting for safety, safety policy.

UNIT V: SAFETY TECHNIQUES AND APPLICATIONS   (9 periods)

Introduction to safety techniques, Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety. Hazard identification techniques, components of safety audit, types of audit, audit methodology, process of safety reporting. Applications of industrial Safety, environmental safety, health safety, electrical safety, fire safety.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Roy Billintonand Ronald N Allen, *Reliability Evaluation of Engineering Systems*, 2nd edition, Springer, New York, 2013.

2. Frank R. Spellman, Nancy E. Whiting, *Safety Engineering: Principles and Practices*, 3rd edition, Rowman& Littlefield, 2018.

REFERENCE BOOKS:

1. Charles E. Ebeling, *An introduction to reliability and maintainability engineering*,2nd edition Tata McGraw-Hill Education, 2010.

2. Dan Petersen, *Techniques of Safety Management: A Systems Approach*, 4thedition american society of safety engineers, 2003.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/105/108/105108128/

2. https://nptel.ac.in/courses/110/105/110105094/

3. https://www.youtube.com/watch?v=uutg8jKrL9w

4. https://www.youtube.com/watch?v=_c-iZ2BAXPw

5. https://www.youtube.com/watch?v=GeMCF3s5EDk

6. https://www.youtube.com/watch?v=xYWyype7cxE

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	1	1	-	-	-	-	-			
CO2	3	3	-	-	2	1	1	-	-	-	-	-			
CO3	3	-	-	-	2	1	1	1	-	-	-	-			
CO4	3	-	-	-	2	1	1	1	-	-	-	-			
Average	3	2.5	1	-	2	1	1	1	-	-	-	-			
Correlation level	3	3	1	-	2	1	1	1	-	-	-	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT40105) ENVIRONMENTAL POLLUTION AND CONTROL
(Open Elective - 1)
(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PREREQUISITES: -

COURSE DESCRIPTION:

Fundamentals of air pollution; Dispersion of pollutants; Effects and control of air pollution; Water pollution; Soil pollution and control; Municipal solid waste management.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1   Analyze air and noise pollution using appropriate tools and techniques to solve complex environmental issues following relevant standards considering society, environment and sustainability besides communicating effectively in graphical form.

CO2   Analyze air and noise pollution control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO3   Analyze water pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO4   Analyze soil pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO5   Analyze solid waste and its management measures using appropriate tools and techniques to solve solid waste disposal issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

DETAILED SYLLABUS:

UNIT I: AIR AND NOISE POLLUTION   (08 Periods)
Air Pollution: Scope, Significance, Classification, Sources – Line, Area, Stationary, Mobile; Effects of air pollutants on man, material and vegetation; Global effects of air pollution; Air pollution meteorology - Lapse rate, Inversion, Plume pattern; Dispersion of air pollutants - Dispersion models and applications; Ambient air quality standards.
Noise Pollution: Sound pressure, Power and intensity, Impacts of noise, permissible limits of noise pollution, measurement of noise, Noise standards.

UNIT II: AIR AND NOISE POLLUTION CONTROL   (10 Periods)
Self cleansing properties of the environment, Dilution method, Control at source, Process changes and equipment modifications, Control of particulates – Types of equipment, Design

and operation - Settling chambers, Centrifugal separators, Bag house filters, Wet scrubbers, Electrostatic precipitators; Control of gaseous pollutants – Adsorption, Absorption, Condensation, Combustion; Control of air pollution from automobiles, Control of noise pollution, Case studies, Latest developments in the air and noise pollution control.

UNIT III: WATER POLLUTION   AND CONTROL   (10 Periods)
Water pollution – Sources, Causes, Effects; Surface and groundwater quality – Physical, Chemical, Biological; Drinking water quality standards, Water purification – Processes, Engineered systems – Aeration, Solids separation, Settling operations, Coagulation, Softening, Filtration, Disinfection; Wastewater – Sources, Causes, Effects, Treatment process and disposal – Primary, Secondary, Tertiary; Case studies, Latest developments in the water pollution control.

UNIT IV: SOIL POLLUTION AND CONTROL   (08 Periods)
Soil pollutants, Sources of soil pollution, Causes, Effects and control of soil pollution, Diseases caused by soil pollution, Methods to minimize soil pollution, Effective measures to control soil pollution, Soil quality standards, Case studies, Latest developments in the soil pollution control.

UNIT V: MUNICIPAL SOLID WASTE MANAGEMENT   (09 Periods)
Municipal solid waste – Types, Composition and characteristics; Methods of collection and transportation; Methods of disposal – Open dumping, Sanitary landfill, Composting and Incineration; Utilization - 6R Concept, Recovery and recycling and Energy Recovery; Latest developments in solid waste management

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:
1. Peavy, H. S, Rowe, D. R., and Tchobanoglous, G., *Environmental Engineering*, McGraw Hill Inc., 1985.
2. Rao, C. S. *Environmental Pollution Control Engineering*, New Age International Pvt. Ltd., 2nd Edition, 2007.
3. Ibrahim A. Mirsa, *Soil Pollution: Origin, Monitoring & Remediation*, Springer, UK, 2nd Edition, 2008.

REFERENCE BOOKS:
1. Rao, M. N. and Rao, H. V. N., *Air Pollution,* Tata McGraw–Hill Education Pvt. Ltd., 19th Edition, 2010.
2. Daniel Vallero, *Fundamentals of Air Pollution,* Academic Press (Elsevier)*,* 5th Edition, 2014.
3. Khopkar, S. M., *Environmental Pollution Monitoring and Control,* New Age International Pvt. Ltd., 2nd Edition, 2007.
4. Domkundwar, V. M., *Environmental Engineering*, Dhanpat Rai & Co. Pvt. Ltd., New Delhi, 2014.

ADDITIONAL LEARNING RESOURCES:
1. *National Ambient Air Quality Standards*, Central Pollution Control Board, New Delhi
2. *Specifications for Drinking Water Standards*, IS10500:2012
3. *Solid Waste Management Rules*, 2016

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	2	2	2	3	2	-	1	-	-			
CO2	3	3	-	2	2	2	2	1	-	1	-	1			
CO3	3	3	-	2	2	2	2	1	-	1	-	1			
CO4	3	3	-	2	2	2	2	2	-	1	-	1			
CO5	3	3	-	2	2	2	2	1	-	1	2	1			
Average	3	3	-	2	2	2	2.2	1.4	-	1	2	1			
Correlation level	3	3	-	2	2	2	2	1.4	-	1	2	1			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT40106) **PLANNING FOR SUSTAINABLE DEVELOPMENT**
(Open Elective - 1)
(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PREREQUISITES: -

COURSE DESCRIPTION:
Sustainable development; Environmental impact; Sustainable Policies; Governance; Theories and strategies; Media and education for sustainability.

COURSE OUTCOMES:
After successful completion of this course, the students will be able to:

CO1. Compare sustainable development theories in national and global context to protect the society and environment.

CO2. Analyze the unforeseen environmental impacts on sustainable development to protect the society and environment.

CO3. Analyze policies and governance for sustainable development considering ethics, economics, society and environment.

CO4. Analyze systems and strategies for sustainable development using appropriate tools and techniques considering ethics, economics, society and environment.

CO5. Analyze the role of media and education in sustainable development using appropriate tools and techniques considering ethics, society and environment besides communicating effectively.

DETAILED SYLLABUS:

UNIT I: SUSTAINABLE DEVELOPMENT   **(09 Periods)**
Definition and concepts of sustainable development, Capitalization of sustainability- National and global context; Sustainable development goals, Emergence and evolution of sustainability and sustainable development, Theories of sustainability, Case studies.

UNIT II: ENVIRONMENTAL IMPACT   **(09 Periods)**
Climate change – Science, Knowledge and sustainability; Unforeseen environmental impacts on development, Challenges of sustainable development, Centrality of resources in sustainable development, Case studies.

UNIT III: SUSTAINABLE POLICIES AND GOVERNANCE   **(09 Periods)**
Governance - Democracy and Eco–welfare; Global civil society and world civil politics, Civic environmentalism, Policy responses to sustainable development, Economics of sustainability, Social responsibility in sustainability, National action, ISO 14001: Environmental management system.

UNIT IV: SUSTAINABLE SYSTEMS AND STRATAGIES   **(09 Periods)**
Need for system innovation, Transition and co–evolution, Theories and methods for sustainable development, Strategies for eco–innovation, Ecological foot print analysis, Socio ecological indicators – Eco labels; Policy programmes for system innovation, Case studies.

UNIT V: MEDIA AND EDUCATION FOR SUSTAINABILITY   (09 Periods)

Role of emerging media, Remarkable design and communication art, Activism and the public interest, Education for sustainability, Participation in decision making, Critical thinking and reflection, Case studies.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:
1. John Blewitt, *Understanding Sustainable Development*, Earth Scan Publications Ltd., 3rd Edition, 2018.
2. Jennifer A. Elliot, *An Introduction to Sustainable Development*, Routledge, 4th Edition, 2013.

REFERENCE BOOKS:
1. Peter Rogers, Kazi F Jalal and John A Boyd, *An Introduction to Sustainable Development*, Earth Scan Publications Ltd., 2008.
2. Simon Dresner, *The Principles of Sustainability*, Earth Scan Publications Ltd., 2nd Edition, 2008.
3. Peter Bartelmus, *Environment Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, 3rd Edition, 2003.
4. Gabriel Moser, Enric Pol, Yvonne Bernard, Mirilia Bonnes, Jose Antonio Corraliza and Maria Vittoria Giuliani, *People Places and Sustainability*, Hogrefe & Huber Publishers, 2nd Edition, 2003.

ADDITIONAL LEARNING RESOURCES:
1. Anil Markandya, *Climate Change and Sustainable Development: Prospects for Developing Countries*, Routledge, 2002

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	1	2	3	-	-	-	-	-			
CO2	3	3	-	-	-	3	3	-	-	-	-	-			
CO3	3	3	-	-	-	2	1	1	-	-	1	-			
CO4	3	3	-	-	1	2	1	1	-	-	1	-			
CO5	2	2	-	-	2	2	1	1	-	2		-			
Average	2.8	2.8	-	-	1.3	2.2	1.8	1	-	2	1	-			
Correlation level	3	3	-	-	1	2	2	1	-	2	1	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

II B. Tech. – II Semester

(20BT40107) RURAL TECHNOLOGY

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:-

COURSE DESCRIPTION:
Technology for rural development; Non-conventional energy; Technologies for rural development; Community development; IT in rural development.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1　Compare various technologies for rural development by solving rural problems through different schemes by considering ethics, society, environment and sustainability.

CO2　Analyze non conventional energy sources using appropriate tools and techniques to solve rural energy problems considering society, environment and sustainability besides communicating effectively in graphical form.

CO3　Select appropriate technologies in different areas of rural development to solve rural issues following latest developments considering society, environment and sustainability.

CO4　Relate water conservation, health, safety and rural employment issues for community development to solve rural problems through appropriate technologies considering ethics, society, environment and sustainability.

CO5　Analyze the impact of IT, public and private partnership on rural development to solve complex rural problems using appropriate tools and techniques considering ethics, society, environment and sustainability.

DETAILED SYLLABUS:

UNIT I: TECHNOLOGY FOR RURAL DEVLOPMENT　　　　　　　　　(09 Periods)
India - Technology and rural development, Pre and post independence period, Rural India Life, Indian farmer, Role of science and technology in rural development, Rural technology and poverty eradication, Rural business hubs, Technology in improving rural infrastructure, Various organizations related to innovation, Issues of technology transfer - CAPART, NABARD, CSIR, NIF.

UNIT II: NON CONVENTIONAL ENERGY　　　　　　　　　　　　　(09 Periods)
Definition of energy, Types of alternative sources of energy, Sources of non conventional energy – Solar energy: Solar pump in agriculture, Solar dryer, Solar cooker, Solar heater; Biogas, Recycling and management, Wastes conservation, Assessment and production of biomass products and their utilization.

UNIT III: TECHNOLOGIES FOR RURAL DEVELOPMENT   (09 Periods)

Food and agro based technologies, Tissue culture, Nursery, Building and construction technologies, Cultivation and processing of economic plants, Cottage and social industries, Latest developments in rural technologies.

UNIT IV: COMMUNITY DEVELOPMENT   (09 Periods)

Water conservation, Rain water Harvesting, Drinking water Standards and simple treatments used, Environment and Sanitation, Bio fertilizers, Medical and aromatic plants, Employment generating technologies–Apiculture, Pisciculture, Aquaculture.

UNIT V: IT IN RURAL DEVELOPMENT   (09 Periods)

Role of information technology (IT) in rural areas, Impact of IT in rural development, Need and necessity of technology, Corporate social responsibilities, Private sector participation (Activities in different spheres: Employment, Education, Health, Agriculture and service sectors) and Saansad Adarsh Gram Yojana (SAGY), Village adoption schemes.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Prabhath, S. V., and Sita Devi, P. Ch., *Technology and Rural India*, Serials Publications,   1st Edition, 2012.
2. Virdi, M. S., *Sustainable Rural Technologies*, Daya Publishing House, 2nd Edition 2018.
3. Chakravarthy, R., and Murthy, P. R. S., *Information Technology and Rural Development*, Pacific Book International, 1st Edition, 2012.

REFERENCE BOOKS:

1. Chakravarthy, R., and Murthy, P. R. S., *Information Technology and Rural Development*, Pacific Book International, 1st Edition, 2012.
2. Shivakanth Singh, *Rural Development Policies and Programmes*, Northern Book Centre,   1st Edition, 2002.
3. Katar Singh and Anil Shishodia*, Rural Development: Principles, Policies, and Management,* SAGE Publications India Private Limited, 4th Edition, 2016.
4. Vinayak Reddy, A., Yadagira Charyulu, M., *Rural Development in India: Policies & Initiatives,* New Century Publications, 1st Edition, 2008.

ADDITIONAL LEARNING RESOURCES:

1. Prasad, L. M., *Principles and Practice of Management*, S. Chand & Sons, 9th Edition, 2019.
2. Venkata Reddy, K., *Agriculture and Rural Development - Gandhian Perspective*, Himalaya Publishing House, 1st Edition, 2017.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	3	2	1	1	1	-	-	-	-			
CO2	2	3	-	2	2	1	1	-	-	1	-	-			
CO3	2	3	-	2	2	1	1	-	-	-	-	1			
CO4	2	3	-	2	2	1	2	1	-	-	-	-			
CO5	2	3	-	3	2	1	1	1	-	-	-	-			
Average	2	3	-	2.4	2	1	1.2	1	-	1	-	1			
Correlation level	2	3	-	3	2	1	1	1	-	1	-	1			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT40305) HUMAN RESOURCE MANAGEMENT

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Introduction to HRM; recruitment, training and Placement, talent management; Basic types of interviews; Components; Compensation and reward administration; Ethics, Employee Relations, and Fair Treatment at Work, Dispute resolution and grievance management, trade unions and their role in collective bargaining;

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1.   Demonstrate the knowledge of concepts and perspective on HRM.

CO2.   Demonstrate the knowledge of recruitment, placement and talent management.

CO3.   Demonstrate the knowledge of training and development.

CO4.   Demonstrate the knowledge of compensation and reward administration.

CO5.   Demonstrate the knowledge of ethics, and employee relations.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO HUMAN RESOURCE MANAGEMENT   (9 Periods)

Importance of Human Resource Management (HRM), Concepts and perspective on HRM, Role of HRM in a competitive business environment, Environment affecting HRM at the enterprise level, The trends shaping HRM, HR metrics and benchmarking, HR accounting, inventory and information systems.

UNIT II: RECRUITMENT, PLACEMENT, AND TALENT MANAGEMENT   (9 Periods)

HR planning and job analysis, Employee testing and selection, Basic types of interviews, Placement, induction and socialization of the employees, Talent acquisition, talent management.

UNIT III: TRAINING AND DEVELOPMENT   (9 Periods)

Employee Orientation/Onboarding, Appraising employee performance and potential evaluation, Techniques for appraising performance, Managing Employee Retention, Engagement, and Careers, Human Resource Development (HRD).

UNIT IV: COMPENSATION   (8 Periods)

Compensation and reward administration, Basic factors in determining pay rates, Job evaluation methods, Pay for Performance and Financial Incentives, Employee benefits and services.

UNIT-V: ENRICHMENT TOPICS IN HRM   (10 Periods)

Ethics, Employee Relations, and Fair Treatment at Work, Dispute resolution and grievance management, trade unions and their role in collective bargaining, Employee Safety and Health, Global Challenges in HRM, Managing Human Resources in Small and Entrepreneurial Firms, Business environment and workforce adjustments, Creating high performance systems, Innovations in HRM.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Garry Dessler and BijuVarkkey, *Human Resource Management*, Pearson education, 16th Edition, 2020.

2. Aswathappa K, *Human Resource Management*, McGraw Hill Education,8th Edition, 2017.

REFERENCE BOOKS:

1. V.S.P Rao, *Human Resource Management*, Taxmann Publications Pvt. Ltd, 2nd Edition 2020.

2. Bohlander George W, Snell Scott, *Principles of Human Resource Management*, Cengage Learning, 16th edition,2013.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1													
CO2	3	1													
CO3	3	1													
CO4	3	1									1				
CO5	3	1				1		1							
Average	3	1				1		1			1				
Correlation level	3	1				1		1			1				

Correlation Levels: 3– High   2 - Medium   1– Low

II B. Tech. – II Semester

(20BT50506) ETHICAL HACKING

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PREREQUISITES: --

COURSE DESCRIPTION:

Ethical hacking, Network and computer attacks, Foot printing, Social engineering, Port scanning, System hacking, Sniffers, Denial of service, Hacking web servers, Wireless hacking, Cryptography, Network Protection System.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate knowledge on the computer security, social engineering and the intent of ethical hacking.

CO2. Select and apply foot printing and port scanning tools to discover vulnerabilities of the computer system.

CO3. Investigate hacking techniques and tools to maintain computer security.

CO4. Analyze cryptosystems and network protection systems for information security and intrusion prevention.

DETAILED SYLLABUS:

UNIT I: ETHICAL HACKING, NETWORK AND COMPUTER ATTACKS   (9 Periods)

Introduction to Ethical Hacking: The role of security and penetration testers, Penetration-Testing methodologies, What you can and cannot do legally.

Network and Computer Attacks: Malicious software, Trojans, Backdoors, Viruses, and Worms, Protection against malware attacks, Intruder attacks on networks and computers, Addressing physical security.

UNIT II:-TCP/IP CONCEPTS AND SOCIAL ENGINEERING   (9 Periods)

TCP/IP Concepts: Overview of TCP/IP – Application layer, Transport layer, Internet layer; IP addressing – Planning IP address assignments, IPv6 addressing.

Social Engineering: What is social engineering, What are the common types of attacks, Understand insider attacks, Understand identity theft, Describe phishing attacks, Understand online scams, Understand URL obfuscation, Social engineering countermeasures.

UNIT III: FOOTPRINTING ANDPORT SCANNING   (9 Periods)

Foot printing: Using web tools for footprinting, Conducting competitive intelligence, Using domain name system zone transfers.

Port Scanning: Port scanning, Using port scanning tools, Conducting ping sweeps, Understanding scripting.

UNIT IV: SYSTEM HACKING   (9 Periods)

System hacking -Password cracking techniques, Types of passwords, Key loggers and other spyware technologies, Escalating privileges, Root kits, How to hide files, Steganography technologies, How to cover your tracks and evidences; Sniffers - Protocols susceptible to sniffing, Active and passive sniffing, ARP poisoning, Ethereal capture and display filters, MAC flooding, DNS spoofing techniques, Sniffing counter measures; Denial of Service - Types of DoS attacks, How DDoS attacks work, How BOTs/BOTNETs work, Smurf attack, SYN flooding, DoS/DDoS counter measures; Session hijacking - Spoofing vs. hijacking, Types of session hijacking, Sequence prediction, Steps in performing session hijacking, Preventing session hijacking.

UNIT-V: CRYPTOGRAPHY, NETWORK PROTECTION SYSTEMS   (9 Periods)

Cryptography: Understanding Cryptography basics, Symmetric and asymmetric algorithms, Public key infrastructure, Cryptography attacks.

Network Protection Systems: Understanding routers, Firewalls, Honeypots.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Michael T. Simpson, Kent Backman, James E. Corley, *Hands-On Ethical Hacking and Network Defense*, 3rd Edition, Cengage Learning, 2017.

2. Kimberly Graves, *CEH: Official Certified Ethical Hacker Review Guide*, Wiley, 2007.

REFERENCE BOOK:

1. Michael Gregg, *Certified Ethical Hacker (CEH) Cert guide*, 3rd Edition, Pearson, 2019.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	-	3	-	-	-	-			
CO2	3	-	3	-	-	-	-	-	-	-	-	-			
CO3	3	-	3	-	-	-	-	-	-	-	-	-			
CO4	3	2	3	-	-	-	-	-	-	-	-	-			
Average	3	2	3	-	-	-	-	-	-	-	-	-			
Correlation level	3	2	3	-	-	-	-	-	-	-	-	-			

Correlation Levels: 3– High   2 - Medium   1– Low

II B. Tech. – II Semester

(20BT51205) AI IN HEALTHCARE

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION: Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties; The Role of Major Corporations in AI in Healthcare; Applications of AI in Healthcare.

COURSE OUTCOMES:

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

CO1. Understand the fundamental concepts of AI in Healthcare sector.

CO2. Analyze the present state and future of AI in Healthcare specialties for different scenarios.

CO3. Apply design concepts and metrics for AI in Healthcare.

CO4. Demonstrate basic concepts and terminologies of future applications of Healthcare in AI.

CO5. Develop AI applications through AI techniques for healthcare.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE

(8 periods)

Introduction to AI in Healthcare, Benefits and Risks, AI in the health sector, AI versus Human Intelligence, The future of AI in health sector, AI and Neural networks.

UNIT II: THE PRESENT STATE AND FUTURE OF AI IN HEALTHCARE SPECIALTIES

(10 periods)

Artificial Intelligence in: preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

UNIT III: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE **(8 periods)**

IBM Watson, The role of Google and Deep mind in AI in Healthcare, Baidu, Facebook and AI in Healthcare, Microsoft and AI in Healthcare.

UNIT IV: FUTURE OF HEALTHCARE IN AI **(10 periods)**

Evidence-based medicine, personalized medicine, Connected medicine, Disease and Condition Management , Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantables, Digital Health and Therapeutics, Education, Incentivized Wellness. Artificial Intelligence, Block chain, Robots, Robot-Assisted

Surgery, Exoskeletons, Inpatient Care, Companions, Drones, Smart Places, Smart Homes, Smart Hospitals, Reductionism, Innovation vs. Deliberation.

UNIT V: APPLICATIONS OF AI IN HEALTHCARE   (9 periods)

Case Study 1: AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

Case Study2: Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

Case Study3: Delivering a Scalable and Engaging Digital Therapy.

Case Study4: Improving Learning Outcomes for Junior Doctors through the Novel Use of Augmented and Virtual Reality for Epilepsy

Case Study5: Big Data, Big Impact, Big Ethics-Diagnosing Disease Risk from Patient Data.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Dr.Parag Mahajan, *Artificial Intelligence in Healthcare, MedManthra Publications*,

2. First Edition 2019.

3. *Arjun Panesar, Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.

REFERENCE BOOKS:

1. Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher, *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*, National Academy of Medicine Publication, First Edition, 2019.

ADDITIONAL LEARNING RESOURCES:

1. https://www.udacity.com/course/ai-for-healthcare-nanodegree--nd320   (AI   for Healthcare).

2. https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare(Surgical robots, new medicines and better care: 32 examples of AI in healthcare).

3. https://healthtechmagazine.net/article/2020/02/future-artificial-intelligence-healthcare (Future of Artificial Intelligence in Healthcare).

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	-			
CO2	2	3	-	2	-	2	2	-	-	-	-	-			
CO3	2	-	2	2	-	-	-	-	-	-	-	-			
CO4	2	-	-	-	2	2	-	-	-	-	-	-			
CO5	2	-	-	-	2	2	-	-	-	-	-	-			
Average	2	2	2	2	2	2	2	-	-	-	-	-			
Correlation level	2	2	2	2	2	2	2	-	-	-	-	-			

Correlation Levels: 3– High   2 - Medium   1– Low

II B. Tech. – II Semester

(20BT51501) BIOINFORMATICS

(Open Elective - 1)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Biological Data Acquisition, Databases, Data Processing, Methods of Analysis, Applications of Bio-informatics

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1.   Understand basic biological data acquisition in bioinformatics.

CO2.   Identify the proper databases for the information search by choosing the biological databases and also submission and retrieval of data from databases.

CO3.   Analyze the results of bioinformatics data using text and sequence-based searching techniques.

CO4.   Analyze the secondary and tertiary structures of proteins by applying different alignment programs

CO5.   Design biological databases and novel drugs by using contextual knowledge on bioinformatics.

DETAILED SYLLABUS:

UNIT I: BIOLOGICAL DATA ACQUISITION   (9 Periods)

Biological information, Retrieval methods for DNA sequence, protein sequence and protein structure information

UNIT II: DATABASES   (9 Periods)

Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary and secondary sequence databases, protein sequence and structure databases.

UNIT III: DATA PROCESSING   (9 Periods)

Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches: Local and global. Distance metrics. Similarity and homology. Scoring matrices, PAM and BLOSUM

UNIT IV: METHODS OF ANALYSIS   (9 Periods)

Dynamic programming algorithms, Needleman-Wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA and BLAST; Multiple Sequence Alignment and software tools for pair wise and multiple sequence alignment, CLUSTAL program, Prediction of Tertiary structure of proteins.

UNIT V: APPLICATIONS   **(9 Periods)**

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis, Genomics, Proteomics, Genome analysis – Genome annotation, DNA Microarray, computer aided drug design (CADD).

Total Periods: 45

Topics for self-study are provided in lesson plan

TEXTBOOKS:

1. Lesk, A. K., "*Introduction to Bioinformatics*" 4th Edition, Oxford University Press, 2013.

2. Dan Gusfield, "*Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology*" Cambridge University Press, 1997.

REFERENCE BOOKS:

1. Baldi, P. and Brunak, S., "*Bioinformatics: The Machine Learning Approach*" 2nd Edition, MIT Press. 2001

2. Mount, D.W., "Bioinformatics Sequence and Genome Analysis" 2nd Edition, Cold Spring Harbor Laboratory Press, 2004

3. Tindall, J., "Beginning Perl for Bioinformatics: An introduction to Perl for Biologists" 1st Edition, O'Reilly Media, 2001

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-			
CO2	3	3	-	-	-	-	-	-	-	-	-	-			
CO3	3	3	2	-	3	-	-	-	-	-	-	-			
CO4	3	3	2	-	3	-	-	-	-	-	-	-			
CO5	3	2	3	2	2	-	-	-	-	-	-	-			
Average	3	2.5	2.3	2	2.6	-	-	-	-	-	-	-			
Correlation level	3	3	3	2	3	-	-	-	-	-	-	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT30132) FLUID MECHANICS AND HYDRAULIC MACHINERY LAB

(Common to CE and ME)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

Courses on Fluid Mechanics, Hydraulic Engineering/Fluid Mechanics and Hydraulic Machinery

COURSE DESCRIPTION:

Calibration of flow meters; Verification of Bernoulli's equation; Performance of turbines and pumps; Losses through pipes.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Evaluate fluid flow characteristics using appropriate tools and techniques to solve fluid mechanics problems by following latest developments and ensuring safety.

CO2. Evaluate the performance and behaviour of hydraulic machinery using appropriate tools and techniques to solve hydraulic machinery problems by following latest developments and ensuring safety.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on fluid mechanics and hydraulic machinery.

LIST OF EXPERIMENTS:

1. Calibration of venturimeter
2. Calibration of orificemeter
3. Determination of coefficient of discharge for a small orifice by a constant head
4. Determination of coefficient of velocity for small orifice by variable head method
5. Calibration of rectangular notch
6. Determination of loss of head due to sudden contraction
7. Determination of coefficient of friction for pipes
8. Verification of Bernoulli's equation
9. Study of impact of jet on vanes
10. Study of hydraulic jump
11. Performance test on Pelton wheel
12. Performance test on Francis turbine
13. Performance test on Kaplan turbine
14. Performance test on single stage centrifugal pump
15. Performance test on multi stage centrifugal pump
16. Performance test on reciprocating pump

REFERENCE BOOKS/LABORATORY MANUALS:

SVEC20 Fluid Mechanics and Hydraulic Machinery Laboratory Manual

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	1	1	-	-	2	1	-	2			
CO2	3	2	-	3	1	1	-	-	2	1	-	2			
CO3	3	2	-	3	1	1	-	-	2	1	-	2			
Average	3	2		3	1	1			2	1		2			
Correlation level	3	2		3	1	1			2	1		2			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

II B. Tech. – II Semester

(20BT40331) ENGINEERING METROLOGY LAB

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		-	-	3	1.5

PRE-REQUISITES:

A course on computer aided machine drawing.

COURSE DESCRIPTION:

High precision Metrology; Standardization; Calibration of instruments such as Vernier calipers, Micrometer, Vernier height gauge; Measure dimensions of shafts, bearings; Alignment tests on lathes and milling machines; Straightness and flatness measurements; Identifying uncertainties in dimensional metrology; Measurement of gear and threaded profiles; Machine Vision system.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Apply suitable tools, instruments and methods for linear, angular, straightness and flatness measurements.

CO2. Apply suitable tools, instruments and methods for measuring gear and screw thread elements.

CO3. Analyze surfaces for roughness measurement using surface roughness tester.

CO4. Work independently or in teams to solve problems with effective communication

List of Exercises/List of Experiments

1. Calibration of Vernier Calipers, Micrometer, Vernier Height Gauge, Dial Gauge and measurement of dimensions of given components

2. Measurement of dimensions of a part using limit gauges

3. Measurement of internal bores by dial bore indicators

4. Measurement of coordinates of a jig plate

5. Measurement of radius of curvature of a given ring

6. (a) Measurement of angle and taper by using Bevel protractor, Sine bars

    (b) Measurement of angle of Taper plug gauge, Taper ring gauge, V- groove

7. Measurement of gear elements by using Gear Tooth Vernier

8. (a) Measurement of screw elements by using Tool Makers microscope

    (b) Measurement of screw elements by using profilometer

    (c) Measurement of effective diameter of an external thread by using Two Wire/Threewire method

9.   Study of angular measurement using Autocollimator

10. Measurement of flatness using Spirit level

11. Measurement of surface roughness using surface roughness tester

12. Checking the limits of dimensional tolerances using electrical and optical comparators

13. Study of Alignment test on lathe and milling machines and measurement of the Resultant forceacting on the tool using Tool Dynamometers

14. Process capability of Lathe measurement using Variable (or) Attribute chart

15. Study of Measurements using Machine Vision system

Note: Minimum Twelve Experiments are to be conducted.

REFERENCE BOOKS/LABORATORY MANUALS:

SVEC20 Engineering Metrology Lab Manual

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1										
CO2	3	2	1												
CO3	3	3	1	1											
CO4									3	3					
Average	3	2.3	1	1	1				3	3					
Correlation level	3	3	1	1	1				3	3					

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT40332) MACHINE TOOLS LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES: --

COURSE DESCRIPTION:

Demonstration on lathe; drilling; milling; slotting machine; shaper; grinding machine; milling machine; provides skill on making products using machines tools; Non-traditional Machines; Tool Geometry;   CNC Machining.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1.   Design and model different components by performing metal cutting operations using lathe machine with in the realistic constraints.

CO2.   Design and model different components by performing metal cutting operations using special machines with in the realistic constraints.

CO3.   Work independently or in teams to solve problems with effective communication

List of Exercises/List of Experiments

1. Perform the given machining operations on a MS round rod as per the given drawing using lathe.

   a) Straight turning, Facing and chamfering operation

   b) Step turning, chamfering and knurling operation

   c) Taper turning, grooving operation

   d) Thread cutting and grooving operation

   e) eccentric turning operation

2. Perform Drilling, tapping and reaming using radial drilling machine

3. Model a V - Block using shaping machine

4. Perform Internal splines cutting using slotting machine

5. Perform Single point cutting tool Grinding using tool and cutter grinder

6. Perform Profile cutting using vertical milling machine

7. Perform Spur gear cutting using horizontal milling machine

8. Perform Surface grinding operation using surface grinder

9. Perform Cylindrical grinding machine using cylindrical grinder

10. Perform Gear Hobbing using gear Hobbing machine.

11. Study of Non-traditional Machines.

12. Study of Tool Geometry

13. Study of CNC Machining.

Note: Minimum Twelve Experiments are to be conducted

REFERENCE BOOKS/LABORATORY MANUALS:

SVEC20 Machine Tools Lab Manual

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1											
CO2	3	3	3	1											
CO3									3	3					
Average	3	3	3	1					3	3					
Correlation level	3	3	3	1					3	3					

   Correlation Levels: 3– High   2 - Medium   1– Low

(20BT40333) MATLAB FOR MECHANICAL ENGINEERS LAB

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		-	1	2	2

PRE-REQUISITES:

Courses on programming in C and Data Structures and Basic Engineering Mechanics.

COURSE DESCRIPTION:

Basics of MATLAB; Functions for plotting; Programming in MATLAB; Application of MATLAB code in Engineering Mechanics and Mechanical Vibrations.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on syntax, built-in functions, mathematical operations of MATLAB.

CO2. Analyze the syntax for preparing MATLAB script file and function file.

CO3. Ana lyze the given data through visualization.

CO4. Develop MATLAB code for solving Mechanical Engineering problems.

DETAILED SYLLABUS:

UNIT- I: BASICS OF MATLAB

Arithmetic operations with scalars, display formats, math built-in functions, Arrays, Mathematical operations with arrays**.**

1. Calculate

   a) $\dfrac{35.7\,X\,64- 7^3}{45+ 5^2}$

   b) $\dfrac{5}{4}\,.7\,.6^2\,\dfrac{3^7}{(9^3- 652)}$

   c) $(2 + 7)^3 + \dfrac{273^{2/3}}{2} + \dfrac{55^2}{3}$

   d) $2^3 + 7^3 + \dfrac{273^3}{2} + 55^{3/2}$

2. Calculate

   a) $\dfrac{3^7\,\log(76)}{7^3+ 546} + \sqrt[3]{910}$

   b) $43\,.\dfrac{(\sqrt[4]{250}+ 23)^2}{e^{(45- 3^3)}}$

3. Calculate

   a) $cos^2\left(\dfrac{5\pi}{6}\right)\sin(\dfrac{7\pi}{8})^2 + \dfrac{\tan(\frac{\pi}{6}\ln 8)}{\sqrt{7}}$

   b) $\cos(\dfrac{5\pi}{6})^2\,Sin^2\left(\dfrac{7\pi}{8}\right) + \dfrac{\tan(\frac{\pi}{6}\ln 8)}{7.\frac{5}{2}}$

4. Define the variable x as x = 13.5. then evaluate

   a) $x^3 + 5x^2 - 26.7\,x - 52$

   b) $\dfrac{\sqrt{14\,x^3}}{e^{3x}}$

   c) $\log|x^2 - x^3|$

5. Define the variable a, b, c and d as   a = 16.9, b = -8.02, c = 68.74 and d = 0.8(ab-c)

   Evaluate

   a) $a + \dfrac{ab}{c}\ \dfrac{(a+d)^2}{\sqrt{|ab|}}$

6. Consider two matrices

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 2 & 3 & 4 \\ -1 & 6 & 7 \end{bmatrix} \quad B = \begin{bmatrix} 7 & 4 & 2 \\ 3 & 5 & 6 \\ -1 & 2 & 1 \end{bmatrix}$$

   Using MATLAB determine the following:

   a) A + B

   b) AB

   c) A2

   d) AT

   e) B-1

   f) BTAT

   g) A2+B2-AB

   h) Determinant of A, determinant of B and determinant of AB.

7. Consider two matrices

$$C = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 3 & 4 \\ -1 & 6 & 7 \end{bmatrix} \quad D = \begin{bmatrix} 13 & -15 & 8 \\ 1 & 25 & 9 \\ 8 & 70 & 6 \end{bmatrix}$$

   Using MATLAB determine the following:

   a) C + D

   b) CD

   c) C2

   d) CT

   e) D-1

   f) DTCT

   g) C2+D2-CD

   h) Determinant of C, determinant of D and determinant of CD.

8. Consider two matrices.

$$E = \begin{bmatrix} 4 \\ -5 \\ 9 \end{bmatrix} \; ; \quad F = \begin{bmatrix} 7 \\ 2 \\ -3 \end{bmatrix}$$

   a) Determine E.F?

UNIT II: PROGRAMMING IN MATLAB

Conditional statements, the switch-case statement, Loops, Nested loops, Nested conditional statements, break and continue commands, User defined Functions and Function files.

1. Write script file and a function file to print the square root of the even integers up to n, by using for loop. (*for both script and function file the output should be like*)

   2 1.4142
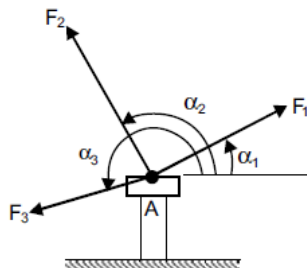
   4 2.0000

   6 2.4495

2. Write a script file to test the integer is even or odd. (use *if-else*)

3. Write a program which calculates the tip in the restaurant according to the amount of the bill, if the bill is less than 10$ the tip is $1.80. If the bill is between $10 and $60 the tip is 18% of the bill, if the bill is above $60 the tip is 20% of the bill.

4. Write a function M-file that computes the following function, where *x* should be scalar.

$$f(x) = \begin{cases} \sin(x)/x & x \neq 0 \\ 1 & x = 0 \end{cases}$$

5. Write a script and function file by using *while* loop to display all powers of two from 2 to 10.

6. Write a for loop to compute the sum of the squares of all integers from 2 to 20:

$$2^2 + 3^2 + 4^2 + - - - - - - - + 20^2$$

7. Write a script and function file for converting rectangular coordinates to polar coordinates, with a function name as *polarcoordinates* and the formulae are:

$$r = \sqrt{x^2 + y^2} \; and \; theta \, (\theta) = \; tan^{-1} \left(\frac{y}{x}\right)$$

8. Write a script and function file that gives the factorial of a positive number. Use command name as *fact (use for loop)*

9. By using *for* loop in a function, write a program for *Fibonacci series* of generating *n* numbers? Use the command name as *fib*.

10. Write a MATLAB program to determine the magnitude and direction of the resultant of 3 coplanar forces applied at point A in figure. Use the following values. F1 = 20kN, F2 = 40kN, F3=200 kN, α_1=400, α_2 =250 and α_3=580.

11. Figure shows two forces, one 500 N and the other P applied by cables on each side of the obstruction A in order to remove the spike. Write a MATLAB program to determine:

   i)   the magnitude of P necessary to such that the resultant T is directed along the spike

   ii) the magnitude of T

   iii) plot P and T as a function of d. (Range of d between 1 and 20 mm).
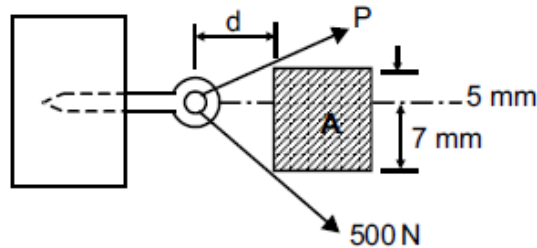
UNIT- III: PLOTING

Plot of given data, plot of a function, multiple graphs in same plot, multiple plots in same page.

1. Let us draw the graph of two polynomials; Write the code in script file? Range [-10,10]

    a) $f(x) = 3x^4 + 2x^3 + 7x^2 + 2x + 9$ and

    b) $g(x) = 5x^3 + 2x + 2$

2. Write the script for plotting the cardioid curve with the following parametric equations with at range of $0: \frac{\pi}{100} : 2\pi$; Take a =3 (can check for any value)

$$x = a(2\cos t - \cos 2t) ; \quad y = a(2\sin t - \sin 2t)$$

3. Plot the function $y = 3x^3 - 26x + 10$, and its first and second derivatives, for -2 ≤ x ≤ 4, all in the same plot.

4. The piston-rod-crank mechanism is used in many engineering applications. In the mechanism shown in the following figure, the crank is rotating at a constant speed of 500 rpm. Calculate and plot the position, velocity, and acceleration of the piston for one revolution of the crank. Write MATLAB commands to make the three plots on the same page. Set angle = 0^0 when t=0.
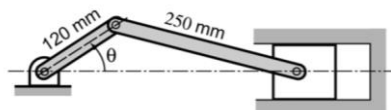
UNIT IV: MATLAB APPLICATION IN ENGINEERING MECHANICS

Preparing MATLAB codes for Resultant and equilibrium force of coplanar force system.

1. Write a MATLAB program to determine the magnitude and direction of the resultant of 3 coplanar forces applied at point A in figure. Use the following values. F1 = 20kN, F2 = 40kN, F3=200 kN, $\alpha_1=40^0$, $\alpha_2 =25^0$ and $\alpha_3=58^0$.
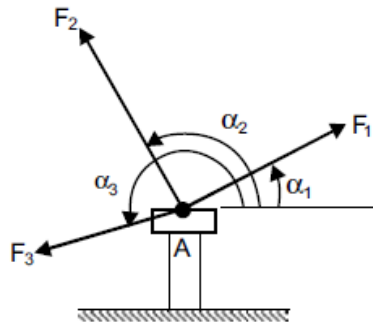
2. Figure shows two forces, one 500 N and the other P applied by cables on each side of the obstruction A in order to remove the spike. Write a MATLAB program to determine:

    i)   the magnitude of P necessary to such that the resultant T is directed along the spike

    ii)   the magnitude of T

    iii)   plot P and T as a function of d. (Range of d between 1 and 20 mm).
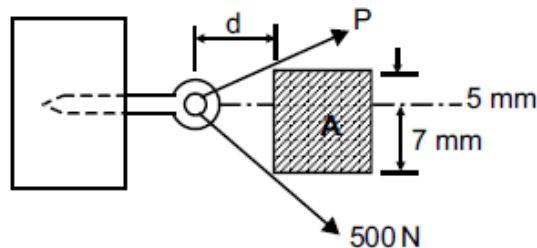
3. Figure shows the location of the center of gravity of a 5000 N truck for the unloaded condition. The location of the added load W_L is at a distance of x inches behind the rear axle. Write a MATLAB program and plot W_L as a function of x for x ranging from 0 to 60 mm.
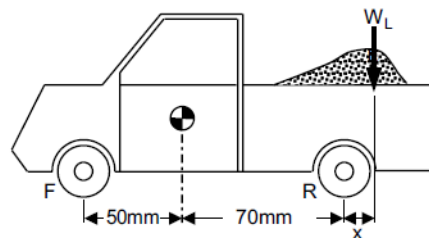
UNIT-V: MATLAB APPLICATION IN MECHANICAL VIBRATIONS

Preparing MATLAB codes for Free vibration of Single Degree of Freedom Systems, free vibration of damped system.

1. Write a MATLAB script for plotting

   (i) the one-dimensional response magnitude for a system with harmonically moving base shown in Fig.

   (ii) the response phase angle for system with harmonically moving base.
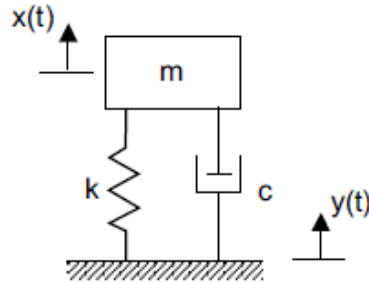
2. An analytical expression for the response of a damped single degree of freedom system to given initial displacement and velocity is given by

$$x(t) = Ce^{-\xi \omega_n t}\cos(\omega_t - \emptyset)$$

   where C and Ø represent the amplitude and phase angle of the response, respectively having the values

$$C = \sqrt{x_0^2 + \left(\frac{\zeta \omega_n x_0 + v_0}{\omega_d}\right)^2}, \phi = \tan^{-1}\left(\frac{\zeta \omega_n x_0 + v_0}{\omega_d x_0}\right)$$

$$\text{and } \omega_d = \sqrt{1-\zeta^2}\,\omega_n$$
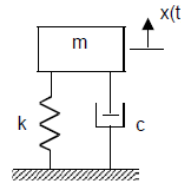
   Plot the response of the system using MATLAB for ω_n =5 rad/sec ξ=0.05, 0.1, 0.2 subjected to the initial conditions x(0) = 0, v_0= 60 cm/s.

TEXTBOOKS:

1. Rao V. Dukkipati, *MATLAB: An Introduction with Application*, New Age International Publishers, Second edition, 2010

2. Amos Gilat, *MATLAB: An Introduction with Applications*, John Wiley & Sons, Fourth Edition.

REFERENCE BOOKS:

1. Rudra Pratap. Getting Started With MATLAB, Oxford University Press. Seventh edition, 2019

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			3					3			3		
CO2	3	3	3	1	3					3			3		
CO3	3	3	3	1	3					3			3		
CO4	3	3	3	1	3					3			3		
Average	3	3	3	1	3					3			3		
Correlation level	3	3	3	1	3					3			3		

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT315AC) DESIGN THINKING

(Audit Course)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	2	-	-	-

PRE-REQUISITES: -

COURSE DESCRIPTION:

Design thinking process, Design thinking phases, empathy tools; Idea generation, visualizing and empathizing; Fidelity for prototypes, prototyping; prototyping for physical products.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze design thinking concepts and principles to perform human centered design process for creative problem solving.

CO2. Create empathy maps to visualize user attitudes and behavior for gaining insights of customers.

CO3. Develop innovative products or services for a customer base using ideation techniques.

CO4. Build prototypes for complex problems using gathered user requirements.

CO5. Apply design thinking tools techniques to produce good design and relevant products or services for a specific target market.

CO6. Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO DESIGN THINKING   **(6 Periods)**

Design Thinking Process: Types of the thinking process, Common methods to change the human thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking, Problem solving, Understanding design thinking and its process model, Design thinking tools.

UNIT II: EMPATHIZE   **(6 Periods)**

Design thinking phases, How to empathize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, Activities during and after the session, Understanding empathy tools : Customer Journey Map, Personas.

UNIT III: IDEATION   **(6 Periods)**

Challenges in idea generation, need for systematic method to connect to user, Visualize, Empathize, and Ideate method, Importance of visualizing and empathizing before ideating, Applying the method, Ideation Tools: How Might We? (HMW), Story board, Brainstorming.

UNIT IV: PROTOTYPING   (6 Periods)

What is a prototype? - Prototyping as a mindset, prototype examples, prototyping for products; Why we prototype? Fidelity for prototypes, Process of prototyping- Minimum Viable prototype

UNIT V: TESTING PROTOTYPES   (6 Periods)

Prototyping for digital products: What's unique for digital, Preparation; Prototyping for physical products: What's unique for physical products, Preparation; Testing prototypes with users.

Total Periods: 30

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. S.Salivahanan, S.Suresh Kumar, D.Praveen Sam, "*Introduction to Design Thinking*",Tata Mc Graw Hill, First Edition,2019.

2. Kathryn McElroy, "*Prototyping for Designers: Developing the best Digital and Physical Products*", O'Reilly,2017.

REFERENCE BOOKS

1. Michael G. Luchs, Scott Swan , Abbie Griffin,"*Design Thinking – New Product Essentials from PDMA*", Wiley, 2015.

2. Vijay Kumar, "*101 Design Methods: A Structured Approach for Driving Innovation in Your Organization*", 2012.

ADDITIONAL LEARNING RESOURCES:

1. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

2. https://www.ibm.com/design/thinking/page/toolkit

3. https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge-by-creating-your-point-of-view-and-ask-how-might-we

4. https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking

5. https://nptel.ac.in/courses/109/104/109104109/

6. https://nptel.ac.in/courses/110106124/

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	3	2	-	-	-	-	-	-	-	-			
CO2	1	3	-	-	-	-	-	-	-	-	-	-			
CO3	1	-	-	3	1	-	-	-	-	-	-	-			
CO4	-	3	-	3	-	-	-	-	-	-	-	-			
CO5	-	-	-	-	1	2	3	-	-	-	-	-			
CO6	1	3	1	-	-	-	1	1	-	-	-	-			
Average	1	3	2	2.6	1	2	2	1	-	-	-	-			
Correlation level	1	3	2	3	1	2	2	1	-	-	-	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(**20BT50301**) **DESIGN OF MACHINE ELEMENTS**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Course on Strength of Materials.

COURSE DESCRIPTION:

General considerations of design, design process; Manufacturing considerations, BIS codes of materials; Combined stresses; theories of failure; Fatigue; Stress concentration; Goodman's line, Soderberg's line; shafts; keys; sleeve or muff, and Flange couplings, Flexible couplings; sleeve and cotter joint, Knuckle joint, mechanical springs.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Design the machine elements subjected to combined and structural loads considering design standards.

CO2. Design the parameters of power transmitting elements such as shafts, keys, couplings and joints.

CO3. Design threaded joints under eccentric loading conditions and welded joints for residual stresses.

CO4. Design journal, ball and roller bearings for the given application.

CO5. Design the parameters of springs and spur gears for the given application.

DETAILED SYLLABUS:

UNIT I: DESIGN FOR COMBINED & FLUCTUATING LOADS   (09 Periods)

Introduction to design, Types of design, General considerations of design, Design process; Manufacturing considerations in the design; BIS coding and Preferred numbers; Combined stresses, Various theories of failures.

Stress concentration, Notch sensitivity, Design for fluctuating stresses fatigue failure, Endurance limit, Estimation of Endurance strength - Goodman's line, Soderberg's line; Design of components for finite and infinite life.

UNIT II: DESIGN OF SHAFTS, KEYS, COUPLINGS AND JOINTS   (09 periods)

Shafts: Shaft design - on the basis of strength and Torsional rigidity, ASME code for shaft design.

Keys: Design of Keys – Sunk keys: Rectangular and Square keys and Applications of keys.

Couplings: Design of couplings - Sleeve or Muff, Protected type Flange couplings, Bush-pin type, Applications of couplings.

Joints: Sleeve and cotter joint, Knuckle joint;

UNIT III: DESIGN OF THREADED AND WELDED JOINTS   (09 periods)

Threaded Joints: Basic Types of screw fastenings - cap screws, set screws; Bolts of uniform strength, locking devices, I.S.O. metric screw threads, bolts under tension,

eccentrically loaded bolted joint in shear, eccentric load parallel and perpendicular to the axis of bolts, and plane containing the bolts.

Welded Joints: Introduction, welding process, types of welded joints, working stresses in welds, Strength of welds, Special cases of fillet welds, Eccentric loads on welded connections, Design procedure.

UNIT IV: BEARINGS   (09 periods)

Journal bearing design, Ball and Roller Bearings, Static load, Dynamic load, Equivalent radial load, Design and Selection of ball and roller bearings.

UNIT V: DESIGN OF MECHANICAL SPRINGS AND SPUR GEAR (09 periods)

Stress and deflections of helical springs, Design of helical springs, springs for fatigue loading, Energy storage capacity in helical springs, Concentric springs; Design procedure for spur gear.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. V. B. Bhandari, *Design of Machine Elements*, Tata McGrawHill, 3rd Edition, 2010.
2. R.S. Khurmi & J.K. Gupta, *Machine Design*, Eurasia Publishing House (pvt.) Ltd. 2005

REFERENCE BOOKS:

1. 1. Joseph E. Shigely, *Mechanical Engineering Design*, TMH Publishers, 9th Edition, 2011.
2. T. Krishna Rao, *Design of Machine Elements Vol-II*, I K International, 1st Edition, 2008.

Data Book: Design data hand book for Mechanical Engineers in SI and Metric units by Balaveera Reddy and Mahadevan.N

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	2	-	-	-	-	-	-	3	-	-
CO2	3	3	3	2	-	2	-	-	-	-	-	-	3	-	-
CO3	3	3	3	2	-	2	-	-	-	-	-	-	3	-	
CO4	3	3	3	2	-	2	-	-	-	-	-	-	3	-	
CO5	3	3	3	2	-	2	-	-	-	-	-	-	3	-	
Average	3	3	3	2	-	2						-	3	-	
Correlation level	3	3	3	2		2							3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT50302) OPERATIONS RESEARCH

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Requirements of Linear Programming Problem, Formulation, Graphical solution, Simplex method, Big-M method, Two Phase Method; Vogel's approximation method; Modified distribution (MODI) method to find optimal solution; Two person zero sum games; Saddle point; Inventory costs and deterministic inventory control models; Project management through network analysis.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Apply linear programming techniques to solve complex problems and obtain optimal solutions.

CO2. Analyze games through appropriate strategies to influence the game outcome.

CO3. Apply suitable inventory control models for cost reduction and simulate them.

CO4. Develop network models and solve project management issues involving diverse resources.

CO5. Apply queuing models to compute the relevant characteristics and simulate them.

DETAILED SYLLABUS:

UNIT I: LINEAR PROGRAMMING PROBLEM   (10 periods)

Requirements of Linear Programming Problem, Formulation, Graphical solution, Simplex method, Big-M method, Two Phase Method, Dual formulation, Dual Simplex Method, Linear Programming special cases- Infeasible solution, Unboundedness, Redundancy, Alternate optimal solutions.

UNIT II: TRANSPORTATION AND ASSIGNMENT MODELS   (08 periods)

Transportation model: Methods to find Basic Feasible Solution- North-West corner rule, Least cost method, Vogel's approximation method; Modified distribution (MODI) method to find optimal solution, Special cases of transportation problems, Transshipment problem.

Assignment model: Hungarian method, Variants of Assignment Problem, Travelling Salesman Problem

UNIT III: GAME THEORY AND INVENTORY MODELS   (10 periods)

Game Theory – Two person zero sum games, Saddle point, Pure strategy, Mixed strategy – Dominance, Algebraic method and Graphical method.

Inventory Models – Functions, Types, Associated costs, Factors involved in inventory problem analysis, Inventory costs and deterministic inventory control models - single item inventory control models without shortages and with shortages, with quantity discounts.

UNIT IV: NETWORK MODELS   (09 periods)

Network Flow models – Minimal Spanning Tree, Shortest Path Problem and Maximal Flow Problem, Project management through network analysis- Critical Path Method, Program Evaluation Review Technique, Cost analysis and Crashing.

UNIT V: QUEUING AND SIMULATION   (08 periods)

Queuing: Infinite queue length model, Poisson arrivals and Exponential service times - single server and multi-server.

Simulation: Monte Carlo simulation, Simulation of a waiting line problem, Simulation of inventory model.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Hamdy A Taha, *Introduction to Operations Research*, Pearson India, 10th Edition, 2017

2. J.K. Sharma, *Operations Research: Theory and Applications*, Macmillan, New Delhi, 5th Edition, 2013.

REFERENCE BOOKS:

1. Hillier, Libermann, *Introduction to Operations Research*, McGraw Hill Education (India) Private Limited, 10th Edition, 2017.

2. KantiSwarup, P.K. Gupta, Manmohan, *Operations Research*, Sultan Chand & Sons, 2019.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1		1					1				3
CO2	3	3	2	1		1					1				3
CO3	3	3	2	1		1					1				3
CO4	3	3	3	1		1					3				3
CO5	3	3	2	1		1					1				3
Average	3	3	2.2	1		1					1.4				3
Correlation level	3	3	2	1		1					1				3

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT50303) THERMAL ENGINEERING-II

Int. Marks	Ext.Marks	TotalMarks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Engineering Thermodynamics and Thermal Engineering-I.

COURSEDESCRIPTION:

Steam Boiler; Classification of Boilers; Working of Steam Boilers; Functions of Various Boiler Mountings and Accessories; Performance parameters of boiler; Characteristics off low through steam nozzles; Working of Steam Condensers and their performance; Cooling water requirements; Steam turbines and their analysis; Compounding and governing; Refrigeration systems; Psychrometry; Air conditioning systems.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the functional and performance characteristics boiler systems to determine its performance parameters.

CO2. Analyze the performance characteristic of steam nozzles and condensers and calculate its performance characteristics.

CO3. Analyze the performance characteristic of steam turbines using velocity diagrams and determine its performance characteristics.

CO4. Calculate the performance characteristics refrigeration systems**.**

CO5. Calculate the psychometric properties during psychometric process in air conditioning systems.

DETAILED SYLLABUS:

UNIT I: STEAM BOILERS   (09 Periods)

Classification of Boilers, Working of Fire Tube Boilers - Simple Vertical Boiler, Cochran Boiler, Cornish Boiler and Locomotive Boiler; Working of Water Tube Boilers–Babcock and Wilcox Boiler, Lamont Boiler and Benson Boiler; Functions of Boiler Mountings and Accessories; Boiler horse power, equivalent evaporation, efficiency and heat balance.

Draught: classification – Height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced draught

UNIT II: STEAM NOZZLES AND CONDENSORS   (09 Periods)

Steam Nozzles: Classification, functions, Flow of steam through the Nozzles, Velocity of Steam at the exit of Nozzle- Ideal and Actual expansion through the Nozzle; Discharge through the Nozzle-Condition for maximum discharge through the Nozzle, Critical Pressure Ratio; Nozzle Efficiency and Velocity Coefficient, Wilsons Line.

Steam Condensers: Classification, Working of Jet and Surface Condensers, Vacuum Efficiency, Condenser Efficiency, Sources of air, Effect of air leakage in Condenser-Edward's Air Pump; Cooling Water Requirement.

UNIT III: IMPULSE TURBINES AND REACTION TURBINES   **(9 Periods)**

Impulse turbine: Classification of Steam Turbines, Working of De-laval Impulse Steam Turbine, Pressure velocity variations, Combined Velocity diagrams of Impulse turbine, Effect of friction, Axial thrust, Tangential thrust and Power developed, Compounding and Governing.

Reaction Turbines: Working of Parson's Reaction Turbine, Degree of Reaction, Pressure velocity variations and combined velocity diagram of Reaction turbine.

UNIT IV: REFRIGERATION   **(09 Periods)**

Introduction to Refrigeration, Units of Refrigeration, Carnot Refrigerator, COP of a refrigerator, Heat Pump, Air refrigeration System-Working Principle and Essential Components of the Plant – COP – Representation of Cycle on T-S and P-h diagram; Vapour Compression Refrigeration (VCR) System – Working Principle and Essential Components of the Plant – COP – Representation of Cycle on T-S and P-h; Vapour absorption system-Working Principle and Essential Components of the Plant – COP; Introduction to refrigerants.

UNIT V: AIR CONDITIONING   **(09 Periods)**

Psychrometry: Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Introduction Air Conditioning Systems-Classification of Air conditioning systems.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. R.K.Rajput, *Thermal Engineering*, Laxmi Publication, 10th Edition,2018

2. Mahesh M. Rathore*, Thermal Engineering,* Tata McGraw-Hill Education, 1st Edition,2010.

REFERENCE BOOKS:

1. R.S.Khurmi& J.S. Gupta, Thermal Engineering, S.Chand, 15th Edition, 2015.

2. R.S.Khurmi& J.S. Gupta*, Refrigeration and Air conditioning,* S.Chand, 5th Edition, 2020.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1		1								3	
CO2	3	3	1	1		1								3	
CO3	3	3	1	1		1								3	
CO4	3	3	1	1		1	1							3	
CO5	3	3	1	1		1	1							3	
Average	3	3	1	1		1	1							3	
Correlation level	3	3	1	1		1	1							3	

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – I Semester

(20BT50304) AUTOMOBILE ENGINEERING

(Professional Elective – 1)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: A course on Thermal Engineering-I

COURSE DESCRIPTION:

Basic components and classification of automobiles; Fuel Supply System; Cooling System; Ignition System; Electrical Systems; Electronic Systems; Transmission System; Steering System; Suspension and Braking System.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on vehicle structure, chassis layout and fuel supply systems.

CO2. Demonstrate the knowledge on cooling systems and ignition systems used in an automobile.

CO3. Demonstrate the knowledge on electrical and electronic systems used in automobile.

CO4. Demonstrate the knowledge on construction and working of transmission systems and steering systems of an automobile.

CO5. Demonstrate the knowledge on construction and working of suspension and braking systems of an automobile.

DETAILED SYLLABUS:

UNIT I: **AUTOMOBILE BASICS AND FUEL SYSTEMS**   **(09 periods)**

Classification of automobiles, Components of a four wheeler automobile, Chassis and body, Rear wheel drive, Front wheel drive, Four wheel drive, Turbo charging, Super charging, Oil filters, Oil pumps.

Fuel system: S.I. Engine - Fuel supply system, Mechanical and electrical fuel pump, Air and fuel filters, Carburetor types; C.I. Engine - Requirements of diesel injection systems, Types of injection systems, Fuel pump, Types of nozzles, Nozzle spray formation, Injection timing.

UNIT II: COOLING AND IGNITION SYSTEMS   **(10 periods)**

Cooling systems: Necessity of cooling system, Requirements of cooling systems, Types, Natural and Forced Circulation System, Thermostat, Types of radiators, Cooling Fan, Water pump, Antifreeze solutions.

Ignition systems: Function of an ignition system, Battery ignition system, Magneto coil ignition system, Electronic ignition system using contact breaker, Capacitive discharge ignition system.

UNIT III: ELECTRICAL AND ELECTRONIC SYSTEMS   (08 periods)

Electrical Systems: Electrical Systems - Introduction, Charging circuit, Generator, Current – voltage regulator; starting system; Bendix drive mechanism, solenoid switch, lighting systems, Horn, wiper.

Electronic Systems: Electronics Systems - Introduction, Electronic Control Unit (ECU), Variable Valve Timing (VVT), Active Suspension System (ASS), Electronic Brake Distribution (EBD), Electronic Stability Program(ESP) Traction Control System (TCS), Global Positioning System (GPS).

UNIT IV: TRANSMISSION AND STEERING SYSTEMS   (10 periods)

Transmission systems: Types of clutches - Cone clutch, Single and multi plate clutch, Centrifugal clutch; Types of Gear box - Constant mesh, Sliding mesh, Synchromesh gear box; Gear shifting mechanism, Automatic transmission, Propeller shaft, Universal joint, Differential, Real axle arrangement.

Steering systems: Requirements and functions of steering system, Layout of steering system, Steering gears, Steering linkages; Under steering, Over steering, Steering ratio, Steering geometry - Camber, Caster, Toe-in, Toe out; Power steering, Wheel alignment and Balancing.

UNIT V:SUSPENSION AND BRAKE ACTUATING SYSTEMS   (08 periods)

Suspension systems: Introduction, Functions of suspension system, Elements of suspension systems, Rigid axle suspension system, Torsion bar, Shock absorber, Telescopic damper, Independent suspension system.

Brake actuating systems: Need and functions of braking system, Classification of brakes, Mechanical, Hydraulic, Pneumatic, Vacuum brake systems.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Dr. Kirpal Singh, *Automobile Engineering*, Vol.1&Vol.2, Standard Publishers distributor, 12th edition, 2011

2. R.K.Rajput, *Automobile Engineering*, Lakshmi Publication, 2nd Edition, 2014.

REFERENCE BOOKS:

1. V.M.Domkundwar, *Automobile Engineering*, Dhanpat Rai & Co, 1st Edition, 2013.

2. V.Ganesan, *IC Engines*, Tata McGraw-Hill, 3rd Edition, 2007.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1				1								3	
CO2	3	1				1								3	
CO3	3	1				1								3	
CO4	3	1				1								3	
CO5	3	1				1								3	
Average	3	1				1								3	
Correlation level	3	1				1								3	

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech – I Semester

(20BT50305) COMPRESSIBLE FLUID FLOW

(Professional Elective – 1)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Fluid Mechanics and Machines and Engineering Thermodynamics.

COURSE DESCRIPTION:

Fundamentals of compressible flows; Mach number; Effect of Mach number on compressibility; One dimensional isentropic flow; Development and strength of the shock Waves; Supersonic flows; Fanno flow and Rayleigh flow.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the flow characteristics of compressible flowsby solving governing equations.

CO2. Analyze one-dimensionalflowsin diffusers and nozzles.

CO3. Analyze compressible flow having shock waves and determine the strength of shock waves.

CO4. Apply governing equations to compressible flow through constant area duct with friction.

CO5. Apply governing equations to compressible flow through constant area duct with heat transfer

DETAILED SYLLABUS:

UNIT I: Fundamentals of Compressible Flows   (09 periods)

Introduction to Compressible Flow-Concept of continuum-system and control volume approach-conservation of mass, momentum and energy-stagnation state-compressibility-Entropy relations-Wave propagation-Acoustic velocity-Mach number-effect of Mach number on compressibility-Pressure coefficient-physical difference between incompressible, subsonic, sonic and supersonic flows-Mach cone-Sonic boom-Reference velocities-Impulse function-adiabatic energy equation-representation of various flow regimes on steady flow adiabatic ellipse.

UNIT II: One Dimensional Isentropic flow: (09 periods)

One dimensional steady isentropic flow-Adiabatic and isentropic flow of a perfect gas-basic equations-Area-Velocity relation using 1D approximation-nozzle and diffuser-mass flow rate-chocking in isentropic flow-flow coefficients and efficiency of nozzle and diffuser-working tables-charts and tables for isentropic flow-operation of nozzle under varying pressure ratios –over expansion and under expansion in nozzles.

UNIT III: Normal shock Waves   (09 periods)

Irreversible discontinuity in supersonic flow-one dimensional shock wave-stationary normal shock-governing equations-Prandtl-Meyer relations-Shock strength-Rankine-Hugoniot

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Relation-Normal Shock on T-S diagram-working formula-curves and tables-Oblique shock waves -supersonic flow over compression and expansion corners (basic idea only)

UNIT IV: Flow in constant area duct with friction (Fanno flow)   (09 periods)

Fanno curve and Fanno flow equations, solution of Fanno flow equations, variation of flow properties, variation of Mach number with duct length, isothermal flow in constant area duct with friction, tables and charts for Fanno flow, Experimental friction coefficients.

UNIT V: Flow in constant area duct with heat transfer (Rayleigh flow)

(09 periods)

Flow through constant area duct with heat transfer (Rayleigh Flow)-Governing equations-Rayleighline on h-s and P-v diagram-Rayleigh relation for perfect gas-maximum possible heat addition-location of maximum enthalpy point-thermal chocking-working tables for Rayleigh flow.

Compressible flow field visualization and measurement - Shadowgraph-Schlieren technique - interferometer - subsonic compressible flow field - measurement (Pressure, Velocity and Temperature) - Wind tunnels –closed and open type

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. S.M.Yahya, *Fundamentals of Compressible Flows*, New age international publication, Delhi, 2018.

2. V. Babu, *Fundamentals of Gas Dynamics, John Wiley & Sons, 2nd Edition, 2008*

REFERENCE BOOKS:

1. Robert D. Zucker, Fundamentals of Gas Dynamics, John Wiley & Sons, 2nd Edition, 2002.

2. John. D. Anderson, *Modern Compressible Flow*, Mc Graw Hill.3rd Edition, 2017.

ADDITIONAL LEARNING RESOURCES:

1. Fundamentals of compressible fluid dynamics- P. Balachandran, PHI Learning, New Delhi.

2. Fluid Mechanics by F.M. White.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1										3	
CO2	3	3	2	1										3	
CO3	3	3	2	1										3	
CO4	3	3	2	1										3	
CO5	3	3	2	1										3	
Average	3	3	2	1										3	
Correlation level	3	3	2	1										3	

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – I Semester

(20BT50306) ENGINEERING METALLURGY

(Professional Elective – I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Engineering Chemistry and Materials Science & Engineering.

COURSE DESCRIPTION:

Iron ores, Alloys and their phase diagrams; various heat treatments; Materials and their classifications; Ferrous and Nonferrous materials application; processing techniques; Material characterization; analyzing the properties of materials.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate knowledge of melting process in various metals and alloys.

CO2. Analyze different phase transformations involved in metals and alloys.

CO3. Demonstrate knowledge of dislocation characteristics and strengthening mechanisms.

CO4. Analyze the mechanical and microstructural properties of materials by applicable tests and characterization techniques.

CO5. Demonstrate knowledge of powder metallurgy process for manufacturing complex parts.

DETAILED SYLLABUS:

UNIT I: MELTING OF METALS   **(09 periods)**

Introduction, Ores of various metals, melting of iron, Blast furnace, Cupola furnace, puddling furnace, melting of steel, Bessemer converter process, L-D process, Basic open-hearth process, Electric furnace Melting of super alloys, Vacuum induction melting, Vacuum arc remelting.

UNIT II: PHASE TRANSFORMATIONS   **(09 periods)**

Introduction - Solidification of metal in Ingot mould – Types of phase transformations – Nucleation and Growth Kinetics – Multiphase transformations, Pearlitic, Bainitic, Martensitic transformations – Formation of austenite – Precipitation and age hardening – Special purpose heat treatment – Ferritic nitrocarbonizing, Cementation, Boronizing, Metalliding, Toyota diffusion, Salt nitriding.

UNIT III: DISLOCATIONS AND STRENGTHENINGMECHANISMS   **(09 periods)**

Basic Concepts, Characteristics of Dislocations, Slip Systems, Slip in Single Crystals, Plastic Deformation of Polycrystalline Materials, Deformation by Twinning, Strengthening by Grain SizeReduction, Solid Solution Strengthening, Strain Hardening, Recovery, Recrystallization, Grain Growth.

UNIT IV: MATERIALTESTING AND CHARACTERIZATION TECHNIQUES (09 periods)

Material Testing: Introduction, Tensile Testing, Hardness, Impact fracture testing, Fatigue, Creep.

Material characterization techniques: Introduction, Steps in metallographic specimen preparation, Optical microscope (OM), Scanning electron microscope (SEM), Transmission electron microscope (TEM), X-ray diffraction (XRD), Fourier Transform Infra-red Spectroscopy (FTIR).

UNIT V: POWDER METALLURGY   (09 periods)

Introduction, Methods of production of metal powders, Atomization process, Electrolysis, Reduction, Mechanical Alloying, Particle size, Shape and distribution, Mixing, Blending, Compacting, Hot Isostatic pressing, Cold Isostatic pressing, Sintering, Applications, Advantages and limitations of powder metallurgy.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Avner S. "*Introduction to Physical Metallurgy*", Tata McGraw Hill, 2nd Edition, 2001.R.

2. Balasubramaniam, *Callister's Materials Science & Engineering*, John Wiley and sons, 2nd edition, 2014.

REFERENCE BOOKS:

1. Agrawal B.K. "*Introduction to Engineering Materials*", Tata McGraw Hill, 1st Edition, 2007.

2. George E Dieter, *Mechanical Metallurgy*, Tata McGraw Hill, 3rd edition, 2013

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	1	-	-	-	-	-	-	3	-	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
Average	3	1.8				1							3		
Correlation level	3	2				1							3		

Correlation Levels: 3– High   2 - Medium   1– Low

III B.Tech. – I Semester

(20BT50307) STATISTICAL INFERENCE AND MODELING

(Professional elective 1)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES : --

COURSE DESCRIPTION:

Random vs Non-random sampling; Two tailed and one tailed Hypothesis testing, Type 1 and Type 2 errors, Hypothesis testing using z and t statistics; Completely Randomized design; Simple and Multiple Linear Regression; residual analysis; Decision making under uncertainty - Laplace, Hurwicz and Savage criteria

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Apply sampling and estimation procedures to appropriately use and construe complex data.

CO2. Demonstrate the plausibility of pre-specified ideas about the parameters of the model by Hypothesis Testing

CO3. Design experiments by ANOVA and determine the existence of a statistically significant difference among several group means.

CO4. Develop appropriate regression models to predict the desired parameters.

CO5. Apply non-parametric tests for uncertain distributions and decision analysis to identify feasible and viable decision alternatives

DETAILED SYLLABUS:

UNIT I: SAMPLING AND ESTIMATION   (08 periods)

Random vs Non-random sampling, Errors in sampling, Central Limit Theorem, Types of estimates, Estimating population mean using z and t statistics, Confidence interval estimation, Maximum likelihood estimation

UNIT II: HYPOTHESIS TESTING   (09 periods)

Procedure for Hypothesis testing, Two tailed and one tailed Hypothesis testing, Type 1 and Type 2 errors, Hypothesis testing using z and t statistics, Chi-square test – Goodness of fit, test of independence and test of homogeneity

UNIT III: ANALYSIS OF VARIANCE AND EXPERIMENTAL DESIGNS   (09 periods)

Analysis of variance, Completely Randomized design (One way ANOVA), Randomized Block design, Factorial Design (Two way ANOVA)

UNIT IV: REGRESSION MODELING STRATEGIES   (10 periods)

Planning for modeling, Choice of the model, model formulation, Interpreting Modeling parameters, Assessment of model fit, Missing data; describing, Resampling, validating and simplifying the model; Simple and Multiple Linear Regression, residual analysis, Collinearity, Multiple regression model with two independent variables

UNIT V: NON-PARAMETRICSTATISTICSAND STATISTICAL DECISION THEORY

(09 periods)

Runs Test, Mann-Whitney Test, Wilcoxon Test, Kruskal-Walis Test, Friedman Test, Spearman's Rank correlation

Decision making under uncertainty - Laplace, Hurwicz and Savage criteria; Decision making under risk – Expected monetary Value, Expected Opportunity Loss, Expected Value of Perfect Information; Decision trees

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Naval Bajpai, *Business Statistics*, Pearson, Second Edition 2013.

2. Casella and Berger, *Statistical Inference*, Cengage Learning, 2001.

REFERENCE BOOKS:

1. Frank E Harrel Jr., *Regression Modeling Strategies*, Springer, Second Edition, 2006.

2. Andrew Gelman and Jennifer Hill, *Data Analysis using Regression and multi level/hierarchical models*, Cambridge, 2007.

3. J K Sharma, *Business Statistics*, Vikas, Fifth Edition, 2020.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1									3
CO2	3	1				1									3
CO3	3	3	3	2	1	1									3
CO4	3	3	3	2	1	1									3
CO5	3	2				1									3
Average	3	2.4	2.3	1.6	1	1									3
Correlation level	3	3	3	2	1	1									3

Correlation Levels: **3– High** **2 - Medium** **1– Low**

(20BT50308) TOOL DESIGN

(Professional Elective-1)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

A Course on Engineering Metrology and Machine Tools

COURSE DESCRIPTION:

Basic cutting parameters; Determination of cutting forces; design of single and multi-point cutting tools; design of dies; design of jigs and fixtures.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge of cutting tools and tool cost estimation for machining of materials.

CO2. Design single point cutting tools for metal removal.

CO3. Design multi-point cutting tool for effective metal removal rate and enhanced productivity.

CO4. Design dies for sheet metal operations.

CO5. Design jigs and fixtures for holding the work and guiding the tool.

DETAILED SYLLABUS:

UNIT I: **INTRODUCTION TO CUTTING TOOLS** **(09 periods)**

Introduction, Different types of cutting tools used for machining, Designation of cutting tools, Types of systems used for designating cutting tools, Selection of tool material, Types, Properties and Characteristics of tool Material, Tool wear, Tool life criteria, variables affecting tool life and machinability, Taylor's tool life equation, Types of coolants, Elements of machining cost, Tool cost estimation.

UNIT II: DESIGN OF SINGLE POINT CUTTING TOOLS **(09 periods)**

Introduction, Basic Elements, Design of Tool Shank, Geometry of single point cutting tool, Nomenclature of single point cutting tool, Influence of Various Angles on Tool Design, Calculation of Forces and Design for Cutting Forces, Mechanics of orthogonal cutting, Merchant's circle diagram, Geometry and their interrelation, Theories of formation of chip and their effect.

UNIT III: DESIGN OF MULTI POINT CUTTING TOOLS **(09 periods)**

Introduction, Classification of multi point cutting tools, Drill geometry, Design of Drills, Rake & Relief angles of twist drill, Speed, Feed and depth of cut, Machining time.

Milling cutters: Up milling & down milling, Cutting speeds and Feed machining times-Design of form cutters, combination tools & reamers.

UNIT IV: DESIGN OF DIES FOR SHEET METAL OPERATIONS   (09 periods)

Design of sheet metal blanking and piercing: Fundamentals of die cutting operations, Types of presses, Die block design, Punch design, Cutting action in a die, Die clearance, Considerations in Press Tool Design, Design procedure for blanking die.

Design of sheet metal bending, forming, drawing and forging dies:

Bending dies, Forming dies, Drawing dies, Determination of blank size, Drawing force, Design procedure for a drawing die, Forging design, Design of forging dies.

UNIT V: DESIGN OF JIGS AND FIXTURES   (09 periods)

Introduction, Concept of degrees of freedom, 3-2-1 principle of location, Principles of location and clamping for jig and fixtures design, Different types of locators and clamps, Jig bushes and its types, Different types of jigs and its design, Essential features of different types of fixtures, Design of fixtures, Indexing jigs and fixtures, Automatic clamping devices.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Donaldson, Lecain and Goold, *Tool Design*, Tata McGraw Hill, 4th edition, 2012.

2. G.R.Nagpal, *Tool Engineering & Design*, Khanna Publishers, Tata McGraw Hill, 6th edition, 2008.

REFERENCE BOOKS:

1. Surendra Kenav and Umesh Chandra, Satyaprakashan, Production Engineering Design (Tool Design), New Delhi.

2. Amitabha Battacharya and Inyong Ham, Design of Cutting Tools use of Metal Cutting Theory, ASTME Publication, Michigan USA.

3. V.Arshinov, G.Alekseev, Metal Cutting Theory and Cutting Tool Design, MIR Publications.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-			1		3		
CO2	3	3	3	1	-	1							3		
CO3	3	3	3	1	-	1							3		
CO4	3	3	3	1	-	1							3		
CO5	3	3	3	1	-	1							3		
Average	3	3	3	1		1					1		3		
Correlation level	3	3	3	1		1					1		3		

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT50309) TRIBOLOGY

(Professional Elective-1)

Int. Marks	Ext. Marks	Total Marks		L T P C
30	70	100		3 - - 3

PRE-REQUISITES:

Course on Basic Engineering Mechanics

COURSE DESCRIPTION:

Surface friction; characteristic, sources, wear of various metals; lubricants, types, lubrication necessity; film lubrication theory; loads on bearing; surface modification; surface coatings; fusion processes; material for bearings.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge of friction characteristics of surfaces.

CO2. Analyze wear mechanisms in different material and determine wear rate.

CO3. Demonstrate the knowledge of lubricants.

CO4. Analyze geometric Characteristics of Surfaces considering Health and safety aspects.

CO5. Demonstrate knowledge of Surface Engineering and Bearing Materials.

DETAILED SYLLABUS:

UNIT I: SURFACES AND FRICTION   **(09 Periods)**

Introduction to tribology, Economic aspects of tribology, Topography of engineering surfaces, Contact between surfaces, Sources of sliding Friction, Adhesion, Ploughing, Energy dissipation mechanisms; Friction Characteristics : metals, non metals, lamellar solids, Ceramic materials and polymers, Rolling Friction, Source of Rolling Friction, Stick slip motion, laws of Friction.

UNIT II: WEAR   **(09 Periods)**

Types of wear, Simple theory of Sliding Wear, Mechanism of sliding wear of metals, Ceramics and Polymers, Wear mechanisms- Abrasive wear, Adhesive, Abrasive wear situations, tribochemical reactions, Corrosive wear, Surface Fatigue wear situations, Fracture wear, fretting, erosion, Estimation of wear rate.

UNIT III: LUBRICANTS   **(09 Periods)**

Introduction, effect and necessity of lubrication, Lubrication types, properties, Requirements of Lubricants, Testing methods, Hydrodynamic Lubrication, Elasto-hydrodynamic lubrication, Boundary Lubrication, solid and semi solid lubricants, Solid Lubrication, Hydrostatic Lubrication.

UNIT IV: SURFACE TOPOGRAPHY   **(09 Periods)**

Geometric Characteristics of Surfaces, Computation of Surface Parameters-Mean, Ten point average, CLA methods, Load bearing curves, Film Parameters for Different Lubrication Regimes, Transition Between Lubrication Regimes, Health and safety aspects of lubricants.

UNIT V: SURFACE ENGINEERING AND BEARING MATERIALS   (09 Periods)

Scope of surface engineering, Surface modifications, Transformation Hardening, Surface fusion, Thermo chemical processes, Surface coatings, Plating and anodizing, Fusion Processes, Vapour Phase processes, Chemical vapour deposition.

Bearing materials: selection of bearing materials, metal bearings, Non-metal bearings.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. I.M. Hutchings, Tribology, Friction and Wear of Engineering Material, Edward Arnold, London, 1992.

2. A.Harnoy, *Bearing Design in Machinery*, Marcel Dekker Inc, New York, 2003

REFERENCE BOOKS:

1. Kenneth C Ludema, *Friction, Wear, Lubrication: A Textbook in Tribology*, CRC Press,1996.

2. A.Cameron, *Basic Lubrication Theory*, Longman, U.K.., 1981.

3. M.J.Neale (Editor), *Tribology Handbook* ,Newnes. Butter worth, Heinemann, U.K.,1995.

4. T.A. Stolarski, *Tribology in Machine Design*, Industrial Press Inc., 1990.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1											3		
CO2	3	3											3		
CO3	3	1											3		
CO4	3	3			2	1							3		
CO5	3	1											3		
Average	3	1.8			2	1							3		
Correlation level	3	2			2	1							3		

Correlation Levels: 3– High   2 - Medium   1– Low

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III B. Tech. – I Semester

(20BT4HS01) BANKING AND INSURANCE

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

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Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE REQUISITE: --

COURSE DESCRIPTION:

Introduction to Banking; Bank-Customer Relationship; Electronic Payment System and Business Models; Introduction To Risk And Insurance; Insurance Overview.

COURSE OUTCOMES:

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

CO1. Demonstrate the importance of Banking and functions of Reserve Bank of India and its role in sustainable development of the country.

CO2. Demonstrate the role, relationships and operations between Banker and Customer.

CO3. Demonstrate the online Banking system, various types of Electronic Payments and Business   models.

CO4. Demonstrate concept of risk and principles, functions, types of Insurance companies.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO BANKING   (9 periods)

Meaning - Importance of banking- Functions of banking - **Reserve Bank of India**: Functions – Role of RBI in sustainable development.

UNIT II: BANK-CUSTOMER RELATIONSHIP   (9 periods)

Debtor-creditor relationship, deposit products or services, payment and collection of cheques. Accounts – Types of accounts, procedure for opening and closing an account - Loans and Advances- principles of lending.

UNIT III: ELECTRONIC PAYMENT SYSTEM&BUSINESS MODELS   (9 periods)

Introduction to Online Banking - types of e-payment system, e-cash, NEFT, RTGS, Credit cards, Electronic Wallet and Debit cards. **Business models**- B2B, B2C, C2C, and B2G.

UNIT IV: INTRODUCTION TO RISK AND INSURANCE   (9 periods)

Concept of risk, risk *Vs* uncertainty. **Insurance**: Definition, Insurance as risk mitigation mechanism, elements of insurance.

UNIT V: INSURANCE OVERVIEW   (9 periods)

Principles of insurance - insurance types - LIC & GIC – insurance functions, IRDA - Insurance Players in India.

<div align="right">

Total Periods: 45

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Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. RanganadhaChary,A.V. and Paul, R.R., *Banking and Financial system*, Kalyani Publisher, New Delhi, 3rdedition, 2016.

2. Sharma,R.K., Shashi K. Gupta and Jagwant Singh, *Banking and Insurance*, Kalyani Publishers, New Delhi, 17th edition, 2014.

REFERENCES BOOKS:

1. Indian Institute of Banking & Finance, Digital Banking, Taxmann Publications Pvt. Ltd., 2016; edition, 2016.

2. Jyotsna Sethi and Nishwan Bhatia, Elements of Banking and Insurance, PHI Learning Pvt. Ltd., 2nd edition, 2012.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	2	-			
CO2	3	-	-	-	-	-	-	-	-	-	2	-			
CO3	3	-	-	-	-	-	-	-	-	-	-	-			
CO4	3	-	-	-	-	-	-	-	-	-	-	-			
Average	3	-	-	-	-	-	-	-	-	-	2	-			
Correlation level	3	-	-	-	-	-	-	-	-	-	2	-			

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT4HS03) COST ACCOUNTING AND FINANCIAL MANAGEMENT

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE REQUISITE: --

COURSE DESCRIPTION:

Cost accounting; cost sheet & preparation of cost sheet; standard costing & variance analysis; financial management & ratio analysis; introduction to investment**.**

COURSE OUTCOMES:

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

CO1. Demonstrate the concepts of Cost Accounting and Management Accounting and the elements of costing.

CO2. Determine the Cost of Production for pricing decisions..

CO3. Apply the Standard Costing and Variance techniques for the control of cost of production.

CO4. Analyze the Profitability and financial condition of an organization using Ratios.

CO5. Apply the Capital Budgeting techniques for making investment decisions in an Organization.

DETAILED SYLLABUS:

UNIT I: COST ACCOUNTING   (9 Periods)

Meaning of Cost and Cost Accounting, Objectives, Scope, Advantages and disadvantages – Cost Accounting *Vs* Management Accounting – Elements of Costing – Installation of costing system – Material Control, Labor Control, Overhead Control.

UNIT II: COST SHEET & PREPARATION OF COST SHEET   (9 Periods)

Analysis of Cost – Preparation of cost sheet, estimate, tender and quotation (Simple problems) – Importance of Costing while pricing the products.

UNIT III: STANDARD COSTING & VARIANCE ANALYSIS   (9 Periods)

Introduction to Standard Costing & Variances – Variance Analysis: Material variances, Labor variances (Simple Problems).

UNIT IV: FINANCIAL MANAGEMENT & RATIO ANALYSIS   (9 Periods)

Meaning, Objectives - Nature and Scope, Importance of FM – **Ratio Analysis:** Types of Ratios: Solvency Ratios, Liquidity Ratios, Turnover Ratios and Profitability Ratios - Financial Statement Analysis through Ratios (Simple Problems).

UNIT V: INTRODUCTION TO INVESTMENT   (9 Periods)

Investment - Meaning and Definition- concept of risk and returns - Capital budgeting techniques – Security Analysis and Portfolio Management (Basic concepts).

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. S.P. Jain and K.L. Narang: *Cost Accounting*, Kalyani Publishers, Ludhiana, 10th edition, 2016.

2. I.M. Pandey, *Financial Management*, Vikas Publishing House Pvt. Ltd., 14th edition, 2016.

REFERENCE BOOKS:

1. The Institute of Company Secretaries of India, *Cost and Management Study Material*, New Delhi.

2. CA Saravana Prasath, *Cost Accounting and Financial management*, Wolters Kluwer India Pvt. Ltd., New Delhi,2018 edition,2018.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-			
CO2	-	3	1	-	-	-	-	-	-	1	-	-			
CO3	-	3	2	-	-	-	-	-	-	2	-	-			
CO4	1	3	2	-	-	-	-	-	-	2	-	-			
CO5	-	3	2	-	-	-	-	-	-	2	-	-			
Average	2	3	1.75	-	-	-	-	-	-	1.75	-	-			
Correlation level	2	3	2	-	-	-	-	-	-	2	-	-			

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – I Semester

(20BT4HS05) GENDER AND ENVIRONMENT

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Gender and the environment relationship, Gendered Roles in the family & community, Gender and sustainable development, Gender in environmental justice, Gender & environmental security.

COURSE OUTCOMES:

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

CO1. Apply the knowledge of gender & environmental connections by analyzing key issues and topics within global environmental politics in environmental decision-making.

CO2. Demonstrate the knowledge of the concepts of gender and sustainable development through debates and policy documents.

CO3. Analyze the concept of environmental security and justice by identifying the sources of insecurity.

DETAILED SYLLABUS:

UNIT I: GENDER AND ENVIRONMENT RELATIONSHIP   (9 Periods)

Introduction – Gender and Environment – Development of gender roles – Society, gender & environment – Understanding environmental politics – Gender-environment connections– Eco-feminism – Cultural eco-feminism – Social eco-feminism – Feminist political ecology

UNIT II: GENDERED ROLES IN THE FAMILY & COMMUNITY   (9 Periods)

Organization of the household – Domestic division of labour – Food: growing, harvesting, shopping, preparing, and cooking - Gender & Power – Planning – Politics – NGO – Gendering of environmental protest – Environmental decision-making

UNIT III: GENDER AND SUSTAINABLE DEVELOPMENT   (9 Periods)

Concept of sustainability & its achievement – Concept of sustainable development – Ecological Modernization – Gender & sustainability debates – Gender & sustainable development debates - Gender in policy documents – Gender, poverty & equity in sustainable development.

UNIT IV: GENDER IN ENVIRONMENTAL JUSTICE   (9 Periods)

Normative Concerns (Fairness, Inequality & Justice) –Making sense of Environmental justice – Ecological debt, Transnational harm, & human rights – Ecological justice – Gender & Environmental Justice – Gender, Vulnerability & risk – Women in environmental justice movements – Knowledge & participation – Gender, sustainability & justice as guiding concepts.

UNIT V: GENDER AND ENVIRONMENTAL SECURITY   **(9 Periods)**

Connections between security & the environment – **Gender, environment & security:** Sustainability as security – poverty & insecurity – Insecurity as injustice – Competing ways of thinking security – Reflecting on sources of insecurity – **Case Study** – Food Security - **Case Study** – The impacts of natural disasters

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Nicole Detraz. *Gender and the Environment.* Polity Press, Cambridge, UK. 2017.

2. Susan Buckingham- Hatfield. *Gender and Environment*. Routledge, London. 2000.

REFERENCE BOOKS:

1. Promillakapur ed. *Empowering Indian Women*. Publication Division, Government of India, New Delhi. 2000.

2. Ronnie Vernooy, Ed. *Social and Gender Analysis Natural Resource Management: Learning Studies and Lessons from Asia.* Sage, New Delhi. 2006

3. Swarup Hemlata and Rajput, Pam. "Gender Dimensions of Environmental and Development Debate: The Indian Experience" In Sturat S. Nagel, (ed). *India's Development and Public Policy*. Ashgate, Burlington. 2000.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	3	3	-	-	-	-	-			
CO2	3	-	-	-	-	2	3	1	-	2	-	-			
CO3	3	1	-	-	-	3	3	-	-	-	-	2			
Average	3	1	-	-	-	2.6	3	1	-	2	-	2			
Correlation level	3	1	-	-	-	3	3	1	-	2	-	2			

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT4HS07) INDIAN ECONOMY

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Introduction; Elementary Economic Analysis; Economic Planning; Time Value of Money; Value Analysis/Value Engineering.

COURSE OUTCOMES:

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

CO1. Understand the basic concepts of economics, economic analysis, economic planning and strata.

CO2. Demonstrate knowledge in capital budgeting, evaluation of engineering projects, depreciation policy and familiarize with the concepts of value analysis vs value engineering.

CO3. Analyze and apply financial information for the evaluation of finance.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION   (9 Periods)

Economics-Flow in an Economy, Law of Supply and Demand; Micro and Macro Economics; Relationship between Science, Engineering, Technology and Economic Development; Concept of Engineering Economics-Types of Efficiency, Definition and Scope of Engineering Economics.

UNIT II: ELEMENTARY ECONOMIC ANALYSIS   (9 Periods)

Economic Analysis – Meaning, Significance, Simple Economic Analysis; Material Selection for a Product, Substitution of Raw Material; Design Selection for a Product; Material Selection-Process Planning, Process Modification.

UNIT III: ECONOMIC PLANNING   (9 Periods)

Introduction - Need For Planning in India, Five year plans(1951-2012), NITI Aayog (from 2014 onwards); Inclusive Growth-Meaning, Significance, Need for inclusive growth in India, Strategy for more inclusive growth, Challenges and Prospects; Employment and Inclusive Growth in India, Role of engineers in sustaining inclusive growth.

UNIT IV: TIME VALUE OF MONEY   (12 Periods)

Concepts and Application; Capital Budgeting-Traditional and Modern Methods; Simple and Compound Interest, Cash Flow Diagram, Principle of Economic Equivalence; Evaluation of Engineering Projects - Present Worth Method, Future Worth Method, Annual Worth Method, Internal Rate of Return Method, Cost-benefit Analysis in Public Projects; Depreciation Policy-Depreciation of Capital Assets, Causes of Depreciation, Straight Line Method and Declining Balance Method.

UNIT V: VALUE ANALYSIS/VALUE ENGINEERING   **(6 Periods)**

Introduction-Value Analysis, Value Engineering, Functions, Aims; Value Analysis vs Value Engineering; Value Engineering Procedure- Advantages, Application Areas.

                                            Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Panneerselvam. R., *Engineering Economics*, PHI Learning Private Limited, New Delhi,2nd edition, 2013.

2. Jain. T. R., V. K. Ohri, O. P. Khanna., *Economics for Engineers*. VK Publication,1st edition, 2015.

REFERENCE BOOKS:

1. Dutt Rudar & Sundhram K. P. M., Indian Economy, S. Chand, New Delhi, 62nd revised edition, 2010.

2. Misra, S. K. & V. K. Puri., Indian Economy: Its Development Experience, Himalaya Publishing House, Mumbai, 32nd edition, 2010.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	2	-	-	-	-	-	-			
CO2	3	-	-	-	-	2	-	-	-	-	-	2			
CO3	3	-	-	-	-	2	-	-	-	-	-	2			
Average	3	-	-	-	-	2	-	-	-	-	-	2			
Correlation level	3	-	-	-	-	2	-	-	-	-	-	2			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT4HS09) LIFE SKILLS

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Positive attitude; Self-discovery and Interpersonal relationships; Cross-cultural communication; Core thinking, Problem solving and Decision making; Business presentations and Public speaking.

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge of strategies involved in developing positive attitude, improving self-discovery by SWOT analysis techniques and managing effective inter personal relationships.

CO2. Apply appropriate speaking styles and techniques by analysing and demonstrating effective cross-cultural communication in different situations.

CO3. Analyse problem solving strategies in decision making by developing core thinking skills.

CO4. Analyse and demonstrate presentation and public speaking skills effectively in business and professional arena.

DETAILED SYLLABUS:

UNIT I: POSITIVE ATTITUDE   (9 Periods)

Introduction–Features of attitudes–Formation of attitudes–Ways of changing attitude in a person– Attitude in a work place–Developing positive attitude–Obstacles in developing positive attitude–Measuring attitude.

UNIT II: SELF DISCOVERY AND INTERPERSONAL RELATIONSHIPS   (9 Periods)

Importance of knowing yourself–Process of knowing yourself–SWOT Analysis–Elements of attitude in interpersonal relationships–Methods to deal with different types of interpersonal relationship skills.

UNIT III: CROSS-CULTURAL COMMUNICATION   (9 Periods)

Different communication styles – Cultural variables – Communication sensitivity and variables of national culture – Individual cultural variables – Cross-cultural communication Strategies – Potential hot spots in cross-cultural communication – Cross-cultural communication – Basic Tips.

UNIT IV: CORE THINKING, PROBLEM SOLVING AND DECISION MAKING (9 Periods)

Process of developing core thinking skills–Categories of thinking: Critical & Creative - understanding problem solving–Cause of problems–Stages of problem solving–Methods of problem solving–Types of decision making.

UNIT V: BUSINESS PRESENTATIONS AND PUBLIC SPEAKING   (9 Periods)

Business presentations and speeches– Structuring the material–Types of delivery–Guidelines for delivery–Effective sales presentation–Controlling nervousness and stage fright.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Dr. K. Alex (2018) *Soft Skills*, S. Chand and Company Limited, New Delhi.

2. Manmohan Joshi (2017) *Soft Skills*, www.bookboon.com, Bangalore.

REFERENCE BOOKS:

1. Meenakshi Raman and Prakash Singh (2015) *Business Communication*, Oxford University Press, New Delhi.

2. Jeff Butterfield (2011) *Soft Skills for Everyone*, Cengage Learning India Private Limited, Delhi.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	3	-	-	-	-	2	3	-			
CO2	1	2	-	-	3	-	-	-	-	3	-	-			
CO3	1	3	-	-	2	-	-	-	-	-	-	-			
CO4	1	2	-	-	-	-	-	-	-	3	-	-			
Average	1.25	2	-	-	2.6	-	-	-	-	2.6	3	-			
Correlation level	1	2	-	-	3	-	-	-	-	3	3	-			

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – I Semester

(20BT4HS11) INDIAN TRADITION AND CULTURE

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Basic traits of Indian Culture; Humanistic Reforms under Jainism and Buddhism; Culture in the medieval period; Socio Religious reforms in Indian Culture; Reform movements for harmonious relations.

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge in Vedic and Upanishadic culture and society to consider human aspirations, values and theories.

CO2. Understand the contributions of Buddhism and Jainism to Indian culture.

CO3. Examine the cultural conditions and achievements of India under Mouryas and Guptas.

CO4. Analyze social religious reforms and reform movements.

DETAILED SYLLABUS:

UNIT I: BASIC TRAITS OF INDIAN CULTURE   (9 Periods)

Meaning and definition and various interpretations of culture - Culture and its features - The Vedic and Upanishad culture and society - Human aspirations and values in these societies - Chaturvidha purushardhas, Chaturashrma and Chaturvarna theory.

UNIT II: HUMANISTIC REFORMS UNDER JAINISM AND BUDDHISM   (9 Periods)

Salient features of Jainism - contributions of Jainism to Indian culture - Contributions of Aachaarya and Mahaapragya - Buddhism as a humanistic culture - The four noble truths of Buddhism - Contributions of Buddhism to Indian culture.

UNIT III: CULTURE IN THE MEDIEVAL PERIOD   (9 Periods)

Unifications of India under Mouryas and Guptas and their cultural achievements - Cultural conditions under satavahanas - Contributions to pallavas and cholas to art and cultural achievements of vijayanagara rulers.

UNIT IV: SOCIO RELIGIOUS REFORMS IN INDIAN CULTURE   (9 Periods)

Western impact on India - Introduction of western education - social and cultural awakening and social reform movements of Rajaramohan Roy - Dayanandha Saraswathi - Anne Besant (theosophical society).

UNIT-V: REFORM MOVEMENTS FOR HARMONIOUS RELATIONS   (9 Periods)

Vivekananda, Eswarchandravidyasagar and Veeresalingam - emancipation of women and struggle against caste - Rise of Indian nationalism - Mahatma Gandhi – Non-violence and satyagraha and eradication of untouchability.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOK:

1. Valluru Prabhakaraiah, *Indian Heritage and Culture*, Neelkamal Publications Pvt. Ltd. Delhi, 1/e , reprint 2015.

REFERENCE BOOKS:

1. L. P. Sharma, *History of Ancient India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.

2. L. P. Sharma, *History of Medieval India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.

3. The Cultural Heritage of India Vol-I, II, III, IV, V, The Ramakrishna Mission Institute of Culture, Calcutta.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	-			
CO2	3	-	-	-	-	1	-	-	-	-	-	2			
CO3	2	-	-	-	-	3	-	-	-	-	-	-			
CO4	2	-	-	-	-	3	-	-	-	-	-	2			
Average	2.5	-	-	-	-	2	-	-	-	-	-	2			
Correlation level	3	-	-	-	-	2	-	-	-	-	-	2			

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – I Semester

(20BT4HS13) CONSTITUTION OF INDIA

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Preamble and its Philosophy; Union Legislature; Federalism in India; Judiciary and Public Services; Nation Building

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge in the Parliamentary proceedings, Election Commission, Public Services and Foreign Policy of India.

CO2. Apply the reasoning informed by the various aspects of the Constitution and its provisions to assess societal issues and the consequent responsibilities relevant to the professional engineering practice.

DETAILED SYLLABUS:

UNIT I: PREAMBLE AND ITS PHILOSOPHY (9 Periods)

Introduction to Indian Constitution; Evolution of Indian Constitution; preamble and its philosophy

UNIT II: UNION LEGISLATURE (9 Periods)

The Parliament, Parliamentary Structure, Process of Legislation; President of India – Powers and Functions; Prime Minister and Council of Ministers; Constitution Amendment Procedure.

UNIT III: FEDERALISM IN INDIA (9 Periods)

Centre-State Administrative Relationship; Governors - Powersand Functions; State Legislature - Composition and powers; Chief Ministers - Powers and Functions; The Election Commission – Powers and Functions.

UNIT IV: JUDICIARY AND PUBLIC SERVICES (9 Periods)

The Union Judiciary - Supreme Court and High Court; Fundamental Rights and Duties All India Services - Central Civil Services -State Services - Local Services.

UNIT-V: INTERNATIONAL PARTICIPATION (9 Periods)

Foreign Policy of India; International Institutions Influence: UNO, WTO, WHO, SAARC, International Summits: BRICS, NSS, UNEP – India's Role in International Negotiations; Environmentalism in India.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOK:

1. Briji Kishore Sharma, *Introduction to the Constitution of India*, Prentice Hall of India, 2005.

REFERENCE BOOKS:

1. Mahendra Pal Singh,V. N. Shukla's, *Constitution of India*, Eastern Book Company, 2011.

2. Pandey J. N., *Constitutional Law of India* - Central Law Agency, 1998

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	-	-	-	3	2	-	-	-	-	-			
CO2	2	-	-	-	-	3	-	3	-	-	-	-			
Average	3	-	-	-	-	3	-	3	-	-	-	-			
Correlation level	3	-	-	-	-	3	2	3	-	-	-	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT50106) DISASTER MITIGATION AND MANAGEMENT

(Open Elective - 2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Disasters; Earthquakes; Floods; Cyclones; Droughts; Landslides; Disaster management.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.

CO2. Propose appropriate mitigation strategies for earthquake and tsunami impacts as per code of practice using suitable techniques ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze the causes and impacts of floods, cyclones and droughts using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze the causes and impacts of landslides using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO5. Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

DETAILED SYLLABUS:

UNIT- I: DISASTERS   (09 Periods)

Types of disasters - Natural disasters; Impact of disasters on environment, infrastructure and development; Concepts of hazards and vulnerability analysis, Hazard Assessment, Guidelines for hazard assessment and vulnerability analysis, Basic principles and elements of disaster mitigation.

UNIT- II: EARTHQUAKES   (09 Periods)

Introduction to earthquake, Intensity scale (MSK–64), Seismic zones and activity in India, Action plan for earthquake disaster preparedness, Elements at risk, Recovery and rehabilitation after earthquake, Concepts of Earthquake resistant design and construction of buildings; Tsunami – Onset, Types and causes, Warning, Elements at risk, Typical effects, Specific preparedness and mitigation strategies, Case studies.

UNIT- III: FLOODS, CYCLONES AND DROUGHTS   (11 Periods)

Floods and Cyclones: Onset, Types, Causes, Warnings, Elements at risk, Typical effects, Indian floods and cyclones, Hazard zones, Potential for reducing hazards, Mitigation strategies and community based mitigation, Case studies.

Droughts: Onset, Types and warning; Causes, Impact, Early warning and response mechanisms, Mitigation strategies, Droughts in India, Case studies.

UNIT- IV: LANDSLIDES   (08 Periods)

Onset, Types and warning; Causes, Elements at risk, Indian landslides, Hazards zones, Typical effects, Mitigation strategies and community based mitigation, Case studies.

UNIT- V: DISASTER MANAGEMENT   (08 Periods)

Disaster management organization and methodology, Disaster management cycle, Disaster management in India – Typical cases and Cost–benefit analysis, Disaster management programs implemented by NGOs and Government of India, Usage of GIS and Remote sensing techniques in disaster management, Leadership and Coordination in Disaster management, Emerging trends in disaster management.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. V. K. Sharma, *Disaster Management, Medtech Publishing, 2nd Edition, 2013*.

2. Anand S. Arya, Anup Karanth, and Ankush Agarwal, *Hazards, Disasters and Your Community: A Primer for Parliamentarians*, GOI–UNDP Disaster Risk Management Programme, Government of India, National Disaster Management Division, Ministry of Home Affairs, New Delhi, Version 1.0, 2005.

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, *Natural Hazards and Disasters*, Cengage Learning, 3rd Edition, 2011.

2. *Disaster Management in India,* A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.

3. Rajendra Kumar Bhandari, *Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers*, Springer India, 2014.

4. R. B. Singh, *Natural Hazards and Disaster Management*, Rawat Publications, 2009.

ADDITIONAL LEARNING RESOURCES:

1. Tushar Bhattacharya, *Disaster Science and Management*, McGraw Hill, 2014.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	2	2	2	2	-	-	-	-			
CO2	3	3	3	3	2	2	1	2	-	2	-	-			
CO3	3	3	-	2	2	2	2	-	-	2	-	-			
CO4	3	3	-	3	2	2	2	-	-	-	-	-			
CO5	3	2	3	2	2	2	1	2	-	1	3	2			
Average	3	2.8	3	2.5	2	2	1.6	2	-	1.6	3	2			
Correlation level	3	3	3	2.5	2	2	2	2	-	2	3	2			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT50107) SUSTAINABLE ENGINEERING

(Open Elective - 2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Principles of sustainability; Sustainability metrics and assessment tools; Sustainable engineering practices; Sustainable engineering applications; Sustainable urbanization and industrialization.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the principles of sustainability to solve complex environmental problems following relevant standards/protocols considering society, health, safety and environment.

CO2. Analyze sustainability metrics and assessment tools to solve complex environmental problems following relevant standards and emerging trends considering society, health, safety, environment and economics besides communicating effectively in graphical form.

CO3. Analyze sustainable engineering practices to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO4. Design sustainable engineering applications to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO5. Analyze sustainable urbanization and industrialization principles to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

DETAILED SYLLABUS:

UNIT I: PRINCIPLES OF SUSTAINABILITY   (09 periods)

Emerging challenges, Sustainability and sustainable engineering; Environmental concerns; Social, economic and legal issues; Availability and depletion of natural resources, Disaster resiliency; Multilateral environmental agreements – Basel convention, Clean development mechanism (CDM), Montreal and Kyoto protocols.

UNIT II: SUSTAINABILITY METRICS AND ASSESSMENT TOOLS   (09 periods)

Sustainability indicators, metrics and assessment tools; Material flow analysis and material budget, Carbon footprint analysis, Life cycle assessment, Streamlined life-cycle assessment

(SLCA), Economic input output-life cycle analysis, Environmental health risk assessment, Other emerging assessment tools.

UNIT III: SUSTAINABLE ENGINEERING PRACTICES   (09 periods)

Sustainable energy engineering, Sustainable waste management, Green and sustainable buildings and infrastructure, Sustainable civil infrastructure, Sustainable remediation of contaminated sites, Climate geoengineering.

UNIT IV: SUSTAINABLE ENGINEERING APPLICATIONS   (09 periods)

Environmental and chemical engineering projects, Materials engineering projects, Infrastructure engineering projects – Background, Methodology, Goal and Scope, Study area, Technical design, Environmental sustainability, Life cycle assessment, Economic sustainability, Social sustainability, Rating systems – ENVISION, LEED, GRIHA, IGBC; Conclusions.

UNIT V: SUSTAINABLE URBANIZATION AND INDUSTRIALIZATION   (09 Periods)

Sustainable urbanization and industrialization, United Nations sustainable development goals – Right to education, Poverty eradication, Social and technological changes; Industrial Processes - Material selection, Energy efficiency, Pollution prevention and control techniques, Industrial Ecology, Industrial symbiosis.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Reddy, K.R., Cameselle, C., and Adams, J.A., *Sustainable Engineering: Drivers, Metrics, Tools, and Applications*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2019, 544p (ISBN: 978-1-119-49393-8).

2. Allen, D. T. and Shonnard, D. R., *Sustainability Engineering: Concepts, Design and Case Studies*, Pearson Education, 1st Edition, 2012.

REFERENCE BOOKS:

1. Bradley. A.S; Adebayo, A. O., Maria, P., *Engineering Applications in Sustainable Design and Development*, Cengage Learning, 1st Edition, 2016.

2. Purohit, S. S., *Green Technology: An Approach for Sustainable Environment*, Agrobios Publication, 1st Edition, 2016.

3. *Energy Conservation Building Code (ECBC) 2007*, Bureau of Energy Efficiency, Govt. of India, New Delhi.

4. Twidell, J. W. and Weir, A. D., *Renewable Energy Resources*, Routledge, Taylor & Francis Group, 3rd Edition, 2015.

ADDITIONAL LEARNING RESOURCES:

1. Daniel A. Vallero and Chris Brasier, *Sustainable Design: The Science of Sustainability and Green Engineering*, Wiley-Blackwell, 1st Edition, 2008.

2. Jorge A. Vanegas, *Sustainable Engineering Practice: An Introduction*, Committee on Sustainability, American Society of Civil Engineers, https://doi.org/10.1061/9780784407509, 2004.

3. Bell, S. and Morse, S, *Sustainability Indicators: Measuring the Immeasurable?*, Earthscan Publications, London, 2nd Edition, 2008.

4. Mackenthun, K.M., *Basic Concepts in Environmental Management*, CRC Press, Taylor & Francis Group, 1st Edition, 1999.

5. *Environment Impact Assessment Guidelines*, Notification of Government of India, 2006.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	-	2	3	2	-	-	-	-			
CO2	3	3	-	2	2	2	2	2	-	1	2	1			
CO3	3	3	-	2	2	2	2	2	-	1	2	-			
CO4	3	3	3	2	2	2	2	2	-	1	2	-			
CO5	3	3	-	2	2	2	2	2	-	1	2	-			
Average	3	3	3	2.2	2	2	2.2	2	-	1	2	1			
Correlation level	3	3	3	2	2	2	2	2	-	1	2	1			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT50108) CONTRACT LAWS AND REGULATIONS

(Open Elective - 2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Construction contracts; Tenders; Arbitration; Legal requirements; Labour regulations.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Develop construction contracts to solve complex contract related problems by following laws and regulations considering project schedule, cost, quality and risk.

CO2. Prepare tenders as per the specifications by following latest developments, laws and regulations to solve complex tender problems considering project schedule, cost, quality and risk.

CO3. Analyze arbitration problems to address the contract disputes following the laws and regulations in the context of society.

CO4. Analyze legal issues pertaining to contracts and tenders considering society.

CO5. Analyze labour regulations to address labour safety issues.

DETAILED SYLLABUS:

UNIT I: CONSTRUCTION CONTRACTS   (09 Periods)

Indian contracts act, Elements of contracts, Types of contracts, Features, Suitability, Design of contract documents, International contract document and laws, Standard contract document, Law of torts.

UNIT II: TENDERS   (09 Periods)

Prequalification, Bidding, Accepting; Evaluation of tender from technical, contractual and financial points of view; Two cover system, Preparation of the documentation, Contract formation and interpretation, Potential contractual problems, Price variation clause, Comparison of actions and laws, Subject matter, Violations, Latest developments in tendering.

UNIT III: ARBITRATION   (09 Periods)

Arbitration, Comparison of actions and laws, Agreements, Appointment of arbitrators, Conditions of arbitration, Powers and duties of arbitrator, Rules of evidence, Enforcement of award, Arbitration disputes, Dispute review board.

UNIT IV: LEGAL REQUIREMENTS   (09 Periods)

Legal requirements for planning, Property law, Agency law, Tax laws – Income tax, Sales tax, Excise and custom duties, Local government approval, Statutory regulations, Insurance and bonding, Laws governing purchase and sale, Use of urban and rural land, Land revenue codes, EMD, Security deposits, Liquidated damages.

UNIT V: LABOUR REGULATIONS   (09 Periods)

Social security, Welfare legislation; Laws relating to wages, bonus and industrial disputes; Labour administration, Insurance and safety regulations, Workmen's compensation act, Maternity benefit act, Child labour act, Other labour laws.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:
1. Subba Rao, G.C.V., *Law of Contracts I & II*, S. Gogia & Co., 11th Edition, 2011.
2. Jimmie Hinze, *Construction Contracts,* McGraw Hill, 3nd Edition, 2011.

REFERENCE BOOKS:
1. Kishore Gajaria, *GT Gajaria's Law Relating to Building and Engineering Contracts in India*, Lexis Nexis Butterworths India, 4th Edition, 2000.
2. Patil, B. S., *Civil Engineering Contracts and Estimates*, University Press (India) Private Ltd., 4th Edition, 2015.
3. Joseph T. Bockrath, *Contracts and the Legal Environment for Engineers and Architects*, McGraw Hill Education, 7th Edition, 2010.
4. Akhileshwar Pathak, *Contract Law*, Oxford University Press, 2011.

ADDITIONAL LEARNING RESOURCES:
1. Markanda, P.C., Naresh Markanda, Rajesh Markanda, *Building and Engineering Contracts- Law and Practice*, Vol-I and II, LexisNexis Publication. 5th Edition, 2017.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	3	-	3	-	2	1	-			
CO2	3	3	3	3	-	3	-	3	-	2	1	2			
CO3	2	2	-	3	-	3	-	3	-	-	-	-			
CO4	2	2	-	-	-	3	-	3	-	-	-	-			
CO5	2	2	-	-	-	3	-	3	-	-	-	-			
Average	2.4	2.4	3	3	-	3	-	3	-	2	1	2			
Correlation level	2	2	3	3	-	3	-	3	-	2	1	2			

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT50310) GLOBAL STRATEGY AND TECHNOLOGY

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PREREQUISITES: --

COURSE DESCRIPTION:

Introduction to strategic management; Strategic management process; Principles of good strategy; Globalization strategies; Research and Development strategies; Technology Management and Transfer; Elements of Transfer Process; Corporate Governance in the Indian scenario.

COURSE OUTCOMES:

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

CO1. Demonstrate the knowledge on strategic management, its approaches, and tools through ethical decision making.

CO2. Analyze the globalization challenges for scrupulous selection of globalization strategies.

CO3. Apply the R&D strategies and trends to enhance the technological breakthroughs for new products and applications.

CO4. Demonstrate the knowledge on technology management and transfer that strengthen the economy and accelerate the application of technology and resources.

CO5. Analyze the challenges of corporate governance in Indian scenario for the effective development of value oriented organizations.

DETAILED SYLLABUS:

UNIT I: STRATEGIC MANAGEMENT   (9 periods)

Introduction, Classes of decisions, Levels of strategy, Core competence, Strategic intent and stretch, Approaches to strategy making, Roles of different strategists, Strategic management-Process, Benefits, Limitations; Ethics in strategic decision making, Principles of good strategy, Strategic Management in India; Common managerial strategy formulation tools.

UNIT II: GLOBALIZATION   (9 periods)

Definition, Stages, Essential conditions for globalization, Globalization strategies, Competitive advantage of Nations and regions, Factors affecting Globalization, Globalization of Indian business.

UNIT III: RESEARCH & DEVELOPMENT STRATEGIES   (9 periods)

Concept, Evolution of R and D Management, R and D as a business, R and D as competitive advantage, Elements of R and D strategies, Integration of R and D, Selection and implementation of R and D strategies, R and D trends and challenges.

UNIT IV: TECHNOLOGY MANAGEMENT AND TRANSFER   **(9 periods)**

Technology Management: Introduction, Technology-Definition, Components, Classification Features; Technology Management-Concept, Nature; Drivers of Management of Technology-Significance, Scope, Responding to technology challenges.

Technology Transfer: Introduction, Definition, Classification, Significance, Elements of process, Types of Technology Transfer, Package, Modes of Transfer, Routes, Channels and Effectiveness of Technology Transfer.

UNIT-V: CORPORATE GOVERNANCE: THE INDIAN SCENARIO   **(9 periods)**

Emergence of corporate governance in India-Landmarks, Models, Codes and status in India, Role and Responsibilities of Regulators, The Board of Directors; Corporate Governance-Specific issues in India, Family owned Business, Corporate Governance and the Indian ethos.

Total periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Francis Cherunilam, *Strategic Management*, Himalaya Publishing House, 3rdEdition, 2002.

2. C. S. G. Krishnamacharyulu and Lalitha Ramakrishnan, *Management of Technology*, Himalaya Publishing House, Second Edition, 2012.

REFERENCE BOOKS:

1. White and Bruton, *The Management of Technology and Innovation:A Strategic Approach*, Cengage Learning, 1stEdition, 2007.

2. S.K.Mandak, *Ethics in Business and Corporate Governance*, TMH, 2ndEdition, 2012.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	1	1	-	1	-	-	1	-			
CO2	3	2	1	-	1	1	-	-	-	-	1	-			
CO3	3	2	1	-	1	1	-	-	-	-	1	-			
CO4	3	2	1	-	1	1	-	-	-	-	1	-			
CO5	3	2	1	-	1	1	-	1	-	-	1	-			
Average	3	2	1	-	1	1	-	1	-	-	1	-			
Correlation level	3	2	1	-	1	1	-	1	-	-	1	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech. – I Semester

(20BT50311) MANAGEMENT SCIENCE

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Concepts of Management; Concepts Related to ethics and social responsibility; Human Resource Management; Operations Management; Statistical Process Control; Inventory Management; Marketing; Project Management; Project Crashing.

COURSE OUTCOMES:

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

CO1. Demonstrate the concepts of management, its functions and processes used in optimum resource utilization within the context of ethics and social responsibility.

CO2. Apply the concepts of HRM for selection and management of human resources.

CO3. Analyze different operations management problems using quality management tools to produce effective, efficient and adoptable products/services.

CO4. Identify different marketing strategies to maximize enterprise profitability and customer satisfaction within the realistic constraints.

CO5. Develop network models in time-cost tradeoff for effective project management.

DETAILED SYLLABUS:

UNIT I: MANAGERIAL FUNCTION AND PROCESS   **(10 periods)**

Concept and foundations of management, Evolution of management thought; Managerial functions – Planning, Organizing, Directing and Controlling; Decision-making; Role of manager, managerial skills; Managing in a global environment, Flexible systems management; Social responsibility and managerial ethics; Process and customer orientation; Managerial processes on direct and indirect value chain.

UNIT II: HUMAN RESOURCE MANAGEMENT   **(8 periods)**

Human Resource challenges; Human Resource Management functions; Human Resource Planning; Job analysis; Job evaluation, Recruitment and selection; Training and Development; Promotion and transfer; Performance management; Compensation management and benefits; Employee morale and productivity; Human Resource Information System.

UNIT III: OPERATIONS MANAGEMENT   **(10 periods)**

Fundamentals of Operations Management, Services as a part of operations management; Facilities location and layout; Line balancing; Quality management – Statistical Process Control, Total Quality Management, Six sigma; Role and importance of materials management, Value analysis, Make or Buy decision, Inventory control, Materials Requirement Planning, Enterprise Resource Planning, Supply Chain Management.

UNIT IV: MARKETING MANAGEMENT **(8 periods)**

Concept, evolution and scope; Marketing strategy formulation and components of marketing plan; Segmenting and targeting the market; Positioning and differentiating the market offering, Analyzing competition; Product strategy; Pricing strategies; Designing and managing marketing channels; Integrated marketing communications.

UNIT-V: PROJECT MANAGEMENT **(9 periods)**

Project management concepts; Project planning – Work Breakdown Structure, Gantt chart; Project scheduling – Critical Path Method, Program Evaluation and Review Technique, Crashing the project for time-cost trade off; Resource Levelling.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. MartandT.Telsang, *Industrial Engineering and Production Management*, S. Chand, 2nd Edition, 2006.

2. Koontz and Weihrich, *Essentials of Management*,TMH, 6th Edition, New Delhi, 2007.

REFERENCE BOOKS:

1. O.P. Khanna, *Industrial Engineering and Management*, Dhanpat Rai and Sons,2010.

2. N.D. Vohra, *Quantitative Techniques in Management*, TMH, 2nd Edition, New Delhi.

3. L.M. Prasad, *Principles and practice of Management*, S. Chand and Sons, 2006.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	1	1	1	1	-	-	2				
CO2	3	2	1	-	1	-	-	-	-	-	1				
CO3	3	2	1	1	1	-	-	-	-	-	1				
CO4	3	2	1	-	1	1	-	-	-	-	1				
CO5	3	2	1	1	1	1	-	-	-	-	2				
Average	3	1.8	1	1	1	1	1	1	-	-	1.4				
Correlation level	3	2	1	1	1	1	1	1	-	-	1				

Correlation Levels: **3– High** **2 - Medium** **1– Low**

(20BT40502) CYBER LAWS AND SECURITY

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Evolution of Cyberspace, Jurisdiction in the borderless Cyberspace, E-Contracting, Models of E-Commerce, Modes of Electronic signatures, E-Money, Intellectual Property Rights, Cybercrimes, Privacy and data security.

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge on jurisdiction in cyberspace and the impact of cybercrime to protect privacy on the Internet.

CO2. Analyze the Indian cyber laws on E-Contracting, E-Commerce, E-signatures and E-money to promote digital law enforcement.

CO3. Apply the knowledge of digital rights in Indian context to protect intellectual properties in electronic world.

CO4. Practice ethics and cyber law regulations for leading electronic transactions on the Internet.

DETAILED SYLLABUS:

UNIT I: EVOLUTION OF CYBERSPACE AND JURISDICTION IN BORDERLESS CYBERSPACE **(9 Periods)**

The Evolution of Cyberspace: Significance of information technology, Drawbacks in information technology, the digital divide, E-governance, Origin of cyberspace, Legal issues in cyberspace, regulating the Internet.

Jurisdiction in the Borderless Cyberspace: Meaning of jurisdiction, Three pre-requisites of jurisdiction, Jurisdictional theories in jurisdiction to prescribe, Tests to determine jurisdiction in Internet law cases, Indian laws to determine personal jurisdiction, Jurisdiction clauses in click wrap agreement.

UNIT II: ELECTRONIC CONTRACTING AND ELECTRONIC COMMERCE **(9 Periods)**

Electronic Contracting: Formation of offline contracts under English common law, Fundamental requirements of an offline contract, Forming an E-contract through website, E-mail contracting, The Indian approach of E-contracts, Contract formation on the Internet and Information Technology Act 2000, B2C E-contracts.

Electronic Commerce: Models, Advantages, Restricted activities, Laws, India's information Technology Act2000, Online customer protection in India(B2B, B2C).

UNIT III: ELECTRONIC SIGNATURES AND ELECTRONIC MONEY   (9 Periods)

Electronic Signatures: The role of signatures, Significance of electronic signatures, Modes of electronic signatures, UNCITRAL model law on electronic signatures 2001, Cryptography, Role of certifying authority in PKI, The Indian Information Technology Act and electronic signatures- Electronic signatures, Prescribed authentication mechanisms, Secure electronic record.

Electronic Money: E-Money, RBI's guidelines on mobile banking and payments, The current E-payment systems, Earlier E-payment systems, Credit cards, Use of SET in online payment system.

UNIT- IV: INTELLECTUAL PROPERTY RIGHTS AND THE INTERNET WORLD

(9 Periods)

Protecting copyright in the E-world, International organizations protecting Intellectual Property, Copyright issues on the Internet, Digital rights management, Patent protection and computer software, India and copyright protection for computer software, Business method patents- Position of Business methods patents in India, Trademark protection on the Internet, Cyber squatting, The Indian trademark law and legal remedies, Hyper linking and framing.

UNIT - V: CYBERCRIMES AND PROTECTING PRIVACY ON INTERNET   (9 Periods)

Cybercrimes: What is cybercrime, Categories, Different kinds of cybercrime, Cybercrimes and Information Technology Act, 2000 - Territorial scope and applicability, India's national cyber security policy.

Protecting Privacy on the Internet: Meaning of privacy, Threat to privacy on the Internet, Use of cookies and web bugs, Terms of use and privacy policy, Government right to interception, Employee privacy rights, Indian legal framework for data protection and privacy, Challenges to right of privacy in India.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOK(S):

1. Karnika Seth, *Computers Internet and New technology Laws*, LexisNexis, 2013.

REFERENCE BOOKS:

1. Sarika Gupta, Gaurav Gupta, *Information Security and Cyber Laws*, Khanna Publishing, 2019.
2. Vivek Sood, *Cyber Law Simplified*, McGraw Hill,2018.
3. Pavan Duggal, *Textbook on Cyber Law*, Universal LexisNexis, 2019.

ADDITIONAL LEARNING RESOURCES:

*   https://swayam.gov.in/nd2_cec20_cs09/preview
*   https://swayam.gov.in/nd2_nou19_cs08/preview

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	-	-	-	-	-	-			
CO2	3	2	-	-	-	3	-	-	-	-	-	-			
CO3	3	-	-	-	-	3	-	-	-	-	-	-			
CO4	-	-	-	-	-	-	-	3	-	-	-	-			
Average	3	2	-	-	-	3	-	3	-	-	-	-			
Correlation level	3	2	-	-	-	3	-	3	-	-	-	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech. – I Semester

(20BT50206) INTELLECTUAL PROPERTY RIGHTS

(Open Elective – 2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Introduction to Intellectual Property; Trade Marks; Law of Copy Rights; Law of Patents; Trade Secrets; Unfair Competition; New Development of Intellectual Property.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Understand the concepts of intellectual property right and new amendments enforced in filling intellectual property right.

CO2. Understand the processes and principles of trade mark registration and apply them for registering trade mark.

CO3. Understand the process and principles of copy rights registration and judicial consequences for violating laws of copyright/patents.

CO4. Understand the process and principles of trade secrets and judicial consequences for coping trade secrets.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO INTELLECTUAL PROPERTY   (10 periods)

Introduction and the need for intellectual property rights (IPR); types of intellectual property- Design, Geographical Indication; International organizations, agencies and treaties.

UNIT II: TRADEMARKS   (08 Periods)

Introduction to trademark, Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

UNIT III: LAW OF COPYRIGHTS   (09 Periods)

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

UNIT IV: TRADESECRETS   (09 periods)

Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT V: NEW DEVELOPMENT OF INTELLECTUAL PROPERTY **(09 periods)**

New developments in: trade mark law, copy right law, patent law, intellectual property audits. International overview on intellectual property; international - trade mark law, copy right law, international patent law, international development in trade secrets law.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Deborah, E. Bouchoux, *Intellectual property: The law of Trademarks, Copyright, Patents, and Trade Secrets,* cengage learning, 4th edition, 2013.

2. PrabuddhaGanguli, *Intellectual property right - Unleashing the knowledge economy*, Tata McGraw Hill Publishing Company Ltd.

REFERENCE BOOKS:

1. Neeraj P., &Khusdeep D. Intellectual Property Rights. India, IN: PHI learning Private Limited. 1st edition 2019.

ADDITIONAL LEARNING RESOURCES:

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf

2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/ 489/wipo_pub_489.pdf

USEFUL WEBSITES:

1. Cell for IPR Promotion and Management(http://cipam.gov.in/)

2. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)

3. Office of the Controller General of Patents, Designs & Trademarks

(http://www.ipindia.nic.in/)

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	-	3	-	-	-	-			
CO2	2	-	-	-	-	2	-	2	-	-	-	-			
CO3	2	-	-	-	-	3	-	2	-	-	-	-			
CO4	2	-	-	-	-	3	-	2	-	-	-	-			
Average	2.25	-	-	-	-	2.75	-	2.25	-	-	-	-			
Correlation level	2	-	-	-	-	3	-	2	-	-	-	-			

Correlation Levels: **3– High** **2 - Medium** **1– Low**

(20BT50406) GREEN TECHNOLOGIES

(Open Elective-2)

(Common to CE, ME, EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: -

COURSE DESCRIPTION:

Principles of green engineering; Green communications; Green energy; Green computing; Green construction; Green manufacturing.

COURSE OUTCOMES:

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

CO1. Analyze energy efficient communication systems such as Telecommunication systems, ICT, Wireless networks and cellular networks by understanding the principles of green communications.

CO2. Understand the impact of conventional energy sources on environment and realize the significance and principles of green energy sources for sustainability.

CO3. Understand the environmental impacts of IT and approaches for Green IT.

CO4. Analyze concepts of sustainable green construction using appropriate tools and techniques following latest developments and considering safety and environment besides communicating effectively in graphical form.

CO5. Demonstrate the environmental impact of traditional manufacturing and explore the need for green manufacturing process promoting sustainability.

DETAILED SYLLABUS:

UNIT I: PRINCIPLES OF GREEN ENGINEERING AND GREEN COMMUNICATIONS
(9 Periods)

Principles of Green Engineering: Introduction, Definition of green engineering, Principles of green engineering

Green Communications: Introduction, Origin of Green Communications, Energy Efficiency in Telecommunication systems, Telecommunication system model and energy Efficiency, Energy saving concepts, Quantifying energy efficiency in ICT, Energy efficiency metrics of green wireless networks, Embodied energy of communication devices- Introduction, The extended energy model, Embodied/Operating Energy of a BS in Cellular network- A Case study; Energy efficient standards for wireline communications.

UNIT II: GREEN ENERGY **(9 Periods)**

Introduction, green energy systems - composition, adverse impacts, Green energy and sustainability, the target and solution. Diversification and localization of energy systems, green energy and sustainable development. Energy sources and their availability. Green energy sources - solar energy, wind energy, geothermal energy, ocean energy, biomass and biogas.

UNIT III: GREEN IT (9 Periods)

Introduction, Awareness to Implementation: Green IT Trends, Green Engineering, Greening by IT: Using RFID for Environmental Sustainability, Smart Grids, Smart Buildings and Homes, Green Supply Chain and Logistics, Enterprise-Wide Environmental Sustainability, A Seven-Step Approach to Creating Green IT Strategy: Balancing the Costs and Benefits of Going Green, Research and Development Directions.

UNIT IV: GREEN CONSTRUCTION (9 Periods)

Green Building: Concept, Necessity, Characteristics, Benefits, Requisites for green building construction, Sustainability, Concept of REDUCE, REUSE, RECYCLE, RETHINK, REPLENISH AND REFUSE (6 R's), Sustainable construction focus point – Site selection, Planning, Water, Energy, Material, Indoor air quality, Construction procedures, case studies of residential and commercial green buildings.

Vastu: Concept, History, scientific approach, elements of vastu for selecting a plot.

Indian Green Building Council: Introduction to IGBC green homes, Benefits of IGBC, IGBC green home rating system, Introduction to USGBC, LEED rating system, Procedure to get IGBC certification, GRIHA Rating.

UNIT V: GREEN MANUFACTURING (9 Periods)

Green Manufacturing - Introduction, Background and Definition; Impact of traditional manufacturing in environmental ecology, Need for green manufacturing, Motivation and barriers to green manufacturing, Advantages and Limitations of green manufacturing, Green manufacturing strategies, Green manufacturing and sustainability, Green manufacturing through clean energy supply, Green packaging and Supply chain.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Konstantinos Samdanis, Peter Rost, Andreas Maeder, MichelaMeo, Christos Verikoukis, *Green Communications: Principles, Concepts and Practice*, John Wiley & Sons, 2015.

2. G.D. Rai, *Non-conventional Energy Sources*, Khanna Publishers, Delhi, 5th Edition,2011.

3. San Murugesan, G.R. Gangadharan, *Harnessing Green IT – Principles and Practices*, John Wiley & Sons Ltd., 2008.

4. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison, *Green Building Handbook*, Volume 1, E & FN Spon, an imprint of Thomson Science & Professional.

5. J Paulo Davim, *Green Manufacturing: Processes and Systems*, Springer, 2012.

6. David A Dornfeld, *Green Manufacturing: Fundamentals and Applications*, Springer, 2013.

REFERENCE BOOKS:

1. Soli J. Arceivala, *Green Technologies for a better future,* McGraw Hill Education (India) Pvt. Ltd, 2014.

2. Marty Poniatowski, *Foundation of Green Information Technology, Prentice Hall, 2009.*

3. Athanasios V Alavanidis, Thomais Vlachogianni, *Green Chemistry and Green Engineering*, SynchronaThemata, 2012.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	2	-	-	-	-	-	-			
CO2	3	1	-	-	-	2	3	-	-	-	-	-			
CO3	3	-	-	-	-	2	3	-	-	-	-	-			
CO4	3	3	-	2	2	-	-	-	-	-	-	-			
CO5	3	2	-	-	-	-	3	-	-	-	-	-			
Average	2.8	2.25	-	2	2	2	3	-	-	-	-	-			
Correlation level	3	3	-	2	2	2	3	-	-	-	-	-			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech. – I Semester

(20BT50331) DESIGN AND DYNAMICS LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

courses on Basic Engineering Mechanics and Dynamics of Machinery.

COURSE DESCRIPTION:

Design of machine Elements; Determination of gyroscopic couple; Unbalanced couple and forces in static and dynamic balancing of rotating masses; Radius of gyration of compound pendulum; Moment of inertia of a flywheel; mass moment of inertia and radius of gyration of bifilar suspension; Coriolis component of acceleration; Pressure distribution in journal bearing; sensitivity and effort for governors; cam - follower mechanism; Vibration parameters of spring mass system, single rotor shaft, two rotor systems, cantilever beam, fixed beam and whirling of shaft.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Determine the characteristics of the control mechanisms such as Governors, Gyroscope, Cam-follower, flywheel and Journal bearings.

CO2. Analyze the unbalanced forces and couple in masses (Rotating & Reciprocating) in different planes and determine the position and direction of the given masses.

CO3. Calculate the vibration characteristics of vibration systems and radius of gyration of bifilar suspension, simple pendulum and compound pendulum.

CO4. Analyze the effect of the Coriolis component of acceleration of the link and derive the equations for Coriolis force.

CO5. Design the machine components using analytical methods and compare with simulations.

CO6. Work independently or in teams to solve problems with effective communication

LIST OF EXPERIMENTS:

1. Determination of gyroscopic couple using Motorized gyroscope.

2. Determination of unbalanced couple and forces in static and dynamic balancing of rotating masses.

3. Determination of radius of gyration of a given compound pendulum.

4. Determination of moment of inertia of a flywheel.

5. Determination of mass moment of inertia and radius of gyration of bifilar suspension.

6. Determination of the Coriolis component of acceleration.

7. Determination of pressure distribution in journal bearing.

8. Determination of sensitivity, effort for Porter, Proell and Hartnell governors.

9. Draw the cam profile and study the jump-off phenomenon in a cam - follower mechanism.

10. Estimation of the frequency of undamped and damped force vibration of a spring mass system.

11. Determine the frequency response curve under different damping conditions for single degree freedom system of vibration.

12. Determination of the natural frequencies of undamped and damped torsional vibration using single rotor shaft system and two rotor system.

13. Determination of critical speed of shaft with concentrated loads using whirling of shaft.

14. Determination of natural frequency and deflection of cantilever beam and fixed beam under transverse vibration

15. Design of cotter Joint, Knuckle Joint and automobile parts using analytical and MAT Lab/Python programming.

Note: Minimum Twelve experiments are to be conducted.

REFERENCE BOOKS/LABORATORY MANUALS:

SVEC20 Design and Dynamics Lab Manual

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1		1									
CO2	3	3	1	1		1									
CO3	3	3	1	1		1									
CO4	3	3	1	1		1									
CO5	3	3	3	1		1									
Average	3	3	1.4	1		1									
Correlation level	3	3	1	1		1									

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – I Semester

(20BT50332) THERMAL ENGINEERING LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	0	0	3	1.5

PRE-REQUISITES:

Course on Thermal Engineering-I.

COURSE DESCRIPTION:

Calculating the performance parameters of 2-stroke and 4- stroke I.C. Engines; Heat balancing of an engine; Practicing the valve and port timing diagrams; Determining frictional power for single and multi- cylinder engines; Compressor performance. Assembly and disassembly of an automobile models; Determining the Fuel properties; determining the performance of vapor compression refrigeration system, Air conditioning system and Water cooler.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the performance and emission characteristics of I.C Engines.

CO2. Analyze the Performance characteristics of reciprocating air compressor and determine volumetric and isothermal efficiency.

CO3. Estimate the performance of Refrigeration and air-conditioning systems to assess its coefficient of performance.

CO4. Calculate the calorific value of fuels using Bomb calorimeter&Junker's Gas Calorimeter and viscosity of fuels using say bolt & red wood Viscometer.

CO5. Demonstrate the knowledge on working of boilers, steam turbines, steam condensers and steam nozzles.

CO6. Work independently or in teams to solve problems with effective communication.

LIST OF EXPERIMENTS

Minimum TWELVE experiments are to be conducted.

1. (a)ValveTimingDiagramusingamodelof4–SDiesel,CI engine

    (b) Port timing diagram of a model of 2-S, SI engine

2. Morse Test on 4-S, 4-C, Petrol Engine using Hydraulic loading

3. Retardation Test on 4-S, 1-C, Diesel Engine using Electrical loading

4. Performance Test on 2-S, 1-C, Petrol Engine using Electrical Loading

5. Economic speed test on 2-S, 1-C, Petrol Engine using Electrical Loading

6. Performance Test on 4-S, 1-C diesel Engine using Mechanical Loading

7. Heat Balance Test on 4-S, 1-C diesel Engine using Mechanical Loading Performance Test Variable Compression Ratio Engine (VCR Engine)

8. Motoring Test on Variable Compression Ratio Engine (VCR Engine)

9. Performance Test on 2-Stage Reciprocating Air compressor Unit

10. Dismantling/Assembly of Engines to identify the parts and their position in an engine

11. Performance and emission characterization tests on Computerized 4-S, 1-C, C.I. engine using Eddy Current loading, Exhaust gas analyzer and Smoke meter.

12. Performance test on vapour compression refrigeration system.

13. Experiments on Fuels:

   (a) Bomb calorimeter for Calorific Value of Solid and Liquidfuel

   (b) Junker's Gas Calorimeter for Calorific Value of gaseousfuel

   (c) Viscosity measurement using saybolt and redwoodViscometer

14. Study of boilers, steam condensers, steam turbines and steam nozzles.

15. Study of vapour absorption refrigeration systems and psychrometric process.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1		-	1	1	-	-	-	-	-	-	3	-
CO2	3	3	1		-	1	1	-	-	-	-	-	-	3	-
CO3	3	3	1		-	1	1	-	-	-	-	-	-	3	-
CO4	3	3	1	-	-	1	1	-	-	-	-	-	-	3	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO6									3	3					
Average	3	3	1	1	1	1	1		3	3				3	
Correlation level	3	3	1	1	1	1	1		3	3				3	

Correlation Levels: 3– High 2 - Medium 1– Low

(20BT51551) INTERNET OF THINGS LAB

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		-	1	2	2

PRE-REQUISITES:-

COURSE DESCRIPTION:

Setting up IoT work-flow, Programming with Python, Micro-controller programming using Arduino, Building IoT Applications using Raspberry Pi, IoT Cloud Infrastructure.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Design an interface to embedded systems using real time sensors with Arduino and Raspberry Pi.

CO2. Develop applications to capture the data generated by sensors and send to cloud.

CO3. Develop real time applications using Node MCU and BLYNK.

CO4. Design applications to push sensor data to cloud using MQTT protocol.

CO5. Work independently and in team to solve problems with effective communication.

Theory Component: **(10 Periods)**

Arduino IDE, 7-segment display, Servo motor, ultrasonic sensor, LCD, Flame sensor, gas sensor, Humidity & temperature sensors, MQTT protocols, ECG System, Raspberry Pi, Home security system with camera, PIR sensor, light sensor, motion detector, NodeMCU, BLYNK, cloud

LIST OF EXPERIMENTS:

1. (a) Design and Simulate LED 7-Segment Display interfacing with Arduino.

    (b) Design and Simulate Servo motor interfacing with Arduino.

2. (a) Design and Simulate ultrasonic sensor and LCD interfacing with Arduino.

    (b) Design and Simulate Flame Sensor interfacing with Arduino.

3. Design and Implement to capture Gas Sensor and send sensor data to cloud from your Node MCU device using Arduino IDE.

4. Design and Implementation of Humidity and Temperature Monitoring Using Arduino and upload data to cloud using MQTT.

5. Design and Implementation of an IoT ECG (Electrocardiogram) System to record hearts electrical activity.

6. Design and Simulate controlling an LED 7-Segment Display with Raspberry Pi.

7. Design and implementation of Raspberry Pi Home Security System with Camera and PIR Sensor with Email Notifications.

8. Design and Implement to upload Light sensor (TSL) data to cloud through Raspberry Pi.

9. Design and Implementation of Motion Detector with NodeMCU and BLYNK.

10. Design and Implementation of Fire notification IoT system with BLYNK.

REFERENCE BOOKS:

1. Adrian McEwen and Hakin Cassimally, *Designing the Internet of Things,* Wiley India.

2. Simon Monk, *Programming Aurdino,* Second Edition, McGraw-Hill Education**,**2016.

3. Matt Richardson and Shawn Wallace, *Getting Started with Raspberry Pi*, O'Reilly, 2014.

4. Rahul Dubey, *An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications* , Cengage Learning India Pvt. Ltd,2019

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	-	-	2	2	-	-	-	-	-			
CO2	2	-	2	-	-	2	3	-	-	-	-	-			
CO3	1	3	2	-	1	1	1	-	-	-	-	-			
CO4	1	2	2	-	3	1	1	1	-	-	-	-			
CO5	-	-	-	-	-	-	-	-	3	3	-	-			
Average	1.5	2.5	2.25	-	2	1.5	1.75	1	3	3	-	-			
Correlation level	2	3	2	-	2	2	2	1	3	3	-	-			

Correlation Levels: 3– High   2 - Medium   1– Low

III B.Tech. - I semester

(20BT50333) SUMMER INTERNSHIP-I

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
-	100	100		-	-	-	1.5

PREREQUISITES: -

COURSE DESCRIPTION:

Expose students to the industrial environment; Create competent professionals for the industry; sharpen the real time technical / managerial skills required at the job; Gain professional experience and understand engineer's responsibilities and ethics; Familiarize with latest equipment, materials and technologies; Gain exposure to technical report writing; Gain exposure to corporate working culture.

COURSE OUTCOMES:

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

CO1. Analyze latest equipment, materials and technologies that are used in industry to solve complex engineering problems following relevant standards, codes, policies and regulations.

CO2. Analyze safety, health, societal, environmental, sustainability, economical and managerial factors considered in industry in solving complex engineering problems.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on practicing engineering.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	-	-	3	-	-	-	3	3	3	3
CO2	-	3	-	-	-	3	3	-	-	-	3	-	3	3	3
CO3	-	-	-	-	-	-	-	-	3	3	-	-	3	3	3
Average	3	3	-	3	3	3	3	3	3	3	3	3	3	3	3
Correlation level	3	3	-	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Levels: 3– High   2 - Medium   1– Low

III B.Tech. I Semester

(20BT503AC) FOUNDATIONS OF ENTREPRENEURSHIP

(Common to CE, ME, ECE, EEE & EIE)

(AUDIT COURSE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	2	-	-	-

COURSE PREREQUISITES: --

COURSE DESCRIPTION:

The nature and growth of entrepreneurship; Characteristics of an entrepreneur; Types of Entrepreneurs; Ethics and social responsibility of entrepreneurs;Generating ideas; Opportunity identification; Implementing and managing the venture; Principles of creativity and innovation; Methods of protecting innovation and creativity; Market research; Feasibility analysis; Sources of funding; Preparation of business plan; Start-Ups; Social Entrepreneurship; Rural entrepreneurship.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate knowledge on personal attributes that enable best use of entrepreneurial opportunities.

CO2. Apply suitable method to protect creativity and innovation.

CO3. Design and prepare high impact strategic and business plan.

CO4. Analyze the major steps and requirements in order to convert innovative idea into a successful start-up.

CO5. Develop an idea to create a business for social change by identifying social entrepreneurship opportunities.

DETAILED SYLLABUS :

UNIT I: ENTREPRENEURIAL MINDSET   **(06 Periods)**

The nature and growth of entrepreneurship, Entrepreneurship and Intrapreneurship, Characteristics of an entrepreneur, Types of Entrepreneurs, Woman as an Entrepreneur, Factors that contribute to the success of entrepreneurs, Ethics and social responsibility of entrepreneurs.

UNIT II: **ENTREPRENEURIAL PROCESS**   **(06 Periods)**

Generating ideas, Opportunity identification, Business concepts, Resources (Financial, Physical and Human), Implementing and managing the venture, Harvesting the venture, Harvesting strategies: Absorption of new concept into mainstream operations, Licensing of rights, Family succession, Liquidate (Shut down) venture, Selling the venture, Management Buy-Out (MBO).

UNIT III: CREATIVITY AND INNOVATION   **(06 Periods)**

Principles of creativity and innovation, Disruptive, incremental and open innovations, Nurturing and managing innovation, Methods of protecting innovation and creativity: Intellectual property rights, Branding, Trademarks, Patents, Copyrights, Registered design protection, Trade secrets.

UNIT IV: NEW VENTURE PLANNING AND CREATION (06 Periods)

Market research (venture opportunity screening), Feasibility analysis, Start-up capital; Sources of funding: equity financing, debt financing (loans, venture funding, angel funding), grants, gifts, bequests and financial statements, Introduction to the business plan, Preparation of business plan.

UNIT – V: Start-Ups and Social Entrepreneurship (06 Periods)

Start-Ups: Definition to start-up, Start-up activities, Promising start-ups, Venture-backed start-ups, Corporate-supported start-ups.

Social Entrepreneurship: Social enterprise-Need - Types - Characteristics and benefits of social enterprises, Rural entrepreneurship.

Total no. of Periods: 30

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Robert D. Hisrich, Mathew J. Manimala, Michael P. Peters, Dean A. Shepherd, *Entrepreneurship*, McGraw Hill Education (India) Private Limited, Eighth Edition, 2013.

2. Marc J Dollinger, *Entrepreneurship: Strategies and Resources*, Pearson, Third Edition, 2003.

REFERENCE BOOKS:

1. Vasant Desai, *Dynamics of Entrepreneurial Development and Management,* Himalaya Publ. House, 2004.

2. *Harvard Business Review on Entrepreneurship,* HBR Paper Back.

3. Thomas W. Zimmerer& Norman M. Scarborough, *Essential of Entrepreneurship and small business management,* PHI.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	1	-	-	1	-			
CO2	3	2	1	-	-	1	-	1	-	-	1	-			
CO3	3	2	2	-	-	2	-	1	-	-	-	-			
CO4	3	3	1	-	-	2	-	1	-	-	3	-			
CO5	3	2	1	-	-	2	-	1	-	-	1	-			
Average	3	2.2	1.2	-	-	1.6	-	1	-	-	1.5	-			
Correlation level	3	2	1	-	-	2	-	1	-	-	2	-			

Correlation Levels: **3– High** **2 - Medium** **1– Low**

III B. Tech. – II Semester

(20BT60301) COMPUTER AIDED DESIGN AND MANUFACTURING

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Courses on Computer Aided Machine Drawing Lab and Manufacturing Technology.

COURSE DESCRIPTION:

Fundamental and conventional CAD processes; Raster scan graphics co-ordinate system; Transformations; Geometric construction models; Curve representation methods; Computer Control in NC; GT; CAPP.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the basic concepts of CAD to generate a suitable geometric model of an object.

CO2. Analyze algorithms for computer graphics and use geometric models to generate complex contours

CO3. Develop the CNC code for complex machining process.

CO4. Demonstrate Computer aided manufacturing and computer aided quality control application over manufacturing.

CO5. Demonstrate knowledge of automation, robotics and applications.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO CAD/CAM, CIM   **(10 Periods)**

Computers in Industrial Manufacturing, Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Integrated Manufacturing (CIM), Design process, Product Life Cycle, CAD hardware, CAD Standards-Introduction, classification and Importance of CAD standards. Computer Integrated Manufacturing - Introduction, Types of Manufacturing System, Nature and role of the elements of CIM System, CIMS Benefits, Database requirements for CIM.

UNIT II: COMPUTER GRAPHICS & GEOMTERIC MODELING   **(10 Periods)**

Computer Graphics: Raster Scan Graphics: DDA Line Algorithm, Bresenham's Line algorithm, Coordinate system, 2D &3DTransformations (Scaling, Translation, Rotation & Reflection)

Geometric Modeling: Requirements of Geometric Modeling, Definition to Parametric and Non-parametric representation, Introduction to curve representation, Analytical and Synthetic curve representation (Bezier, B-spline & Nurbs).

UNIT III: COMPUTER NUMERICAL CONTROL   **(09 Periods)**

Introduction to CNC, CNC Hardware basics (Structure of CNC machine tools, Actuation systems, Feedback devices), CNC Tooling (Automatic tool changers, Work holding, CNC

Programming, Part Programming fundamentals, Manual part programming methods, Preparatory Functions, Miscellaneous Functions, Canned Cycles.

UNIT IV: COMPUTER AIDED PROCESS PLANNING & QUALITY CONTROL

(08 Periods)

Group Technology: Introduction, Part Family, Classification and Coding, Types of coding systems, Identification systems (RFID, Barcodes), Group Technology Cells, Benefits of Group Technology. Computer Aided Process Planning: Retrieval & Generative Computer Aided Process Planning and CAPP systems, CAPP implementation considerations, Benefits of CAPP.

Computer Aided Quality Control: Introduction, Inspection and Testing, Contact & Non-Contact inspection methods.

UNIT V: AUTOMATION AND ROBOTICS   (08 Periods)

AUTOMATION: Introduction to automation, Elements of automation, Types of automation systems, part transfer methods and mechanisms- flow lines-types.

ROBOTICS: Introduction to robotics, Law of robotics, Anatomy, Configuration of robots, Robot end effectors-classification, Robotic joints, grippers.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. P.N. Rao, *CAD/CAM: Principles and Applications*, TMH, 2004

2. Radhakrishnan and Subramaniah, *CAD/CAM/CIM*, New Age International, 2004

3. Michael E.Mortenson*, Geometric Modelling*, wiley 2013

REFERENCE BOOKS:

1. Ibrahim Zeid, CAD/CAM Theory and Practice, McGraw Hill,2010.

2. MikellP.Groover, Computer Aided Design & Computer Aided Manufacturing, PearsonEducation,2006.

3. E. Micheal, *Geometric Modelling*, John Wiley &Sons ,3rdedition 2013.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1		1	1							3		
CO2	3	3	1	1	1	1							3		
CO3	3	3	1	1	2	1							3		
CO4	3	1	1	1	1	1							3		
CO5	3	1			1	1							3		
Average	3	1.8	1	1	1.2	1							3		
Correlation level	3	2	1	1	1	1							3		

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT60302) HEAT TRANSFER

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-		3

PRE-REQUISITES:

Courses on Multi-Variable Calculus and Differential Equations, Engineering Thermodynamics and Fluid Mechanics and Machines.

COURSE DESCRIPTION:

Modes of heat transfer; One-dimensional steady and transient conduction; Analysis of extended surfaces; Convection heat transfer; free and forced convection; boiling and condensation; Heat exchangers; radiation; Concept of black body; heat exchange between surfaces.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Apply the principles of heat transfer in steady state conduction and determine the heat transfer characteristics.

CO2. Analyze the fins to increase heat transfer rate and Transient heat conduction process for heat transfer characteristics.

CO3. Analyze fluid flow systems and determine heat transfer characteristics in forced and free convection process.

CO4. Design heat exchangers, boilers and condensers for the given heat transfer rates and determine heat transfer characteristics.

CO5. Apply the principles of radiation in the heat exchange between black and grey bodies and determine heat transfer characteristics.

DETAILED SYLLABUS:

UNIT I: CONDUCTION HEAT TRANSFER   **(09 periods)**

Basics of Heat Transfer, Modes and Mechanism of heat transfer, Conduction, convection and radiation, General differential equation of heat conduction - Cartesian, Cylindrical and Spherical Coordinates; One dimensional steady state heat conduction - Conduction through plane wall, cylinders and spherical systems; Composite systems, Critical thickness of insulation.

UNIT II: EXTENDED SURFACES AND TRANSIENT HEAT CONDUCTION   **(09 Periods)**

Extended surfaces, Types of fins, - Efficiency, Effectiveness and Temperature distribution on Long Fin, Fin with Insulated Tip and Short Fin; Introductions to unsteady heat conduction - Lumped heat analysis, Infinite and semi-infinite solids, use of Heisler's chart.

UNIT III: CONVECTION HEAT TRANSFER   **(10 Periods)**

Boundary layer concepts - Hydrodynamic and thermal boundary layer theory, Dimensional analysis, Buckingham's п-theorem applied to forced and natural convection.

Forced convection: External flows - Flow over plates, cylinders and spheres; internal flows- flow through Horizontal pipe, annular pipe.

Natural convection: Flow over the vertical plate, horizontal plate, horizontal cylinders.

UNIT IV: HEAT EXCHANGERS AND PHASE CHANGE HEAT TRANSFER   (09 Periods)

Heat Exchangers: Classification of Heat Exchangers, Overall Heat Transfer Coefficient and Fouling Factor, Log Mean Temperature Difference (LMTD): parallel & counter flow, Correction factor, Effectiveness - NTU methods of analysis of heat exchangers.

Boiling: Pool Boiling Regimes, Determination of Heat Transfer Coefficient in Nucleate Boiling, Critical Heat Flux and Film Boiling.

Condensation: Film wise and Drop wise Condensation, Nusselt's Theory of Condensation on a Vertical Plate.

UNIT V: RADIATION HEAT TRANSFER   (08 Periods)

Fundamentals of Radiation, Emission Characteristics - Irradiation, Total and Monochromatic radiation, Laws of Radiation - Planck, Wien's displacement, Kirchhoff, Lambert's cosine, Stefan–Boltzmann, Heat Exchange between Two Black Bodies and Gray Bodies, Concepts of Shape Factor, Emissivity, Radiation Shields.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International, 5th Edition, 2017.

2. R.K.Rajput, Heat and Mass Transfer, S.Chand & Company Ltd, 7th Edition, 2018.

REFERENCE BOOKS:

1. P.K.Nag, Heat Transfer, McGraw Hill Education, 3rd Edition, 2011.

2. Holman.J.P, Heat Transfer, TMH, 10th Edition, 2017.

3. Yunus Cengel, Heat and Mass Transfer, Mc Graw Hill Publications, 5th Edition, 2015.

4. C.P Kothandaraman and S.Subramanyan, Heat and Mass Transfer data book, New Age International, 9th Edition, 2018.

Note: Heat Transfer Data Book mentioned in Reference No.4 is needed during Examinations.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	1	1	-	-	-	-	-	-	3	-
CO2	3	3	2	1	-	1	1	-	-	-	-	-	-	3	-
CO3	3	3	2	1	-	1	1	-	-	-	-	-	-	3	
CO4	3	3	3	1	-	1	1	-	-	-	-	-	-	3	
CO5	3	3	2	1	-	1	1	-	-	-	-	-	-	3	
Average	3	3	2.1	1	-	1	1					-	-	3	
Correlation level	3	3	2	1		1	1							3	

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT60303) INDUSTRIAL ENGINEERING AND MANAGEMENT

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Management – Concept; Staffing, Leading and Controlling; Leading Effective Teams, Planning and Implementing Change; Allowances and Standard time calculations; Line balancing, Maintenance; Statistical Process Control.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on essentials of management theories and approaches by valuing ethics and social responsibility.

CO2. Analyze organizational structures and formulate leadership strategies for organizational transformation.

CO3. Apply work study techniques for uniform and enhanced production flow.

CO4. Analyze maintenance and facility planning problems and solve anomalies in breakdown, availability and redundancy.

CO5. Apply quality control tools and techniques for acceptance decisions, process adjustments and minimal rework by following quality standards, industry Acts and safety measures.

DETAILED SYLLABUS:

UNIT I: ESSENTIALS OF MANAGEMENT   (09 periods)

Management – Concept, Process, Theories and Approaches; Management Roles and Skills Functions – Planning, Organizing, Staffing, Leading and Controlling; Decision Making – Concept, Process, Techniques and Tools; Business Ethics, Corporate Social Responsibility and Corporate Governance

UNIT II: MANAGEMENT OF ORGANIZATIONAL BEHAVIOUR   (09 periods)

Leadership and management, Classic Motivational Theories, Situational Leadership, Effective Communication, Leading Effective Teams, Planning and Implementing Change, Leadership Strategies for Organizational Transformation.

UNIT III: WORK STUDY   (09 periods)

Productivity, Method study – Steps, Charts and Diagrams, Principles of Motion economy; Work measurement – Time study – Rating, Allowances and Standard time calculations; Work sampling, Human Factors and Ergonomics.

UNIT IV: FACILITIES PLANNING AND MAINTENANCE   (09 periods)

Types of Production, Plant Location and Layout, Line balancing, Maintenance – Breakdown, Preventive and Predictive; 5S and TPM; Reliability – Series, Parallel, Series-Parallel device configurations, Bath-tub curve, MTBF, MTTR, Availability and Redundancy.

UNIT V: QUALITY ASSURANCE AND INDUSTRIAL SAFETY   (09 periods)

Statistical Process Control – Control Charts for Variables and Attributes, Process Capability; Acceptance sampling – Sampling Plans, OC curve; ISO 9000 Standards and Total Quality Management, Benchmarking, Industrial Safety rules, Investigation and Analysis of Accidents, Indian Factories Act, Workmen Compensation Act and Industrial Disputes Act

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS

1. Martand Telsang, Industrial Engineering and Production Management, S. Chand, 2nd Edition, 2006

2. Kenneth H. Blanchard, Paul Hersey and Dewey E. Johnson, Management of Organizational Behaviour, Pearson, 10th Edition, 2015

REFERENCE BOOKS

1. Harold Koontz, Heinz Weihrich, et al, Essentials of Management, McGraw Hill, 11th Edition, 2020

2. M I Khan and N A Siddiqui, Industrial Engineering and Management, New Age International, 1st Edition, 2018

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1		1							3
CO2	3	3	1			1									3
CO3	3	1	1			1									3
CO4	3	3	1			1									3
CO5	3	2	1		1	1		1							3
Average	3	2.2	1		1	1		1							3
Correlation level	3	2	1		1	1		1							3

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – II Semester

(20BT60304) CASTING AND WELDING TECHNOLOGY

(Professional Elective - 2)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

A course on Manufacturing Technology

COURSE DESCRIPTION:

Introduction to materials and their manufacturing techniques; Casting methods; Design of pattern and dies; Gating design; Special casting and welding processes; Weld metal characterization; analyzing the properties of weldment; standards and codes followed in industry.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Design patterns, dies, gating systems and riser systems in casting metallurgy considering standards.

CO2. Demonstrate knowledge on modern molding, core making and special casting process.

CO3. Design weld joints in welding metallurgy considering standards.

CO4. Demonstrate knowledge on special welding process.

CO5. Analyze casting and welding process involving advanced processes with environmental considerations.

DETAILED SYLLABUS:

UNIT I: CASTING METALLURGY AND DESIGN   (10 periods)

Casting metallurgy and design-Heat transfer between metal and mould-Solidification of pure metals and alloys-Shrinkage in cast metals-Feeding characteristics of Alloys; Progressive and directional solidification-Elements and types of gating systems; Pressurized and non-pressurized gating; design considerations of gating system; applications. Risers: types and Functions of risers; Computer Aided design for gating and riser systems.

UNIT II: SPECIAL CASTING PROCESSES   (10 periods)

Special Casting Processes: Investment casting processes; Continuous casting processes; Die casting- low pressure / Gravity, pressure and squeeze; Centrifugal Casting: Calculations of various parameters in centrifugal casting, die temperature, Rotational speeds, advantages, limitations and applications; Defects in various special casting processes.

UNIT III: WELDING METALLURGY AND DESIGN   (9 periods)

Welding metallurgy and design-Heat affected zone and its characteristics-Weldability of steels, Stainless steel, Aluminium and Titanium alloys-Hydrogen Embrittlement-Lamellar tearing - Residual Stress-Heat transfer and solidification-Analysis of stresses in welded structures - pre and post welding heat treatments-Weld joint design-Welding defects-testing of weldment.

UNIT IV: SPECIAL WELDING PROCESSES   (7 periods)

Special welding processes-Friction Welding-Friction stir welding-Explosive Welding-Diffusion Bonding-High frequency Induction Welding-Ultrasonic Welding-Electron beam welding-Laser beam welding.

UNIT V: RECENT ADVANCES IN CASTING AND WELDING   (9 periods)

Recent advances in casting and welding-Layout of mechanized foundry-sand reclamation-Material handling in foundry-Pollution control in Foundry-Recent trends in casting-Computer Aided design of Casting. Automation in welding-Welding Robots-Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding. Introduction to codes and standards, Welding procedure specification, Welding performance qualification.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Ravi B, "Metal Casting: Computer Aided Design and Analysis" Prentice Hall ,2005.

2. R S Parmer,"Welding Engineering Technology", Khanna publishers, 2nd Edition, 2008.

REFERENCE BOOKS:

1. John Campbell, "Casting Practice" Elsevier Science Publishing C0.,2004.

2. Richard L Little, "Welding and Welding Technology" Tata McGraw Hill, 2004.

3. ASM Hand Book "Casting", ASM International 1998

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	-	-	-	-	-	-	3	-	-
CO2	3				1	1	-	-	-	-	-	-	3	-	-
CO3	3	3	3	1		1	-	-	-	-	-	-	3	-	-
CO4	3				1	1	-	-	-	-	-	-	3	-	-
CO5	3	3			1	1	1						3		
Average	3	3	3	1	1	1	1	-	-	-	-	-	3	-	-
Correlation level	3	3	3	1	1	1	1						3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B.Tech – II Semester

(20BT60305) COMPOSITE MATERIALS

(Professional Elective – 2)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Courses on Basic Engineering Mechanics and Materials Science and Engineering

COURSE DESCRIPTION:

Composite materials and their classifications; various matrices and reinforcements; manufacturing process of various composites; analyzing the properties of composite materials.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate knowledge of composite materials for various engineering applications.

CO2. Analyze the effect of fiber length, fiber orientation and concentration on composite properties.

CO3. Demonstrate knowledge of manufacturing processes of composites.

CO4. Analyze composites for appropriate joining and machining techniques.

CO5. Analyze the failure behavior during testing of composite materials.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO COMPOSITE MATERIALS   (9 periods)

Composite Materials: Definition -Special Features of Composites - Drawbacks of Composites - Classification of Composite Materials: Particle Reinforced Composites - Dispersion Strengthened Composites - Fiber Reinforced Composites -Structural Composites, Processing techniques for Composite materials, Applications and Barriers of Composite Materials.

UNIT II: RAW MATERIALS FOR COMPOSITE PRODUCTION   (9 periods)

Matrix Phase: Types and Functions, **Reinforcements Phase:** Types and Functions, Effect of reinforcement (Fiber length, Fiber orientation and Concentration) on overall composite performance, Fabrics and its types, Prepegs and its types, Preforms and Honeycomb Materials, Molding compounds and its types.

UNIT III: MANUFACTURING PROCESS OF COMPOSITES   (9 periods)

Manufacturing Process: Basic Steps in a Composites Manufacturing Process.

Manufacturing Processes for Thermoset Composites: Prepegs Lay-Up Process, Wet Lay-Up Process, Spray-Up Process, Filament Winding Process, Pultrusion Process, Resin Transfer Molding Process, Compression Molding Process, Roll Wrapping Process, Injection Molding Process.

Manufacturing Processes for Thermoplastic Composites: Thermoplastic Tape Winding, Thermoplastic Pultrusion Process, Part Fabrication, Autoclave Processing, Diaphragm Forming Process, Injection Molding.

UNIT IV: JOINING AND MACHINING OF COMPOSITES   (9 periods)

Joining: Definition, principles, selection and design guidelines surface preparation, types, advantages, limitations and failures modes in adhesive joints, Mechanical joints: Principles, types, advantages, limitations, design parameters, failure modes

Machining: Objectives of Machining, Challenges during Machining of Composites, Failure Mode during Machining of Composites, Cutting tools, Types of machining operations.

UNIT V: TESTING OF COMPOSITES   (9 periods)

Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing; Non – Destructive testing.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Sanjay K. Mazumdar, "*Composites Manufacturing - Materials*, Product and Process Engineering", CRC Press LLC, 1st edition, USA, 2002.

2. Deborah D. L. Chung, "*Composite Materials – Science & Applications*", 2nd edition, Springer Verlag, USA, 2009.

REFERENCE BOOKS:

1. Daniel B. Miracle and Steven L. Donaldson, ASM Handbook, "Composites", ASTM International, Vol-21, 2001.

2. William. D. Callister, "Materials Science and Engineering-An Introduction", John Wiley and sons, 7th edition, USA, 2007.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		-	-	-	1	-	-	-	-	-	-	3	-	-
CO2	3	3			-	1	-	-	-	-	-	-	3	-	-
CO3	3			-		1	-	-	-	-	-	-	3	-	-
CO4	3	3		-		1	-	-	-	-	-	-	3	-	-
CO5	3	3			1	1	-	-	-	-	-	-	3	-	-
Average	3	3			1	1							3		
Correlation level	3	3			1	1							3		

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT60306) DESIGN OF TRANSMISSION SYSTEMS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Strength of Materials.

COURSEDESCRIPTION:

Helical, Bevel, Worm Gears; Stress analysis of gears; Gear box, Gear train; Working of gear box and Gear train; Functions of Various gear box and gear train; Hydraulic controls for Automatic transmission system; Hydrostatic, Hydrodynamic, Hydrokinetic drives; Construction of drives; Working of drives and their performance; Automatic transmission system; intelligent electronic control systems.

COURSEOUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Design Helical, Bevel and worm gears using strength and wear equations for power transmitting applications.

CO2. Design gear box and determine speeds for machine tools applications.

CO3. Design gear trains for automatic transmission.

CO4. Analyze the performance of Hydrostatic, Hydrodynamic and Hydrokinetic drives and determine the performance parameters.

CO5. Analyze functional characteristics of automatic transmission systems with intelligent electronic control and hydraulic clutch activation systems.

DETAILED SYLLABUS:

UNIT I: HELICAL, BEVEL AND WORM GEARS: (9 Periods)

Parallel Helical Gears – Kinematics, Tooth proportions, Force analysis, Stresses in Helical gear, Design of helical gear, Crossed Helical gears; Straight Bevel gears – Kinematics, Force analysis, Stresses in straight bevel gear tooth, Design of bevel gear; Worm gearing – Kinematics, Forces, Friction and Efficiencies, Stresses in worm gear tooth.

UNIT II: GEAR BOX: (9 Periods)

Need for a gear box in an automobile and types of Gear boxes – Construction and working of Sliding mesh, Constant mesh gear box, Epi-cyclic gear box , over drive torque converter, ray diagrams, Synchromesh gear box and principle of synchronizers; Design of multi speed gear boxes for machine tools.

UNIT III: GEAR TRAINS : (8 Periods)

Construction and working Principle of Epi-cyclic gear train, Planetary gear box, Ford T Model gear box, Wilson gear box, Cotal electromagnetic transmission and Automatic over drive. Gear ratios for Wilson gear box and Automatic Over drive. Hydraulic control system for Automatic transmission.

UNIT IV: HYDROSTATIC, HYDRODYNAMIC AND HYDROKINETIC DRIVES:

(10 Periods)

Hydrostatic drives: Introduction to hydrostatic drives, Working principle, types, Advantages and limitations of Hydrostatic drives, Comparison of hydrostatic drive with hydro dynamic drive, Construction and working of Janny Hydrostatic drive.

Hydrodynamic and Hydrokinetic drives: Introduction to fluid coupling, Fluid coupling – Construction, Principle of operation and Performance characteristics, Drag torque and various drag reducing devices of fluid coupling, Problems on design and torque capacity of fluid coupling, Construction and working of Torque converter, converter coupling, Multistage torque converter, and Poly phase torque converter - Performance characteristic of multistage and poly phase torque converters.

UNIT V: AUTOMATIC TRANSMISSION: **(9 Periods)**

Layout of Automatic transmission system, construction and working of Turbo glide transmission, Power glide transmission, ECT- intelligent transmission, Automatic transmission with intelligent electronic control systems, Hydraulic clutch actuation for Automatic transmission. Chevrolet "Turboglide" Transmission, Continuously Variable

Transmission (CVT) – Types – Operations of a typical CVT.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "*Mechanical Engineering Design*", 11th Edition, Tata McGraw-Hill, 2020.

2. Harald Naunheimer , Bernd Bertsche , Joachim Ryborz , Wolfgang Novak "*Automotive Transmission: Fundamentals, Selection, Design and Application*", 2nd Edition, Springer, 2011.

REFERENCE BOOKS:

1. Robert L. Norton, "Machine Design"- an integrated approach, (5th Edition) Pearson publisher, 2000.

2. Bhandari V, Design of Machine Elements, 5th Edition, Tata McGraw-Hill Book Co, 2020.

ADDITIONAL LEARNING RESOURCES:

1. Judge A. W., "Modern Transmission", 3rd ed., Chapman & Hall Std., London, 1989.

2. CDX Automotive, "Fundamentals of Automotive Technology, Principles and practice", Jones &Barlett Publishers, 2013.

3. Newton Steeds & Garrot, "Motor Vehicles", SAE International and Butterworth Heinemann, 2001.

4. Malisa, "Hand Book of Gear Design", Tata Mc Graw Hill, International Edition, 2000.

5. Mahadevan, k, Reddy, K. Balaveera, "Design Data Handbook for Mechanical Engineering in SI and Metric Units", CBS; 4th edition,2019.

Data Book: Design data hand book for Mechanical Engineers in SI and Metric units by Balaveera Reddy and Mahadevan.N

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1		1							3		
CO2	3	3	3	1		1							3		
CO3	3	3	3	1		1							3		
CO4	3	3	2	1		1							3		
CO5	3	3	2	1		1							3		
Average	3	3	2.6	1		1							3		
Correlation level	3	3	3	1		1							3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech – II Semester

(20BT60307) GAS TURBINES AND JET PROPULSION

(Professional Elective – 2)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	--	3

PRE-REQUISITES:

A Course on Thermal Engineering-II

COURSE DESCRIPTION:

Jet propulsion gas turbine; engine types; performance; turbojet and turbofan engines; designs of compressor; combustor and turbines; Jet and Rocket propulsions.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the gas turbine cycles using PV and TS diagrams and solve problems.

CO2. Analyze gas turbines and Air compressors for performance characteristics.

CO3. Analyze the combustion process in gas turbines and determine its performance characteristics.

CO4. Apply the principles of Jet Propulsion and solve problems.

CO5. Demonstrate the knowledge of rocket propulsion systems.

DETAILED SYLLABUS:

UNIT I: ANALYSIS OF GAS TURBINE CYCLES   (09 periods)

Development of gas turbine, Classification of gas turbines, Gas turbine vs. reciprocating I C engine, Gas turbine vs steam turbine, Applications of gas turbines, the basic cycle Analysis of simple gas turbine cycle, Effect of thermodynamic variables on the performance of simple gas turbine plant, Improvements in simple gas turbine cycle, Actual gas turbine cycle, Closed cycle gas turbine, Helium cooled, closed gas turbine for nuclear power plants , Total energy system incorporating gas turbine, Semi-closed cycle gas turbine, Gas turbine plant arrangement

UNIT II: Gas TURBINES AND AIR COMPRESSOR   (09 periods)

Axial flow and radial flow turbines, impulse and reaction turbines, fundamental relations and velocity triangles, elementary vortex theory, limiting factors in turbine design, blade materials; blade attachments and blade cooling.

Centrifugal and Axial flow compressors, degree of reaction, design of impellers and Blading, vortex theory, elementary air-foil theory and cascade theory, performance characteristics.

UNIT III: GAS TURBINE COMBUSTION CHAMBER   (09 periods)

Introduction, Requirements, Combustion process in gas turbine, Types of combustion chamber, Flow pattern in a combustion chamber, Performance and operating characteristics of combustion chambers, Fuel injection in combustion chamber, Effect of incomplete combustion.

UNIT IV: JET PROPULSION   (09 periods)

Introduction, Thrust, Thrust vs. thrust horse power, Efficiencies, Airscrew, Turbojet, Thrust augmentation, Turboprop engine, Bypass and ducted fan engines, Regenerative ducted fan engine, Turbo shaft engine, Ram jet, Pulsejet, Comparison of various propulsion devices. Air craft launch and recovery systems (EMALS and AAG).

UNIT V: ROCKET PROPULSION   (09 periods)

Introduction, classification of rockets, Principle of rocket propulsion, Analysis of an ideal chemical rocket, Optimum expansion ratio for rocket, The chemical rocket, Advantages of liquid propellant rockets over solid propellant rockets, Free radical Propulsion, Nuclear Propulsion, Ion propulsion, Plasma propulsion.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Mathur, M., and Sharma, R.P., "*Gas Turbines and Jet & Rocket Propulsion*", Standard Publishers, New Delhi, 2014.

2. Ganesan, V., *Gas Turbines* 3/e, Tata McGraw Hill Book Company, New Delhi, 2010

REFERENCE BOOKS:

1. Yahya. S.M., *Fundamental of compressible flow with Aircraft and Rocket Propulsion*", New Age International (p) Ltd., New Delhi, 2005.

2. Cohen.H., Rogers R.E.C and Sravanamutoo, "*Gas turbine theory*", Addison Wesley Ltd., 1987.

3. Rathakrishnan. E., "*Gas Dynamics*", Prentice Hall of India, New Delhi, 2001.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1			1								3	
CO2	3	3	1			1								3	
CO3	3	3	1			1								3	
CO4	3	3	1			1								3	
CO5	3					1								3	
Average	3	3	1			1								3	
Correlation level	3	3	1			1								3	

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech. – II Semester

(20BT60308) INTERNAL COMBUSTION ENGINES

(Professional Elective – 2)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

A course on thermal Engineering-I

COURSE DESCRIPTION:

Fuel air cycles and actual cycles of internal combustion engines; Combustion phenomena in spark ignition engine; Combustion phenomena in compression ignition engines; Engine friction and lubrication; Non conventional engine.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on internal combustion engine systems.

CO2. Analyze fuel air cycles and actual cycles to find the various heat losses.

CO3. Analyze the combustion phenomenon in SI Engines and study the effect of variables on combustion phenomenon.

CO4. Analyze the combustion phenomenon in CI Engines and study the effect of variables on combustion phenomenon.

CO5. Demonstrate the knowledge on advances in Internal Combustion engines.

DETAILED SYLLABUS:

UNIT I: **INTERNAL COMBUSTION ENGINE SYSTEMS:**   **(9 periods)**

I. C. ENGINES - Classification - Working principles; Engine systems –Fuel, Carburettor, Fuel Injection, Ignition, Cooling and Lubrication System; principle of wankle engine, principles of supercharging and turbo charging.

UNIT II: **FUEL AIR CYCLES AND ACTUAL CYCLES:**   **(9 periods)**

Fuel Air Cycles: Assumptions for fuel–air cycles, Reasons for variation of specific heats of gases, change of internal energy and enthalpy during a process with variable specific heats, isentropic expansion with variable specific heats, effect of variable specific heats dissociation, comparison of air standard and fuel air cycles,

Actual Cycles: Effect of operating variables, comparison of air standard and actual cycles, effect of time loss, heat loss and exhaust loss in Petrol and Diesel engines.

UNIT III: COMBUSTION IN S.I. ENGINES   **(9 periods)**

Stages of combustion in SI engines, combustion parameters, Flame front propagation, Factors influencing the flame speed, abnormal combustion, Phenomenon of knock in S.I engines, factors affecting knock in SI engine, Combustion chambers for SI Engines, Fuel Requirements and Fuel Rating, Emission from SI Engines and its control..

UNIT IV: COMBUSTION IN C.I. ENGINES   **(9 periods)**

Stages of combustion in C.I engines,combustion parameters, Factor affecting delay period; Phenomenon of knock in C.I engine,factors affecting knock in CI engine, comparison of knock in S.I and C.I engines, Combustion chambers for C.I engines, Fuel Requirements and Fuel Rating, Emission from CI Engines and its control.

UNIT V: ADVANCED IC ENGINES   **(9 periods)**

Introduction, Common Rail Direct Injection Engine, Dual fuel and Multi-Fuel engine, free piston engine, Gasoline Direct Injection Engine, Homogeneous Compression Ignition Engine, Lean burn Engine, Stratified engine, Variable Compression ratio engineand LHR engines.

                                       Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. V. Ganesan, *I.C. Engines*, TMH, 3rd Edition, 2008.

2. R.K.Rajput, *Thermal Engineering*, Laxmi publications, 8th Edition, 2010

REFERENCE BOOKS:

1. M.L Mathur&R.P.Sharma, *Internal combustion engines*, Dhanpat Rai & Sons, 8th Edition, 2014.

2. Mahesh M Rathore, *Thermal Engineering*, Tata Mcgrawhill Education, 2010.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1				1								3	
CO2	3	3	1			1								3	
CO3	3	3	1			1	1							3	
CO4	3	3	1			1	1							3	
CO5	3	1				1								3	
Average	3	1.5	1											3	
Correlation level	3	2	1			1	1							3	

    Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT60309) QUALITY MANAGEMENT AND RELIABILITY ENGINEERING

(Professional Elective – 2)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	--	--	3

PRE-REQUISITES:--

COURSE DESCRIPTION:

Introduction to Quality, Quality Costs, Quality Circles, QC Tools, Statistical Quality Control, Control Charts, Acceptance Sampling Evaluation, Reliability, Types of Failures, Reliability Improvement.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate knowledge on the concepts of standardization and bodies of standardization for improvement of quality.

CO2. Apply quality control codes, standards, and techniques in controlling the quality of a product/ process.

CO3. Analyze sampling plans for continuous quality in production.

CO4. Develop failure hazard models to improve reliability.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION   (9 Periods)

Definition of Quality, Quality Control, Factors Affecting Quality, Stages of Evaluation, Quality Management System, Quality Standards, Need for Standardization, Tools for Continuous Improvement-Deming cycle, Poka-Yoke, and Kaizen; Quality related costs, contemporary quality engineering philosophy, Quality systems and international standards, Quality Circles-Concepts, Objectives and advantages, QC Tools, Introduction to Six Sigma Concept, Advantages.

UNIT II: STATISTICAL QUALITY CONTROL   (9 Periods)

Introduction to SQC, Causes of Variation, Control Charts for Variables- $\overline{X}$ and R Charts; Interpretation of Control Charts, Control Charts for Attributes- P chart, C chart, U chart; Quality Rating System.

UNIT III: ACCEPTANCE SAMPLING   (9 periods)

Acceptance Sampling Plans for Attributes- Types of Sampling Plans, Advantages and Disadvantages of Sampling Plans; Evaluation of Sampling Plans, OC Curve- Characteristics of OC Curve, Producer Risk and Consumer Risk, AOQ, AQL, ATI, ASN; Brief Introduction to Acceptance Sampling Plans for Continuous Production and Acceptance Sampling Plan for Variables.

UNIT IV: CONCEPTS OF RELIABILITY   (9 Periods)

Quality and Reliability, Importance of Reliability, Reliability Data Collection, Failure Data Analysis- MTTF, MTBF, Failure Rate, Hazard Rate, Failure Rate Curve; Types of Failures-

Hazard Models (Exponential and Weibull); System Reliability with Components in Series, in Parallel and Mixed configurations.

UNIT-V: RELIABILITY IMPROVEMENT   (9 Periods)

Active and Standby Redundancies, Fault Tree Analysis, Reliability Optimization, Maintainability and Availability and Application of Reliability in Maintenance Strategies.

(**Total Periods: 45**)

Topics for self-study are provided in lesson plan

TEXTBOOKS:

1. Dale H Bester field et al, *Total Quality Management*, Pearson Education,3rd edition, 2011.

2. 2. L S Srinath, *Reliability engineering*, East west press, 4th edition, 2005.

REFERENCE BOOKS:

1. Howard Giltow, *Quality Management*, Tata McGraw Hill, 3rd edition,2008.

2. Amitava Mitra, *Fundamentals of Quality Control and Improvement*, Wiley, 3rd edition,2013.

3. Grant E.L, *Statistical Quality Control*, McGraw Hill education (India) Pvt. limited, 7th edition,2005.

4. Montgomery D. C., '*Introduction to Statistical Quality Control'*, John Wiley - 2010

5. Ebeling C., '*An Introduction to Reliability and Maintainability Engineering'*, Tata McGraw Hill Publishing Company Ltd. - 2004

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1									3
CO2	3	3	1			1									3
CO3	3	3	1			1									3
CO4	3	3	3			1	1								3
Average	3	3	1.6			1	1								3
Correlation level	3	3	2			1	1								3

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech. – II Semester

(20BT60310) AUTOMOTIVE FUELS AND COMBUSTION

(Professional Elective – 3)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

A course on Thermal Engineering-I

COURSE DESCRIPTION:

Basic idea of fuel production procedure, Effect on human health due to pollution caused by I.C engine, Needs of alternative fuel, Types of alternative fuel used in petrol and diesel engine.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge of automotive fuels and their storage and handling systems.

CO2. Analyze the desirable characteristics of alternate fuels.

CO3. Analyze composition and characteristics of alternate fuels for enhancing the performance and controlling the emission.

CO4. Demonstrate the knowledge of automotive emission, emission control methods and emission standards.

DETAILED SYLLABUS

UNIT I: ATOMOTIVE FUELS (9 periods)

Introduction, Classification of fuels, Solid Fuels - Origin of coal, Wood and Charcoal, Composition of coal, Properties of different grades of coal, Preparation and storage of coal, Coal washing, Briquetting; Liquid fuels - Introduction, Chemical structure of petroleum-Paraffin Series, Olefin series, Napthalene series, Aromatic series, Production, composition, Petroleum refining; Gaseous fuels -Gasification of liquid fuel, Synthetic fuels.

UNIT II: PROPERTIES OF ATOMOTIVE FUELS (9 periods)

Introduction, Desirable properties of IC engine fuel - Moisture Content, Particle Size and Size distribution, Bulk Specific gravity,Calorific value, Specific gravity, flash and fire point, pour point, metal content, ultimate analysis, proximate analysis, fly ash analysis, Hard grove Grindeability Index, Density, Viscosity, Aromatic Content, Sulphur content, octane number and cetane number.

UNIT III: ALCOHOLS AND VEGETABLE OILS AS ALTERNATE FUEL　　　(9 periods)

Alcohols: Introduction to alcohols, Production methods, Properties, use of alcohols in CI and SI engines, Reformulated gasoline for SI engine, Water Gasoline Mixture for SI engine, Alcohol for CI engine, Surface Ignition of Alcohols in CI engine.

Vegetable oil: Introduction, Edible and Non Edible oils, Various methods of using Vegetable oil in CI engine, Biodiesel-sources, Preparation of Biodiesel, Characteristics of CI engine with Biodiesel as fuel, Biodiesel oxidation stability, Blending, Preheating, emulsification.

UNIT IV: HYDROGEN AND BIOGAS AS ALTERNATE FUEL　　　(9 periods)

Production methods of hydrogen, Hydrogen Engine, Combustive properties of hydrogen, Problems in hydrogen as fuel, Techniques of using hydrogen in SI and CI engines. Hydrogen storage – safety aspects of hydrogen fuel. Biogas-various production methods-properties, Use in SI and CI engine, Performance and emission characteristics.

UNIT-V: IC ENGINE EMISSIONS AND CONTROL　　　(9 Periods)

Engine Exhaust Emissions, Bharat stage emission standards (BSES), Euro norms, Flow in crevices, Leakage Past the exhaust valve, Valve overlap, Deposit on walls, Thermal Converters, Catalytic converters- Sulphur, Cold Start-Ups, CI engines-Particulate traps, Non exhaust Emissions-Evaporative emissions, Emissions control Technique, Modern evaporative emission control system, Crankcase Blowby, Intake manifold return PCV System, EGR, SCR.

Total Periods : 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Ayhan Demirbas, '*Biodiesel A Realistic Fuel Alternative for Diesel Engines'*, Springer-Verlag London Limited, 2008.

2. Devaradjane. Dr. G., Kumaresan. Dr. M., "*Automobile Engineering*", AMK Publishers, 13th Edition, 2013.

REFERENCE BOOKS:

1. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, *The Biodiesel Handbook*, AOCS Press Champaign, Illinois 2005.

2. Richard L Bechtold P.E., *Alternative Fuels Guide book*, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1												3	
CO2	3	3				1	1							3	
CO3	3	3				1	1							3	
CO4	3	1				1	1							3	
Average	3	2				1	1							3	
Correlation level	3	2				1	1							3	

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT60311) DESIGN OF PRESSURE VESSELS AND PIPING SYSTEMS

(Professional Elective–3)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Courses on Strength of Materials and Design of Machine Elements.

COURSE DESCRIPTION:

Material selection, Estimation of stresses; Formulation of fatigue models, Factor of safety; Design of Heads, Covers, Nozzle, Gasket & End closure; Buckling phenomenon, buckling problems and Design of piping layout.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Design cylindrical shells by applying conceptual knowledge of stresses in field problems and selection of materials.

CO2. Analyze safety factors to find fatigue stresses in cylindrical plates to meet ASME Boiler standards.

CO3. Design pressure vessel components such as end closures, bolted flanges and supports to meet the applications.

CO4. Design the pressure vessel cylinders for protection against buckling effects in thick walled cylinders considering the standard solutions.

CO5. Design piping layout system consists of Tees, bends, bellows and valves to meet the piping ASME code standard requirements.

DETAILED SYLLABUS:

UNIT I: DESIGN OF CYLINDRICAL SHELLS   (09 periods)

Introduction to pressure vessels, Design Philosophy, Structural Integrity, material considerations, Stresses in pressure vessels, shrink fit stresses in built up cylinders, autofrettage of thick cylinders, thermal stresses and their significance, methods for determining stresses.

Design of Cylindrical Shells: ASME equations - Thin shell equations - Thick shell equations.

UNIT II: FATIGUE ASSESSMENT AND DISCONTINUITY STRESSES: (09 periods)

Fatigue Assessment: Introduction to theories of failure; Allowable stress limits in ASME Boiler & Pressure Vessel, Design for cyclic loading, Protection against fracture, S–N curves, Design curves, Cumulative damage. Fatigue, shock, high pressure, high temperature, irradiation, corrosion, and other hostile environments.

Discontinuity Stresses -Beams on elastic foundation, Cutouts and Reinforcements. Stress concentration in plate having circular hole due to bi-axial loading, excessive elastic deformation, plastic instability, brittle, rupture and creep. Design of nozzle.

UNIT III: END CLOSURES, BOLTED FLANGES & SUPPORTS: (10 periods)

End Closures - Introduction to ASME equations for various types of heads – Hemispherical, flat, ellipsoidal, torispherical, and conical heads.

Bolted Flanges - Introduction to bolted flanges, RF and FF flanges - Gasket loading behavior - Application of ASME equations for flange analysis and bolt design.

Design of Supports: Design of base plate and support lugs, Support skirts. Types of anchor bolt, its material and allowable stresses, Design for wind load- Design for seismic load- Theory of reinforcement - Design of cone cylinder intersections - Use of codes

UNIT IV: DESIGN OF PRESSURE VESSELS FOR BUCKLING LOADS: (08 periods)

Introduction to Buckling, types of Buckling, Elastic Buckling of circular ring and cylinders under external pressure, Collapse of thick walled cylinders or tubes under external pressure, Effect of supports on elastic Buckling of Cylinders, Design of circumferential stiffeners, Buckling under combined External pressure and axial loading.

UNIT V: DESIGN OF PIPING LAYOUT   (09 periods)

Introduction to Piping layout, Flow diagram, piping layout and piping stress analysis; Flexibility factor and stress intensification factor; Design of piping system as per B31.1 piping code.

Introduction to Piping components, bends, tees, bellows and valves.

Design and analysis of piping systems – Pipes and tubing under external and internal pressure –design of tube-sheets and tube seats, and use of post-weld heat treatment to affect residual stress in final rupture

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. John F. Harvey, "*Theory and Design of Pressure Vessels*", CBS Publishers and Distributors, 1987.

2. Somnath Chattopadhyay, *Pressure Vessels: Design and Practice*, 1st Edition, CRC Press, 2005.

REFERENCE BOOKS:

1. Henry H. Bedner, "*Pressure Vessels, Design Hand Book*", CBS publishers and Distributors, 1987.

2. William. J., Bees, "*Approximate Methods in the Design and Analysis of Pressure Vessels and Piping*", Pre ASME Pressure Vessels and Piping Conference, 1997.

ADDITIONAL LEARNING RESOURCES:

1. Stanley, M. Wales, "*Chemical process equipment, selection and Design*",Buterworths series in Chemical Engineering, 1988.

2. Pullarcot, Sunil Kumar, "*Practical Guide to Pressure Vessel Manufacturing*", CRC Press 2019.

3. Brownell L. E & Young. E. D , *Process equipment design*, Wiley Eastern Ltd., India,1959.

4. ASME Pressure Vessel and Boiler code, Section VIII Div 1, 2, and 3.

5. ASME B31.1-2016: *Power Piping: ASME Code for Pressure Piping*, B31, ANSI,2016.

6. Ellenberger P. - '*Pressure Vessels: ASME Code Simplified*' - McGraw Hill Company - 2004, 8th Edition.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1		2							3		
CO2	3	3	2	1		2							3		
CO3	3	3	3	1		2							3		
CO4	3	3	3	1		2							3		
CO5	3	3	3	1		2							3		
Average	3	3	2.8	1		2							3		
Correlation level	3	3	3	1		2							3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech. II Semester

(20BT60312) MECHANICAL BEHAVIOR OF MATERIALS

(Professional Elective–3)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	--	--	3

PRE-REQUISITES:

Courses on Material Science and Engineering and Design of Machine Elements

COURSE DESCRIPTION:

Elastic and plastic behavior of materials. Strengthening mechanisms, fatigue and its factor affecting, creep and fracture.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on mechanism involved in elastic and plastic behavior of materials.

CO2. Apply strengthening mechanism for ferrous and non ferrous materials.

CO3. Analyze Fatigue behavior of components using S-N curve.

CO4. Analyze fractures and mechanics of fractures and determine its parameters.

CO5. Analyze the materials using creep tests for engineering applications.

DETAILED SYLLABUS:

UNIT I: ELASTIC AND PLASTIC BEHAVIOUR   (09 periods)

Elastic behavior of materials, Hooke's law, plastic behavior, dislocation theory, Burger's vectors and dislocation loops, dislocations in the FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, dislocation climb, intersections of dislocations, Jogs, dislocation sources, multiplication of dislocations, dislocation pile-ups, Slip and twinning.

UNIT II: STRENGTHENING MECHANISMS   (09 periods)

Elementary discussion of cold working, grain boundary strengthening. Solid solution strengthening, Martensitic strengthening, Precipitation strengthening, Particulate Strengthening, Dispersion strengthening, Fiber strengthening, Examples of above strengthening mechanisms from ferrous and non-ferrous systems, Yield point phenomenon, strain aging and dynamic strain aging.

UNIT III: FATIGUE BEHAVIOUR   (09 periods)

Fatigue: Stress cycles, S-N curves, Effect of mean stress, Factors affecting Fatigue, Structural changes accompanying fatigue, Cumulative damage, HCF / LCF, thermo - mechanical fatigue, application of fracture mechanics to fatigue crack propagation, fatigue testing machines- Pari's Equation, Residual life prediction under Fatigue. Macro, Microstructural features of fatigue fracture.

UNIT IV: FRACTURE AND FRACTURE MECHANICS   (09 periods)

Types of fracture, Basic mechanisms of ductile and brittle fracture, Griffith's theory of brittle fracture, Orowan's modification. Izod and Charpy Impacts tests, Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, Determination of DBTT.

Fracture mechanics-Introduction, Modes of fracture, Stress intensity factor, Strain energy release rate, Fracture toughness and Determination of KIC, Introduction to COD, J integral.

UNIT V: CREEP BEHAVIOUR AND TESTING   (09 periods)

Creep curve, Stages in creep curve and explanation, Structural changes during creep, Creep mechanisms, Metallurgical factors affecting creep, High temperature alloys, Stress rupture testing, Creep testing machines, Parametric methods of extrapolation. Deformation Mechanism Maps according to Frost/Ashby.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Dieter, G. E., *Mechanical Metallurgy*, McGraw-Hill Co., 3rd Edition, 2017.
2. Thomas H.Courtney, *Mechanical Behavior of Materials*", McGraw-Hilll, 2nd edition, 2019.

REFERENCE BOOKS:

1. Suryanarayana, A. V. K., *Testing of Metallic Materials*, Prentice Hall India, New Delhi.
2. Marc Andr'e Meyers and Krishan Kumar Chawla, "*Mechanical Behavior of Materials*" Cambridge University Press, 2009.
3. Prashant Kumar, *Elements of Fracture Mechanics*, McGraw-Hilll, 2009.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			-	-	-	-	-	-	-	-	3	-	-
CO2	3	1			-	1		-	-	-	-	-	3	-	-
CO3	3	3	1		-	1		-	-	-	-	-	3	-	-
CO4	3	3	1		-	1		-	-	-	-	-	3	-	-
CO5	3	3	1		-	1		-	-	-	-	-	3	-	-
Average	3	3	1			1							3		
Correlation level	3	3	1			1							3		

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – II Semester

(20BT60313) NON-TRADITIONAL MACHINING PROCESSES

(Professional Elective–3)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Course on Engineering Workshop and Manufacturing Technology

COURSE DESCRIPTION:

The course details various non-conventional manufacturing processes. It consists of manufacturing processes classification and necessity of non conventional manufacturing processes. Also details about the working principle, mechanism of material removal, sources of energy used for material removal, the set up/equipment and relative advantages and disadvantages.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on chemical energy based machining processes.

CO2. Demonstrate the knowledge on electrochemical energy based machining processes.

CO3. Demonstrate the knowledge mechanical energy based machining process

CO4. Demonstrate the knowledge on electrical energy based machining processes.

CO5. Demonstrate the knowledge on thermal energy based machining process.

DETAILED SYLLABUS

UNIT I: CHEMICAL ENERGY BASED PROCESSES   (9 periods)

Need for non-traditional machining methods, Classification of modern machining processes, Comparative study of different processes, Considerations in process selection, Materials and its applications.

Chemical machining –Fundamentals - Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and Material removal rate - Applications.

UNIT II: ELECTRO-CHEMICAL ENERGY BASED PROCESSES   (9 periods)

Principles of ECM- Surface Roughness and Material removal rate- Process Parameters – Electro Chemical Grinding - Electro Chemical Honing – Electro Chemical Deburring- Applications.

UNIT III: MECHANICAL ENERGY BASED PROCESSES   (9 periods)

Basic principles, Types of abrasives - Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining.(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – Material removal mechanism - Applications.

UNIT IV: ELECTRICAL ENERGY BASED PROCESSES   (9 periods)

Electric Discharge Machining (EDM)- working Principle-Process Parameters-Surface Finish and Material Removal Rate- electrode / Tool – Power and control Circuits-Mechanics of metal removal in EDM, process parameters, Selection of tool electrode and dielectric fluids, Methods of surface finish and machining accuracy, Characteristics of spark eroded surface and machine tool selection,Wire EDM-principle & its applications.

UNIT V: THERMAL ENERGY BASED PROCESSES   (9 periods)

Electron Beam Machining: Generation and control of electron beam for machining, Theory of electron beam machining, Comparison of thermal and non-thermal processes, Applications, Advantages, Limitations.

Laser Beam Machining: General principle and application of laser beam machining, Thermal features, Cutting speed and accuracy of cut, Laser drilling.

Plasma Arc Machining: Principle, Metal removal mechanism, Process parameters, Accuracyand surface finish, Applications, Advantages and limitations.

Total No. of Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Vijay.K. Jain "*Advanced Machining Processes*" Allied Publishers Pvt. Ltd., New Delhi, 2007

2. Pandey P.C. and Shan H.S. "*Modern Machining Processes*" Tata McGraw-Hill, New Delhi, 2007.

REFERENCE BOOKS:

1. Benedict. G.F. "*Nontraditional Manufacturing Processes*", Marcel Dekker Inc., New York, 1987.

2. Mc Geough, "*Advanced Methods of Machining*", Chapman and Hall, London, 1998.

3. Paul De Garmo, J.T. Black, and Ronald. A. Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 10thEdition, New Delhi, 2012.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1				1	1						3		
CO2	3	1				1	1						3		
CO3	3	1				1	1						3		
CO4	3	1				1	1						3		
CO5	3	1				1	1						3		
Average	3	1				1	1						3		
Correlation level	3	1				1	1						3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech. II Semester

(20BT60314) OPTIMIZATION TECHNIQUES

(Professional elective 3)

(Common to CE, ME, CSE, CSSE, CSE(AI), CSE(DS) and CSBS)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

A course on Differential equations and Multi variable calculus

COURSE DESCRIPTION:

Introduction to optimization; classical optimization techniques; classification of optimization problems; linear programming; Transshipment and Travelling salesman problem; non-linear programming; un-constrained non-linear programming; constrained non-linear programming; dynamic programming; Genetic Algorithm; Ant Colony Optimization.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Model and solve unconstrained optimization problems.

CO2. Apply LP Techniques and Conduct Sensitivity analysis for real life Problems

CO3. Apply Non-Linear Programming techniques for real life problems.

CO4. Analyze various complex problems by using Dynamic programming approaches.

CO5. Model and solve complex problems using evolutionary algorithms to optimize the parameters.

DETAILED SYLLABUS:

UNIT I: CLASSICAL OPTIMIZATION TECHNIQUES   (09 periods)

Introduction, Engineering applications of optimization, Statement of an optimization problem, Design vector, Design constraints, Constraint surface, Objective function, Classification of optimization problems, Single variable optimization, Multi variable optimization without constraints, Multi variable optimization with equality constraints - Lagrange multipliers method; Multi variable optimization with inequality constraint - Kuhn Tucker conditions.

UNIT II: LINEAR PROGRAMMING   (09 periods)

Introduction, Formulation, Primal Simplex method, Dual simplex method, Sensitivity Analysis, Goal programming

UNIT III: NON-LINEAR PROGRAMMING   (09 periods)

One dimensional minimization methods, classification - Fibonacci method, quadratic interpolation method; classification of unconstrained minimization methods - Powell's method, steepest descent method (Cauchy's method); classification of constrained optimization techniques - interior and exterior penalty function methods.

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UNIT IV: DYNAMIC PROGRAMMING   (09 periods)

Multistage decision processes, Concept of sub optimization and Principle of optimality, Computational procedure in dynamic programming - Calculus method, Tabular method; Linear Programming problem by dynamic programming approach, Applications - reliability problem, shortest path problem, and capital budgeting problem.

UNIT V: EVOLUTIONARY OPTIMIZATION ALGORITHMS   (09 periods)

Introduction to Evolutionary optimization, genetic algorithm-Mathematical Modeling of Genetic algorithm, Ant Colony Optimization, particle swarm Optimization and differential evolution techniques.

Total No. of Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Singiresu S Rao, *Engineering Optimization: Theory and Practice*, New Age International, 3rdEdition, 2013.

2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, *Engineering Optimization: Methods and applications*, Wiley India Pvt. Ltd., 2nd Edition2006.

3. Dan Simon, *Evolutionary Optimization Algorithms*, John Wiley & Sons, 2013.

REFERENCE BOOKS:

1. C Mohan and Kusum Deep, *Optimization Techniques*, New Age International Publishers, 1st Edition, 2010.

2. Hamdy A. Taha, *Introduction to Operations Research*, PHI, 10th edition, 2017.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1		1									3
CO2	3	3	3	1		1									3
CO3	3	3	3	1		1									3
CO4	3	3	3	1		1									3
CO5	3	3	3	1		1									3
Average	3	3	3	1		1									3
Correlation level	3	3	3	1		1									3

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT60315) REFRIGERATION AND AIR CONDITIONING

(Professional Elective - 3)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Thermal Engineering-II and Fluid Mechanics & Hydraulic Machinery

COURSE DESCRIPTION:

Refrigeration cycles; Application of thermodynamics; heat transfer to the refrigeration cycles; Analysis and design of various refrigeration systems; Study of components of refrigeration system; refrigerants selection; Psychrometry; Heat gain and Heat loss calculations. Air conditioning equipment; load calculations; heat pump circuits.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1.   Analyze the performance of air and vapour compression refrigeration systems and solve problems related to it.

CO2.   Demonstrate the knowledge of desirable properties refrigerants and constructional features of refrigeration equipment.

CO3.   Demonstrate knowledge of constructional features and working of vapor absorption refrigeration systems, steam jet refrigeration systems and non-conventional refrigeration systems.

CO4.   Design the air conditioning systems using psychrometric principles by considering various heat loads.

CO5.   Demonstrate knowledge of comfort air conditioning, air conditioning equipment and heat pump circuits

DETAILED SYLLABUS:

UNIT I: AIR AND VAPOR COMPRESSION REFRIGERATION SYSTEMS   (9 periods)

Air refrigeration cycle: Introduction, open and dense air refrigeration cycle, Energy Efficiency Ratio (EER), BEE star rating Air refrigeration systems - Bell-Coleman cycle, applications; Aircraft air refrigeration systems: Need for aircraft refrigeration, simple air cooling system, simple air evaporative cooling system and bootstrap air cooling system;

vapor compression refrigeration cycle: Effect of liquid subcooling & superheating, effect of evaporator and condenser pressures, Cascade refrigeration system.

UNIT II: REFRIGERATION EQUIPMENT AND REFRIGERANTS   (9 periods)

Refrigeration equipment: Introduction, working and applications of Compressors, Condensers, Evaporators, Expansion devices.

Refrigerants: Classification, properties, ASHRAE numbering system for refrigerants, selection of refrigerants, alternate refrigerants, impact of refrigerants on environment.

UNIT III: VAPOUR ABSORPTION REFRIGERATION SYSTEM AND EMERGING TECHNOLOGIES   (9 periods)

Classification, Working principle of NH3 – water system, Li Br – water (Two shells & four shells) system, Calculation of maximum COP, Electrolux refrigeration system.

Steam jet refrigeration system: Working principle, basic components.

Non-conventional refrigeration system: Principle and operation of Thermo-electric refrigerator, Thermoacoustic Refrigeration, Vortex tube.

UNIT IV: DESIGN OF AIR CONDITIONING SYSTEMS   (9 periods)

classification of air-conditioning systems, summer, winter and year round air conditioning systems; Different Heat sources: Adiabatic mixing of two air streams, Bypass factor, Room Sensible Heat Factor (RSHF), Grand Sensible Heat Factor (GSHF), Effective Room Sensible Heat Factor (ERSHF); cooling load calculations, sensible heat load, latent heat load.

UNIT V: COMFORT AIR CONDITION AND EQUIPMENTS   (9 periods)

Comfort Conditions: need and requirements of comfort air conditioning, Thermal exchange of body with environment, concept of effective temperature, Comfort chart.

Air Conditioning Equipment: Introduction, working and applications of Humidifiers, Dehumidifiers; Air-filters, Fans, Blowers, Ducts**.**

Heat pump: Introduction, different heat pump circuits, air to air, water to air.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Domkundwar Arora Domkundwar, *A Course in Refrigeration and Air conditioning*, Dhanpat Rai publication, 8th Edition, 2018.

2. C.P Arora, *Refrigeration and Air Conditioning*, TMH, 8th Edition, 2017.

REFERENCE BOOKS:

1. P.L.Ballaney, *Refrigeration and Air Conditioning*, Khanna Publications, 15th Edition, 2012.

2. Manohar Prasad, *Refrigeration and Air Conditioning*, New Age International, 3rd Edition, 2016

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3				1	1							3	
CO2	3	1				1	1							3	
CO3	3	1				1	1							3	
CO4	3	3	3	1		1	1							3	
CO5	3	1				1	1							3	
Average	3	1.8	3	1		1	1							3	
Correlation level	3	2	3	1		1	1							3	

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – II Semester

(20BT60316) ARTIFICIAL INTELLIGENCE AND ROBOTICS

(Inter disciplinary elective – 1)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Design of machine elements, Kinematics of machinery and Dynamics of machinery.

COURSE DESCRIPTION:

Introduction of Artificial Intelligence; Introduction of Robots classifications; Components; Robot drive mechanisms; Mechanical transmission methods aided in functioning of robots; Forward kinematics; inverse kinematics; Manipulator dynamics; Trajectory planning and avoidance of obstacles; Robot programming; Robot Application in Industry; Future Application and Challenges and Case Studies.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on applications of AI, and select search strategies based on application requirement.

CO2. Demonstrate the concepts involved in robot systems.

CO3. Analyze kinematics and dynamics of robots.

CO4. Analyze trajectory planning to avoid obstacles involving sensors and control.

CO5. Develop programming for robotic applications.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION OF AI   (09 periods)

Artificial Intelligence: Introduction to Artificial Intelligence (AI), History. AI techniques, LISP programming, AI and Robotics, LISP in the factory, sensoring and digitizing function in machine vision, image processing and analysis, training and vision system.

Intelligent Agents: Agents and Environments, the Concept of Rationality, the Nature of Environments, the Structure of Agents.

SLE: State of the Art of AI applications.

UNIT II: INTRODUCTION OF ROBOTICS   (09 periods)

Robot, Brief History, Classifications, Laws of Robotics, Robotic system, Robot anatomy, common robot configurations, coordinate system, Joint notation schemes, Work volume, Degrees of freedom, Components, End effectors – Classification of End effectors, Tools as end effectors; Teach pendant, sensors, Specification of robots, Applications, safety measures.

UNIT III: MANIPULATOR KINEMATICS & DYNAMICS   (10 periods)

Manipulator kinematics: Mathematical Preliminaries on Vectors & Matrices, Homogeneous transformations as applicable to rotation and translation, (D-H) notation, Forward kinematics, Inverse kinematics, Manipulators with two, Three degrees of freedom.

Manipulator dynamics: Introduction, Inertia of a Link, Lagrangian formulation for a planar 2R manipulator.

UNIT IV: TRAJECTORY PLANNING & SENSORS   (10 periods)

Trajectory planning: Trajectory planning and avoidance of obstacles, Path planning, Skew motion, Joint integrated motion, straight line motion.

Sensors: Position sensors, Velocity sensors, Tactile sensors, Proximity sensors, Machine vision sensors, Fail safe hazard sensor systems and Compliance mechanism

UNIT V: ROBOT PROGRAMMING AND APPLICATIONS   (07 periods)

Robot programming: Types, Features of languages and Software packages.

Robot application: Robot Application in Industry, Task programming, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges, and Case Studies.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Stuart Russell and Peter Nowig, *Artificial Intelligence: A Modern Approach*, PEARSON Publication, 4th edition, 2020.

2. M.P.Groover, *Industrial Robotics: Technology, Programming*, and Applications, Tata McGraw-Hill Edition 2008.

3. John. J. Craig, *Introduction to Robotics: Mechanics and Control*, Edition 3, Pearson/Prentice Hall, 2005.

REFERENCE BOOKS:

1. DAN.W.Patterson, *Introduction to Artificial Intelligence and Expert Systems* , PHI, 2nd edition, 2009.

2. Richard. D.Klafter, *Robotics Engineering: an integrated approach*, Prentice-Hall publisher, 1st Edition 1988.

3. K. S. Fu., R. C. Gonzalez, C. S. G. Lee , *Robotics: Control Sensing, Vision and Intelligence*, International Edition, TATA McGraw Hill, 2008.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			1	1							3		
CO2	3	1			1	1							3		
CO3	3	3	1	1	1	1							3		
CO4	3	3	1	1	1	1							3		
CO5	3	3	3	1	1	1							3		
Average	3	2.2	1.6	1	1	1							3		
Correlation level	3	2	2	1	1	1							3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech. – II Semester

(20BT60317) AUTOMOTIVE ELECTRONICS

(Inter disciplinary elective – 1)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

A course on thermal engineering-I

COURSE DESCRIPTION:

Electronic control in various systems in automobile; Importance of microcontrollers; Sensors and actuators used in automobile; Electronics engines; Automotive instrumentation in signal conversion and lightening system.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on automotive systems, electronic controls in automobiles.

CO2. Demonstrate the knowledge on automotive grade microcontrollers and components of microcomputer in automobile.

CO3. Demonstrate the knowledge on sensors, actuators, signal conditioning techniques, interfacing techniques and actuator mechanisms used in automotive systems.

CO4. Analyze functional and operational characteristics of electronics interventions in engines.

CO5. Demonstrate the knowledge on automotive instrumentation system.

DETAILED SYLLABUS:

UNIT 1: AUTOMOTIVE SYSTEMS   (9 periods)

Introduction, Need for electronic control in automobiles; various sub-systems of automobile: Engine, Transmission System, Steering and Brake Systems; Classification and working of IC engine: Gasoline, Diesel engines, 2-stroke, 4-stroke engines; Engine Control methods: Air-fuel ratio control, Spark timing, Start of fuel injection.

UNIT II: MICROCOMPUTERS   (9 periods)

Microcomputer: Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table.

UNIT III: SENSORS AND ACTUATORS   (9 periods)

Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensors, Position sensors: Throttle position sensors, accelerator pedal position sensors and crankshaft position sensors, Air mass flow sensors. Solenoids, stepper motors and relays.

UNIT IV: ELECTRONIC ENGINE AND VEHICLE MANAGEMENT SYSTEM   (9 periods)

Electronic engine control: Input, output and control strategies, electronic fuel control system, fuel control modes: open loop and closed loop control at various modes, EGR control, Electronic ignition systems–Spark advance correction schemes, fuel injection timing control. Cruise control system, Antilock braking system, electronic suspension system, electronic steering control, traction control system, Transmission control, Safety: Airbags, collision avoiding system, low tire pressure warning system.

UNIT V: AUTOMOTIVE INSTRUMENTATION SYSTEM   (9 periods)

Input and output signal conversion, multiplexing, fuel quantity measurement, coolant temperature and oil pressure measurement, display devices- LED, LCD, VFD and CRT, On-board diagnostics (OBD), OBD-II, off-board diagnostics.

                                                                            Total No. of Periods:45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. William BRibbens, *Understanding Automotive Electronics*, Newne Butterworth-Heinermann, 2003.

2. Crouse W H, *Automobile Electrical Equipment*, McGraw Hill, New York 2005.

REFERENCE BOOKS:

1. Bechhold "Understanding Automotive Electronics", SAE, 1998.

2. Robert Bosch "Automotive Hand Book", SAE 5/e, 2000.

3. Tom Denton, "Automobile Electrical and Electronic Systems" 3/e, Edward Arnold, London, 2004.

4. Eric Chowanietz, "Automotive Electronics", SAE International, USA, 1995.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1				1								3	
CO2	3	1			1	1								3	
CO3	3	1			1	1								3	
CO4	3	3			1	1								3	
CO5	3	1				1								3	
Average	3	1			1	1								3	
Correlation level	3	1			1	1								3	

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. – II Semester

(20BT60318) INDUSTRIAL AUTOMATION AND CONTROL SYSTEMS

(Inter disciplinary elective – 1)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	--	--	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Automation in Production System; Advanced Automation Functions; Material Handling Systems; GT and Cellular Manufacturing; FMS; Industrial Control Systems; AI in manufacturing.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate knowledge on Industrial automation components and systems used in automated manufacturing industries.

CO2. Design material handling systems for a manufacturing plant based on its working principle and capabilities.

CO3. Analyze transfer lines in automation involving Manufacturing Cells, GT, Cellular Manufacturing, FMS, and FMS.

CO4. Demonstrate the knowledge on control systems in manufacturing.

CO5. Develop mathematical models for manufacturing plants using AI.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO AUTOMATION: **(07 periods)**

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

UNIT II: MATERIAL HANDLING SYSTEMS   **(10 periods)**

Overview of Material Handling Systems, Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

UNIT III: AUTOMATION IN MANUFACTURING   **(09 periods)**

Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines &Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly.

UNIT IV: CONTROL SYSTEM IN MANUFACTURING   **(09 periods)**

Industrial Control Systems, Process Industries Verses Discrete - Manufacturing, Industries Continuous Verses Discrete Control, Computer Process and its Forms. Sensors Actuators and other Control System Components, Application of control system in manufacturing

UNIT V: ARTIFICIAL INTELLIGENCE IN MANUFACTURING (10 periods)

Introduction/need for system Modeling, Building Mathematical Model of a manufacturing Plant, ModernTools – Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

(*Total Periods: 45*)

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. R.C. Dorf, John Wiley and Sons, *Hand book of design, manufacturing and Automation*, Wiley-Interscience; 1st edition, 1994.
2. M.P. Groover, *Automation, Production Systems and Computer Integrated Manufacturing*, Pearson Education, 4th Edition, 2016.

REFERENCE BOOKS:

1. W.P.David, *Industrial Automation*, Wiley-Interscience, 1st Edition, 1991.

2. Krishna Kant, *Computer Based Industrial Control*, PHI, 2nd Edition, 2011.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	**3**	-	-
CO2	3	3	3	1	1	1	-	-	-	-	-	-	**3**	-	-
CO3	3	3	1		1	1	-	-	-	-	-	-	**3**	-	-
CO4	3	1	1		1	1	-	-	-	-	-	-	**3**	-	-
CO5	3	3	3	1	3	1	-	-	-	-	-	-	**3**	-	-
Average	3	2.2	2	1	1.5	1	-	-	-	-	-	-	**3**	-	-
Correlation level	3	2	2	1	2	1							**3**		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT60319) MACHINERY FAULT DIAGNOSIS AND SIGNAL PROCESSING

(Inter Disciplinary Elective–1)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Basic Engineering Mechanics, Kinematics of Machinery and Dynamics of Machinery.

COURSE DESCRIPTION:

Introduction to Condition Based Maintenance, Types and Benefits of Vibration Analysis; Basic Signal Processing Techniques- visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring; Fault Detection- Vibration Criteria- Use of Frequency Spectra- CPB Spectrum; Diagnostic Techniques- Gear Diagnostics techniques- Bearing Diagnostics; Vibration Monitoring- vibration data collection, instruments, measurement location, time domain analysis, frequency domain analysis.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

- CO1. Apply maintenance and condition monitoring techniques to machines.
- CO2. Apply signal processing techniques to components of machines.
- CO3. Analyze and correct the Machinery faults using fault Trending and Prognostics tools.
- CO4. Analyze machine elements using various Diagnostic Techniques
- CO5. Analyze characteristics of vibration using suitable monitoring techniques.

DETAILED SYLLABUS

UNIT I: CONDITION BASED MAINTENANCE   (9 periods)

Introduction, Maintenance Strategies, Condition Monitoring Methods- Vibration Analysis- Oil Analysis- Performance Analysis- Thermography; Types and Benefits of Vibration Analysis; Vibration Transducers- Absolute vs Relative Vibration Measurement -Proximity Probes - Velocity Transducers – Accelerometers -Dual Vibration Probes -Laser Vibrometers; Torsional Vibration Transducers- Shaft encoders- Torsional Laser Vibrometers; Condition Monitoring - Basic Problems.

UNIT II: SIGNAL PROCESSING TECHNIQUES   (9 periods)

Basic concept, techniques - visual monitoring, temperature monitoring, vibration monitoring,lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring.Probability distribution and density, Fourier analysis, Hilbert Transform, Cepstrum analysis,Digital filtering, Deterministic / random signal separation, Time-frequency analysis.

UNIT III: FAULT DETECTION   (9 periods)

Introduction, Rotating Machines - Vibration Criteria- Use of Frequency Spectra- CPB Spectrum Comparison; Reciprocating Machines- Vibration Criteria for Reciprocating Machines- Time–Frequency Diagrams- Torsional Vibration; Fault Trending and Prognostics-Trend Analysis- Trending of Simple Parameters- Trending of Impulsiveness; Determination of Spall Size in Bearings; Advanced Prognostics- Data-Driven Models- Hybrid Models.

UNIT IV: DIAGNOSTIC TECHNIQUES (9 periods)

Harmonic and Sideband Cursors; Minimum Entropy Deconvolution; Gear Diagnostics-Techniques Based on the TSA- Transmission Error as a Diagnostic Tool- Separation of Spalls and Cracks- Diagnostics of Gears with Varying Speed and Load; Rolling Element Bearing Diagnostics- Signal Models for Bearing Faults- A Semi-automated Bearing Diagnostic Procedure; Reciprocating Machine and IC Engine Diagnostics- Time–Frequency Methods-Cylinder Pressure Identification.

UNIT V: VIBRATION MONITORING (9 periods)

Vibration Monitoring Introduction, vibration data collection, techniques, instruments, measurement location, time domain analysis, frequency domain analysis, time-frequency domain analysis and commonly witnessed machinery faults diagnosed by vibration analysis. Vibration signals from rotating and reciprocating machines – signal classification, signals generated by rotating machines, signals generated by reciprocating machines.

(**Total Periods: 45)**

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Robert Bond Randall, *Vibration-Based Condition Monitoring – Industrial, Aerospace and Automotive applications*, John Wiley & Sons Ltd., 2011 DOI:10.1002/9780470977668

2. R.A.Collacot , *Mechanical Fault Diagnosis*, Chapman and Hall Ltd., 1977.

3. NOC: Machinery Fault Diagnosis and Signal Processing Prof. Amiya Ranjan Mohanty Mechanical Engineering IIT Kharagpur.

4. R.C.Mishra, K.Pathak, *Maintenance Engineering and Management*, Prentice Hall ofIndia Pvt. Ltd., 2002.

REFERENCES MATERIALS/BOOKS:

1. Dr. K. Balaveera Reddy, ISTE Summer School on Machinery Diagnostics and Preventive Maintenance, KREC, Surathkal, 1995.

2. Dr. A. Ramachandra, ISTE-STTP on Maintenance of Machinery, 2000.

3. John S. Mitchell, Introduction to Machinery Analysis and Monitoring, PennWell Books, 1993.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1			1							3		
CO2	3	2	1			1							3		
CO3	3	3	1			1							3		
CO4	3	3	1			1							3		
CO5	3	3	1	1	1	1							3		
Average	3	2.6	1	1	1	1							3		
Correlation level	3	3	1	1	1	1							3		

Correlation Levels: 3– High 2 - Medium 1– Low

III B. Tech. – II Semester

(20BT60320) **NON- CONVENTIONAL ENERGY SOURCES**

(Inter disciplinary elective – 1)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:-

COURSE DESCRIPTION:

Overview and importance of nonconventional energy sources; Solar Energy collection, solar energy storage and applications; Wind energy conversion; Biomass energy conversion; Geothermal energy Conversion; Ocean energy conversion: Ocean thermal energy conversion, Wave energy and tidal energy conversion.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on energy resources, energy conservation and solar energy.

CO2. Analyze the performance characteristics of solar heat collectors.

CO3. Demonstrate the knowledge on PV systems, energy storage and conversion systems.

CO4 Demonstrate the knowledge on construction and working of wind energy and bio-energy conversion systems.

CO5. Demonstrate the knowledge on construction and working of Geothermal and Ocean Energy conversion systems.

DETAILED SYLLABUS:

UNIT I: ENERGY CONSERVATION AND SOLAR ENERGY   (09 periods)

Energy sources and Conservation: Introduction, Conventional energy sources**,** Classification, Importance of renewable energy sources, energy alternatives, need and Principles of energy conservation.

Fundamentals of Solar Energy: Site selection for solar plant, Solar constant and solar radiation geometry, Solar time and day length, Estimation of monthly average daily total radiation on horizontal surface and tilted surface, Measurement of solar radiation - Pyranometer, Pyrheliometer and Sunshine recorder.

UNIT II: SOLAR ENERGY COLLECTION DEVICES   (09 periods)

Flat plate collector, Losses through flat plate collector; Transmissivity of the cover system, Transmittance – Absorptance product, Parameters affecting the collector performance, Efficiency of flat plate collector, Selective surfaces, Air collectors and types, Classification of concentrating collectors.

UNIT III: SOLAR ENERGY APPLICATIONS   (09 periods)

Solar Photo Voltaic Systems: Basic principle of PV cell, Arrangements of PV cells, classification of PV cell, Solar PV Applications.

Solar Thermal Applications: Methods of storing solar energy - sensible heat storage, latent heat storage, Applications -Solar water heating, Solar Refrigeration, Solar thermal power generation, Solar distillation.

UNIT IV: WIND ENERGY AND BIOMASS ENERGY CONVERSION   (09 periods)

Wind Energy Conversion: Introduction, Site selection for wind energy plant, General formula - Betz limit - Lift and Drag - Basis of wind energy conversion - Effect of density, frequency variances, angle of attack, and wind speed, classification and working of horizontal axis wind turbine - vertical axis Wind turbines, Types of blades, Wind energy conversion systems, environmental consideration.

Biomass Energy Conversion: Pyrolysis of Biomass to produce solid, liquid and gaseous fuels , Classification of biogas plants, Types of Digesters – Floating drum, fixed dome type biogas plants, comparison; variations of Biogas models – pragati biogas model, Jwala biogas model, CAMATEC model and Deena bandhu biogas model, Factors affecting digester performance.

UNIT V: GEOTHERMAL AND OCEAN ENERGY CONVERSION   (09 periods)

Geothermal Energy Conversion: Introduction, geothermal sources - Hydro thermal resources, geo pressurized resources, hot dry rocks, Power generation through liquid dominated system, vapour dominated system, applications of geothermal energy, environmental consideration.

Ocean Energy Conversion: Ocean thermal Energy conversion - Lambert's law, OTEC conversion technologies- Claude cycle and Anderson cycle, Environmental impacts of OTEC; Tidal energy conversion - Principles of tidal and wave power generation, tidal energy conversion - single basin and double basin systems.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. G.D, Rai, *Non-conventional Energy Sources*, Khanna Publishers, 5th Editon, 2011.

2. B.H.Khan, *Non-conventional Energy Sources*, TMH, 3rd Edition, 2016.

REFERENCE BOOKS:

1. S.P.Sukhatme and J.K Nayak, *Solar Energy Principles of Thermal Collection and Storage*, TMH, 3rd edition, 2008.

2. W.R.Murphy & G.Mckay, *Energy Management*, Butterworth, London, 2nd Edition, 2007**.**

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1				1	1							3	
CO2	3	3	1	1		1	1							3	
CO3	3	1	1			1	1							3	
CO4	3	1	1			1	1							3	
CO5	3	1	1			1	1							3	
Average	3	1.4	1			1	1							3	
Correlation level	3	1	1	1		1	1							3	

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. II-Semester

(20BT60321) PROGRAMMABLE LOGIC CONTROLLER IN AUTOMATION

(Inter disciplinary elective – 1)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

A course on Basic electrical and electronics engineering

COURSE DESCRIPTION:

Introduction to Microprocessors; basic microcontrollers; Assembly language programming concepts; Digital signal controls and processing; Controls for robots in automation.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge of the internal architecture of 8085 processor.

CO2. Demonstrate the architecture and capabilities of microprocessors and microcontrollers.

CO3. Apply assembly language programs for interrupt and timer programming in different modes.

CO4. Apply the concept of Z-Transform, digital filters and algorithms for digital control.

CO5. Demonstrate knowledge of automation using robotics for industrial Applications.

DETAILED SYLLABUS

UNIT I: INTRODUCTION TO MICROPROCESSORS (9 periods)

Introduction: Number systems, codes. Digital electronics: logic gates, combinational circuits design, flip-flops. Sequential logic circuits design: counters, shift registers.

Introduction to 8085: 8085 architecture, registers, ALU, bus systems, 8255 PPI, 8253 programmable timer, ADC and DAC, functional block diagram of 8085.

UNIT II: INTRODUCTION TO MICROCONTROLLERS (8 periods)

The 8051 architecture : Introduction, 8051 Micro controller hardware, input / output ports and circuits, external memory, counter and timers, synchronous serial and asynchronous serial communication, interrupts and priorities.

UNIT III: ASSEMBLY LANGUAGE PROGRAMMING AND APPLICATIONS (8 periods)

Basic Assembly Language Programming Concepts: Assembly language programming process, addressing modes, instruction set of 8051 microcontroller, assembly language programming, and introduction to C programming.

Applications: Interfacing with keyboards, D/A and A/D conversions, serial data communication, programmable timers.

UNIT IV: DIGITAL CONTROL (8 periods)

Introduction to Digital Control: Sampling theorem, signal conversion and processing, Z-Transform, digital filters, implementation of digital algorithm

UNIT V: AUTOMATION   **(12 periods)**

Automation: Need for Automation, Robot components, control system concepts, analysis, control of joints, adaptive and optimal control. End effectors, classification, mechanical, magnetic, vacuum, adhesive drive systems and controls, force analysis and gripper design. Direct and inverse kinematics for industrial robots.

                                                  (Total No. of Periods: 45)

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Michael D. Ciletti, M. Morris Mano, *Digital Design*, 4/e. Pearson Education, 2007.

2. Ramesh S. Gaonkar, *Microprocessors, Architecture, Programming and Applications with the 8085*, 5/e, Penram, 2011.

3. Thomas R. Kurfess, *Robotics And Automation Handbook*, CRC Press, 2004, ISBN 0-8493-1804-1

REFERENCE BOOKS:

1. William H. Gothmann, *Digital Electronics: An Introduction to Theory and Practice*, , PHI Learning Private Limited, 1982.

2. John.F.Wakerly, *Microcomputer Architecture and Programming,* John Wiley and Sons 1981

3. Kenneth. J. Ayala, *The 8051 Microcontroller*, 3/e, Cengage Learning, 2004.

4. Benjamin C. Kuo, *Digital Control Systems*, Oxford University Press 2/e, Indian Edition, 2007.

5. Raj Kamal, *The Concepts and Features of Microcontrollers*, Wheeler Publishing, 2005.

6. Groover M.P. Weiss Mithell Nagel R.N., Odery N.G., "*Industrial Robotics, Technology, Programming and Applications*", McGraw Hill International Editions, 1986.

7. Klafter,"*Robotics Engineering*", PHI Pvt. Ltd., New Delhi.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	-	-	-	-	-	3	-	-
CO2	3	-			1	-	-	-	-	-	-	-	3	-	-
CO3	3	2	1	1	2	-	-	-	-	-	-	-	3	-	-
CO4	3	2	1	1	2	-	-	-	-	-	-	-	3	-	-
CO5	3	-	-	-	1	-	-	-	-	-	-	-	3	-	-
Average	3	2	1	1	1.5	1							3		
Correlation level	3	2	1	1	2	1							3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT60331) COMPUTER AIDED DESIGN AND MANUFACTURING LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

A Course on Computer Aided Engineering Drawing.

COURSE DESCRIPTION:

Fundamental Concepts of CAD and Simulation; 2D and 3D Part Modeling, Manual Part Programming, CNC Code Generation.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1: Develop part drawings for machine components using drafting software.

CO2: Model the machine components using 3D modeling software.

CO3: Develop part programming in CNC applications.

CO4: Work independently or in teams to solve problems with effective communication

LIST OF EXPERIMENTS

any **twelve** experiments are to be conducted.

Exercises (2-D & 3-D) using design packages:

Part Modeling: Development of part drawings for various components in the form of orthographic and isometric, Representation of dimensioning and tolerances scanning and plotting.

List of exercises: (Minimum 5 exercises)

1. Prepare the solid model1 of given figure with required dimensions in isometric representation.

2. Prepare the solid model2 of given figure with required dimensions in isometric representation.

3. Prepare the solid model3 of given figure with required dimensions in isometric representation.

4. Prepare the solid model4 of given figure with required dimensions in isometric representation.

5. Prepare the solid model5 of given figure with required dimensions in isometric representation.

6. Prepare the solid model6 of given figure with required dimensions in isometric representation.

7. Prepare the solid model7 of given figure with required dimensions in isometric representation.

Assembly Modeling: Generation of various 3D models through protrusion, revolve, shell sweep, Creation of various features, Study of parent child relation, Feature based and

Boolean based modeling surface and assembly modeling, Study of various standard translators, Design simple components.

List of exercises: (Minimum 3 exercises)

1. Develop the part drawing of Knuckle joint assembly
2. Develop the part drawing of Plumber block assembly
3. Develop the part drawing of Crank hook assembly
4. Develop the part drawing of connecting rod in the orthographic representation.
5. Develop the part drawing of revolving center
6. Development of the part drawing of footstep bearing

CNC machines:

List of exercises: (Minimum 4 exercises)

1. Simulation of CNC Lathe and Milling Manual Part Programs.
2. Simulation of simple components on CNC Lathe 1.
3. Simulation of simple components on CNC Lathe 2
4. Simulation of simple components on CNC Milling.
5. Simulation of simple components using CANNED CYCLE.

CAD Packages: SOLIDWORKS, CATIA, Unigraphics, Solid Edge, CREO.

CAM Packages: Master CAM, Sinu train.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	2	-	-	-	-	-	-	3	-	-
CO2	3	3	3	1	3	2	-	-	-	-	-		3	-	-
CO3	3	3	3	1	3	2	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Average	3	3	3	1	3	2			3	3			3		
Correlation level	3	3	3	1	3	2			3	3			3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

III B. Tech – II Semester

(20BT60332) HEAT TRANSFER LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

A course on Engineering Thermodynamics and Fluid Mechanics and hydraulics Machinery

COURSE DESCRIPTION:

Experimental studies on mechanisms of heat transfer; Film wise and drop wise condensation; Steady and unsteady flow; Effectiveness of heat exchanger; thermal conductivity; emissivity; Stefan - Boltzmann constant.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the conduction heat transfer process by performing experiments on composite systems, metal rod and transient heat conduction systems and determine the heat transfer characteristics.

CO2. Analyze the convection heat transfer process by performing experiments on Pin Fin, Horizontal tube and vertical tube systems and calculate heat transfer characteristics.

CO3. Analyze the heat exchangers, boilers and condensers for heat transfer rates by performing experiments and determine the heat transfer characteristics.

CO4. Analyze radiation heat transfer process by performing experiments on black bodies and gray bodies and determine heat transfer characteristics.

CO5. Demonstrate the knowledge on heat transfer process in heat pipes and simulation of heat flow systems.

CO6. Work independently or in teams to solve problems with effective communication

DETAILED SYLLABUS:

LIST OF EXPERIMENTS:

1. Determination of Thermal conductivity of metal rod using thermal conductivity Apparatus.

2. Determination of Thermal conductivity of insulating powder material through concentric sphere apparatus.

3. Determination of Thermal conductivity of insulating material by lagged pipe apparatus.

4. Determination of Overall heat transfer co-efficient through Composite Slab Apparatus.

5. Determination of Temperature distribution and heat transfer rate in Transient heat conduction mode using the Transient heat conduction apparatus.

6. Determination of Convective Heat transfer coefficient in natural convection using natural convection apparatus.

7. Determination of Convective Heat transfer coefficient in forced convection using forced convection apparatus.

8. Determination of Temperature distribution, efficiency and effectiveness of Pin- Fin using pin-fin Apparatus.

9. Determination of overall heat transfer coefficient of Parallel and counter flow heat exchanger using Parallel and counter flow heat exchanger Apparatus.

10. Determination of Critical heat flux using the Critical Heat flux apparatus.

11. Determination of Heat transfer in drop and film wise condensation using drop and film wise condensation apparatus.

12. Determination of Stefan Boltzmann constant using the Stefan Boltzmann Apparatus.

13. Determination of Emissivity of a gray body using the Emissivity apparatus.

14. Study of two-phase heat flow in heat pipes.

15. Study of simulation of heat flow systems using simulation tools.

NOTE: Student shall perform minimum of twelve experiments

1. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International, 5th Edition, 2017.

2. SVEC20 Heat transfer Manual

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1		1								3	
CO2	3	3	1	1		1								3	
CO3	3	3	1	1		1								3	
CO4	3	3	1	1		1								3	
CO5	3	3	1	1	1	1								3	
CO6									3	3					
Average	3	3	1	1	1	1			3	3				3	
Correlation level	3	3	1	1	1	1			3	3				3	

Correlation Levels: 3– High   2 - Medium   1– Low

III B. Tech. II Semester

(20BT60333) SIMULATION AND ANALYSIS LAB

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		-	1	2	2

PRE-REQUISITES:

Courses on Computer aided design and manufacturing lab, Computer Aided Machine Drawing.

COURSE DESCRIPTION:

Fundamental Concepts of geometric modeling; Analysis of Simple Structural, Thermal and CFD problems.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Develop 3D solid model parts of mechanical systems and assemble the parts using CAD software.

CO2. Analyze the simulation models and structural problems in mechanical engineering to calculate stress and strains destitutions using FEM software.

CO3. Analyze the simulation models and thermal problems in mechanical engineering to calculate temperature distribution using FEM and CFD software.

CO4. Analyze and simulate mechanical engineering systems using simulation software.

C05: Work independently or in teams to solve problems with effective communication

LIST OF EXPERIMENTS

Minimum **TEN** experiments should be conducted.

Structural Analysis:

1. Simulate the stress concentration phenomena on a flat plate with central hole under the application of tensile load.

2. Determination of deflection and stresses in 2D trusses and beams.

3. Determination of deflections component and principal and Von-Mises stresses in simple 3D plane and axisymmetric components.

Thermal Analysis:

1. 2D problem with conduction and convection boundary conditions.

2. Conductive heat transfer Analysis of plane and axisymmetric components.

3. Convective heat transfer Analysis of 2D components.

4. Harmonic, transient and spectrum analysis of simple systems.

CFD Analysis:

1. Simple fluid flow and heat transfer problems.
2. Modeling Periodic flow and heat transfer.
3. Modeling external compressible flows.
4. Modeling transient compressible flows.
5. Modeling radiation and natural convection.

Simulation:

1. Simulation cam and follower mechanism
2. Simulate air conditioning systems
3. Simulation of heat transfer and fluid flow systems

Note: Any Two Software Packages from each of the module:

CAD Packages: SOLIDWORKS, CATIA, Unigraphics, Solid Edge, CREO.

Analysis Packages: HyperMesh, ANSYS, CFD, STAR-CD, Autodesk A360.

Simulation Packages: Matlab, SciLab, C language.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	1							3		
CO2	3	3	3	1	3	1							3		
CO3	3	3	3	1	3	1								3	
CO4	3	3	3	1	3	1							3		
CO5									3	3					
Average	3	3	3	1	3	1			3	3			3		
Correlation level	3	3	3	1	3	1			3	3			3	3	

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

(20BT5MC01) PROFESSIONAL ETHICS

(Mandatory Course)

(Common to CE, ME, ECE, EEE & EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	-	30	2	-	-	-

PRE-REQUISITES:-

COURSE DESCRIPTION:

Engineering Ethics; Professional Ideals and Virtues; Engineering as Social Experimentation; Responsibilities and Rights; Global Issues.

COURSE OUTCOMES:

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

CO1. Demonstrate knowledge of Engineering Ethics, Senses of engineering ethics, Moral dilemmas and theories in professional engineering practice

CO2. Analyze the concepts of Professional ideals to assess and to address societal, health, safety, legal and cultural issues in discharging the professional responsibilities

CO3. Apply the reasoning informed by the various aspects of Code of Ethics and its provisions to assess societal issues and carry out Professional responsibilities effectively

CO4. Practice Collegiality considering conflict of interests to safeguard professional rights in professional engineering practice.

CO5. Provide professional engineering solutions considering distinct ethics to address global issues.

DETAILED SYLLABUS:

UNIT I: ENGINEERING ETHICS   **(5 periods)**

Scope and aim of engineering ethics, Senses of engineering ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral autonomy-Kohlberg's theory, Gilligan's theory, Consensus and controversy.

UNIT II: PROFESSIONAL IDEALS AND VIRTUES   **(6 periods)**

Theories about virtues, Professions, Professionalism, Characteristics, Expectations, Professional responsibility, Integrity, Self-respect, Sense of responsibility, Self-interest, Customs and religion, Self-interest and ethical egoism, Customs and ethical relativism, Religion and divine command ethics, Use of ethical theories, Resolving moral dilemmas and moral leadership.

UNIT III: ENGINEERING AS SOCIAL EXPERIMENTATION   **(7 periods)**

Engineering as experimentation, Similarities to standard experiments, Learning from the past and knowledge gained, Engineers as responsible experimenters, Conscientiousness,

Moral autonomy and accountability, The challenger case, Codes of ethics and limitations, Industrial standards, Problems with the law of engineering.

UNIT IV: Rights and Responsibilities of an engineer   (6 periods)

Collegiality and loyalty, Respect for authority, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, Rights of engineers, Professional rights, Whistle-blowing, The BART case, Employee rights and discrimination.

UNIT V: GLOBAL ISSUE   (6 periods)

Multinational corporations, Professional ethics, Environmental ethics, Computer ethics, Engineers as consultants, Witnesses, Advisors and Leaders, Engineers as Managers, Managerial ethics applied to Engineering Profession, moral leadership.

Total Periods: 30

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Mike W. Martin and Roland Schinzinger, *Ethics in Engineering*, Tata McGraw-Hill, 3rdedition, 2007.

2. Govindarajan, M., Nata Govindarajan, M., Natarajan, S. and Senthilkumar, V.S., *Engineering Ethics*, Prentice Hall of India, 2004.

REFERENCE BOOKS:

1. S. Kannan and K. Srilakshmi, *Human Values and Professional Ethics*, Taxmann Allied Services Pvt. Ltd., 2009

2. Edmund G. Seebauer and Robert L. Barry, *Fundamental of Ethics for Scientists and Engineers*, Oxford University Press, 2001

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-			
CO2	2	3	-	-	1	2	2	2	-	-	-	-			
CO3	1	1	-	-	2	2	2	3	-	-	-	-			
CO4	1	1	-	-	1	3	1	1	-	-	-	-			
CO5	1	1	-	-	2	1	3	2	-	-	-	-			
Average	1.6	1.5	--	--	1.5	2	2	2	--	--	--	--			
Correlation level	2	2	--	--	2	2	2	2	--	--	--	--			

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

IV B.Tech. - I Semester

(20BT5HS02) PRINCIPLES OF BUSINESS ECONOMICS AND ACCOUNTANCY

(Common to CE and ME)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE REQUISITE: --

COURSE DESCRIPTION:

Business economics and demand analysis; theory of production and cost analysis; markets and pricing; principles of accounting and capital; final accounts and tally erp 9.0

COURSE OUTCOMES:

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

CO1.   Demonstrate the principles of Business Economics and theories of Demand.
CO2.   Apply the theories of Production and Cost for the managerial decision making of an organization.
CO3.   Determine the Price and Output relation in the different Market structures.
CO4.   Demonstrate the principles of Accountancy and sources of Capital.
CO5.   Analyse the profitability and soundness of an organization.

DETAILED SYLLABUS:

UNIT I: BUSINESS ECONOMICS AND DEMAND ANALYSIS   (9 periods)

Definition - Nature and Scope of Business Economics - **Demand:** Determinants of demand – Demand function - Law of demand, assumptions and exceptions - Elasticity of demand – Types of elasticity of demand - Demand forecasting and methods of demand forecasting.

UNIT II: THEORY OF PRODUCTION AND COST ANALYSIS   (9 periods)

Production Function: Input-output relationship - Law of Variable proportion- Isoquants and Isocosts

Cost Concepts: Total, Average and Marginal Cost **-** Fixed vs. Variable costs – Opportunity Costs Vs Outlay Costs– Separable Costs Vs Joint Costs, Urgent Costs Vs Postponable Costs- Avoidable Costs Vs Unavoidable Costs

Break Even Analysis (BEA) – Assumptions, Merits and demerits - Determination of Break Even Point (Simple problems).

UNIT III: MARKETS AND PRICING   (9 periods)

Market Structure: Types of Markets - Features of perfect competition - Monopoly and monopolistic competition - Price and Output determination in perfect competition, monopoly and monopolistic Markets.

Pricing: Objectives and policies of pricing – Sealed bid pricing - Marginal cost pricing - Cost plus pricing - Going rate pricing – penetration Pricing –skimming Pricing - Block pricing – Peak load pricing - Cross subsidization.

UNIT IV: PRINCIPLES OF ACCOUNTING & CAPITAL (9 periods)

Accountancy: Introduction – Concepts – Conventions – Double Entry Book Keeping – Journal – Ledger - Trial Balance (Simple problems)

Capital: Significance - Types of capital – Sources of Capital.

UNIT V: FINAL ACCOUNTS & TALLY ERP 9.0 (9 periods)

Introduction to Final Accounts - Trading account - Profit and Loss account and Balance Sheet with simple adjustments (Simple problems)

Tally ERP 9.0: Introduction – Create a company – Create ledger – Posting vouchers – Advantages of Tally.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. H L Ahuja, *Business Economics (Thirteenth edition)*, S Chand Publishing, Jan 2016.

2. Larry M. Walther, *Financial Accounting,* Create Space Independent Publishing Platform, July 2017.

REFERENCE BOOKS:

1. Joseph G.Nellis and David Parker, *Principles of Business Economics*, Pearson Education Canada, 2nd edition, 2016.

2. S.P. Jain and K.L. Narang, *Financial Accounting*, Kalyani Publishers, Ludhiana, 12th edition, 2018.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-			
CO2	1	3	-	-	-	-	-	-	-	-	-	-			
CO3	2	3	-	-	-	-	-	-	-	-	1	-			
CO4	3	1	1	-	-	-	-	-	-	-	-	-			
CO5	-	3	1	-	-	-	-	-	-	2	1	-			
Average	2.25	2.4	1	--	--	--	--	--	--	2	1	--			
Correlation level	2	3	1	--	--	--	--	--	--	2	1	--			

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. I Semester

(20BT70301) OPERATIONS MANAGEMENT

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITE:

A course on Operations Research

COURSE DESCRIPTION:

Introduction to Operations Management, Services as a part of operations management; Regression and correlation methods; Material Requirements Planning Logic; Capacity Requirements Planning; Scheduling of Job Shops; Operational Control issues in Mass Production systems; Continuous improvement Process.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Apply operations strategy through strategic means, measures and decisions for attaining operational excellence.

CO2. Model demand forecasting problems and develop accurate forecasts.

CO3. Apply aggregate production planning techniques to order optimal material quantities.

CO4. Apply operation scheduling and control issues for smooth production.

CO5. Demonstrate lean management strategies for creating a stable workflow based on actual customer demand.

DETAILED SYLLABUS:

UNIT I: OPERATIONS STRATEGY   (08 periods)

Introduction to Operations Management, Services as a part of operations management, Relevance of Operations Strategy, Strategy formulation process, Measures of operational excellence, Options for strategic decisions in operations, World-class manufacturing practices, Emerging trends and implications for operations

UNIT II: DEMAND FORECASTING   (09 periods)

Forecasting techniques- causal and time series models, moving average, exponential smoothing, trend and seasonality; Regression and correlation methods; Accuracy of forecasts, Application and control of forecasts.

UNIT III: AGGREGATE PRODUCTION PLANNING   (10 periods)

Need for Aggregate Production Planning, Alternatives for managing demand and supply, Strategies for Aggregate Production Planning, Master Production Scheduling, Material Requirements Planning Logic, Capacity Requirements Planning, Distribution Requirements Planning, Enterprise Resource Planning and Supply Chain Management.

UNIT IV: OPERATIONS SCHEDULING   (09 periods)

Need for Scheduling, Scheduling rules and performance criteria, Scheduling of Flow Shops – Johnson's rule; Scheduling of Job Shops, Operational Control issues in Mass Production systems, Operations Planning and Control based on Theory of Constraints.

UNIT V: LEAN MANAGEMENT   (09 periods)

Philosophy of Lean Management, Elements of JIT Manufacturing, Production Planning and Control in JIT, Continuous improvement Process, Organizational challenges in Lean Management, Six-Sigma approach to Quality Control, Six-Sigma Methodology, and Lean Six-Sigma

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. B.Mahadevan, *Operations Management*, Pearson education, 3rd edition, 2014.

2. Lee J Krajewski, M K Malhotra and Larry P Ritzman, *Operations management – Processes and Supply Chains*, 12th edition, 2019.

REFERENCE BOOKS:

1. Monks J.G., *Operations Management*, Schaums outline series, McGrawHill, 2nd edition, 2020.

2. R Pannerselvam, *Production and Operations Management*, PHI learning, 3rd edition, 2012.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1			1					1				3
CO2	3	3	2	1		1					1				3
CO3	3	3	1			1					1				3
CO4	3	3	1			1					1				3
CO5	3					1					1				3
Average	3	3	1.25			1					1				3
Correlation level	3	3	1	3		1					1				3

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. I-Semester

(20BT70302) COMPUTATIONAL FLUID DYNAMICS

(Professional Elective – 4)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Multi-Variable Calculus and Differential Equations and Fluid Mechanics and Machines and Heat Transfer.

COURSE DESCRIPTION:

Introduction to Computational Fluid Dynamics(CFD); Various Numerical methods; Solution methods for governing equations; Finite difference method and its application to heat transfer problems; Errors and stability analysis; Finite Volume method; Study flow analysis; Simple CFD techniques.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Apply governing equations of fluid dynamics for solving fluid mechanics and heat transfer problems.

CO2. Apply Discretization Techniques to solve algebraic equation of Grids With Appropriate Transformation.

CO3. Analyze numerical models of the Fluid flow and Heat transfer phenomenon using finite difference method as discretization and grid generation techniques for Parabolic Partial Differential Equations.

CO4. Analyze numerical models of the Fluid flow and Heat transfer phenomenon using finite difference method as discretization and grid generation techniques for elliptic and hyperbolic equations.

CO5. Analyze mathematical models of fluid dynamics using Finite volume approach.

UNIT I: GOVERNING EQUATIONS   (9 periods)

Introduction, applications of CFD in diverse fields, Governing equations of fluid dynamics – Continuity, Momentum and energy equations; Generic differential and integral form for governing equations, Initial and Boundary conditions, Differences between Finite element method, Finite difference method and Finite volume method, Classification of partial differential equations – Hyperbolic, Parabolic, Elliptic and Mixed types; Applications and relevance.

UNIT II: DISCRETIZATION TECHNIQUES   (9 periods)

Basic Aspects of Discretization: Introduction to finite differences, Finite difference equations using Taylor series expansion and polynomials, Explicit and implicit approaches, Uniform and unequally spaced grid points.

Grids With Appropriate Transformation: General transformation of the equations, Metrics and Jacobians, The transformed governing equations of the CFD, Boundary fitted coordinate systems, Algebraic and elliptic grid generation techniques, Adaptive grids.

UNIT III: FINITE DIFFERENCE FORMULATIONS (9 periods)

Parabolic Partial Differential Equations: Finite difference formulations, Explicit methods – FTCS, Richardson and DuFort-Frankel methods, Implicit methods – Laasonen, Crank-Nicolson and Beta formulation methods, Approximate factorization, Fractional step methods, Consistency analysis, Linearization.

Stability Analysis: Discrete Perturbation Stability analysis, von Neumann Stability analysis, Error analysis, Modified equations, Artificial dissipation and dispersion.

UNIT IV: ELLIPTIC AND HYPERBOLIC EQUATIONS (9 periods)

Elliptic Equations: Finite difference formulation, solution algorithms: Jacobi-iteration method, Gauss-Siedel iteration method, point- and line-successive over-relaxation methods, alternative direction implicit methods.

Hyperbolic Equations: Explicit and implicit finite difference formulations, splitting methods, multi-step methods, applications to linear and nonlinear problems, linear damping, flux corrected transport, monotone and total variation diminishing schemes, tvd formulations, entropy condition, first-order and second-order TVD schemes, introduction to modern tools.

UNIT V: FINITE VOLUME METHOD (9 periods)

Introduction, Finding the flux at interface, Central schemes - Lax-Friedrichs Method, Lax-Wendroff Method, Two-Step Lax-Wendroff Method and MacCormack Method; Upwind Method in Finite Volume methods - Flux Splitting Method Steger and Warming, vanLeer, Roe's Method and finding Roe's Averages; Numerical procedure for SIMPLE algorithm, Boundary conditions for the pressure correction method; Stream function, Vorticity method, introduction to modern tools.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. John. D. Anderson, *Computational Fluid Dynamics, the Basics with Applications*, Mc Graw Hill.6th Edition, 1995.

2. Hoffman, K.A., and Chiang, S.T., *Computational Fluid Dynamics, Vol. I, II and III*, Engineering Education System, Kansas, USA, 2000.

REFERENCE BOOKS:

1. Tapan K. Sengupta, *Fundamentals of Computational Fluid Dynamics*, 1st Edition, Universities Press, 2004.

2. Suhas V. Patankar, *Numerical Heat Transfer and Fluid Flow*, 1st Edition, CRC, 1980.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1										3	
CO2	3	3	2	1	1									3	
CO3	3	3	2	1	1									3	
CO4	3	3	2	1	1									3	
CO5	3	3	2	1	1									3	
Average	3	3	2	1	1									3	
Correlation level	3	3	2	1	1									3	

Correlation Levels: 3– High 2 - Medium 1– Low

IV B. Tech. – I Semester

(20BT70303) FINITE ELEMENT METHOD

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Courses on Design of Machine Elements, Heat Transfer.

COURSE DESCRIPTION:

Discretization; Formulation of finite element expression; Finite Element approach to solve 1-D problems; beams; trusses; CST problems; Heat transfer problems and Dynamic analysis problems.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Apply FEM techniques and approaches for solving One-dimensional field problems.

CO2. Analyze element stiffness matrices and shape functions for formulation of mathematical models to find stresses in trusses and beams.

CO3. Analyze CST element andaxi-symmetric element for formulationof mathematic models and solve by using Finite Element Methods.

CO4. Analyzeiso-parametric elements and heat transfer problems for formulations mathematic models and solve byusing Finite Element Methods.

CO5. Analyze Lumped mass matrix and Eigen vectorsfor formulation of models and solve vibration analysis problems.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION   TO FINITE ELEMENT METHOD   (09 periods)

Introduction to Finite Element Method for solving field problems, Stress and Equilibrium, Strain - Displacement relations, Stress - strain relations,

One-dimensional finite element method: Bar elements, Finite element modeling, coordinates and shape functions, Element matrices, assembling of global stiffness matrix and load vector, Principle of minimum potential energy, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element.

UNIT II: TRUSSES & BEAMS   (09 periods)

Trusses: Plane trusses, local and global coordinate systems, formulation for direction cosines, Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, and temperature effects.

Beams: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT III: TWO-DIMENSIONAL & AXI-SYMMETRIC MODELS   (09 periods)

Two dimensional problems: Basic concepts of plane stress and plane strain, stiffness matrix of Constant Strain Triangle (CST) element, finite element solution of plane stress problems.

Axi-symmetric model: Finite element modelling of axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

UNIT IV: ISO-PARAMETRIC FORMULATION & HEAT TRANSFER ANALYSIS

(11 periods)

Iso-parametric formulation: Sub parametric, super parametric and iso-parametric elements, 2 dimensional 4 noded iso-parametric elements, numerical integration.

Heat transfer problems: One-dimensional finite element formulation of heat transfer with conduction, convection and Heat transfer through fins, Two-dimensional finite element formulation.

UNIT V: DYNAMIC ANALYSIS   (07 periods)

Introduction to dynamic considerations, Hamilton's principle, Dynamics of spring mass system, consistent mass matrix, Formulation of FEM model, element matrices, One-dimensional bar, truss, CST elements, Lumped mass matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar and beam element. List of FEM software packages.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Tirupati R. Chandrupatla& Ashok D. Belegundu, *Introduction to Finite Elements in Engineering*, PHI learning, 3rd Edition, 2011

2. Daryl L. Logan, *First course in the Finite Element Method*, Cengage Learning, 4th Edition 2007

REFERENCE BOOKS:

1. S. S. Rao, *Finite Element Methods in Engineering*, Elsevier, 5th Edition, 2012.

2. J. N. Reddy, *An Introduction to Finite Element Method*, Tata Mc Graw-Hill, 3rd Edition, 2005.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2			1							3	3	
CO2	3	3	2			1							3		
CO3	3	3	2			1							3		
CO4	3	3	2			1							3		
CO5	3	3	2		1	1							3	3	
Average	3	3	2			1							3	3	
Correlation level	3	3	2		1	1							3	3	

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. – I Semester

(20BT70304) MATERIAL PROCESSING TECHNIQUES

(Professional Elective-4)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Materials Science and engineering , Manufacturing Technology, Engineering Metrolgy and Machine Tools.

COURSE DESCRIPTION:

Metal forming and its types; Micromachining and its measuring techniques; fundamentals of laser and its applications; advanced welding processes and testing; advanced finishing processes.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on advances in metal forming processes, process parameters and their techniques.

CO2. Demonstrate the knowledge on micro-machining process and its measuring techniques.

CO3. Analyze the functional characteristics of laser processing for diverse applications.

CO4. Demonstrate the knowledge on advanced welding process and tests to enhance the quality of welds

CO5. Apply appropriate finishing techniques and explore the mechanisms involved.

DETAILED SYLLABUS:

UNIT I: ADVANCES IN METAL FORMING   **(9 periods)**

Conventional processes-High Energy Rate Forming techniques-Explosive forming, Electro hydraulic forming, Magnetic pulse forming, Super plastic forming, Rubber forming, Flow forming - Principles and process parameters- Advantages -Limitations and Applications. Overviews of powder metal forming technique-Advantages- Applications-Powder perform forging- Hot and cold Isostatic pressing- Powder rolling-Tooling and process parameters.

UNIT II: MICRO-MACHINING   **(9 periods)**

Introduction to micromachining technologies, Microelectro discharge Machining: Principles of micro-EDM, Micro-EDM by Die-sinking and WEDG, Micro-WEDM, Micro-WEDG, Micro-ECM, Principles of micro-turning, Micro-drilling and Micro-milling, Micro grinding, Hybrid micro-machining method, On-line measurement by machine vision and integratedprobe, Measuring Techniques in micro-machining, Surface integrity and other related measurements.

UNIT III: LASER MATERIALS PROCESSING   **(9 periods)**

Fundamentals of industrial lasers - Laser materials interaction theories - Laser processing for various industries such as metals, non-metals, photovoltaic, bio-medical applications. Laser optics- Heat flow theory, Pulsed lasers, Pulsed laser heating, Laser cutting, Laser welding, Laser surface modifications. Diffusion Modelling, Laser cladding, Laser texturing, Laser bending, Laser safety and Laser micromachining.

UNIT IV –ADVANCED FABRICATION PROCESSES   **(9 periods)**

Introduction, Advancements in Fabrication Techniques -Thermit welding, Electro slag welding, Electron beam welding, laser beam welding, forge welding, friction welding, diffusion welding, explosion welding, ultrasonic metal welding, destructive & non-destructive testing of welds.

UNIT V-ADVANCED FINE FINISHING PROCESS   **(9 periods)**

Abrasive Flow Machining; Magnetic Abrasive Finishing; Magneto Rheological Abrasive Finishing: Principle, Process equipment; Analysis and modelling of finishing mechanism; Parametric analysis; Applications.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. M P Groover, "*Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*, John Wiley & Sons,3rdEdition, India, 2007.

2. Pandey, P.C., and Shan, H.S., "*Modern Machining Processes",* Tata McGraw-Hill Education, New Edition, UK, 2017.

REFERENCE BOOKS:

1. SeropeKalpakjian, "*Manufacturing Processes for Engineering Materials*", Pearson Education, 5th Edition, UK, 2017.

2. PeterSchaaf, "*Laser Processing of Materials: Fundamentals*, Applications and Developments", Springer Publishers, 1st Edition, 2010.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1						-	-	-	-	-	3		
CO2	3	1			-			-	-	-	-	-	3		
CO3	3	3			-			-	-	-	-	-	3		
CO4	3	1			-			-	-	-	-	-	3		
CO5	3	2			1	-		-	-	-	-	-	3		
Average	3	1.6			1	-		-	-	-	-	-	3		
Correlation level	3	2			1	-		-	-	-	-	-	3		

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. – I Semester

(20BT70305) POWER PLANT ENGINEERING

(Professional Elective-4)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

Courses on Engineering Thermodynamics, Thermal Engineering-II and Heat transfer.

COURSE DESCRIPTION:

Energy sources; Types of Power Plants; Thermal power plant; Study of various systems of thermal power plant; Combustion and Firing Methods; Diesel Power plant; Gas Turbine Power Plants; Hydroelectric power plants and Nuclear power plants; Power generation and recovery systems; Various conventional and nonconventional sources of energy with power plant economics.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on construction and working principles of various subsystems and pollution control methods in thermal power plant,

CO2. Demonstrate the knowledge on various components, working principle and Performance improvements in diesel and gas power plants.

CO3. Demonstrate the knowledge on hydroelectric power plant and nuclear power Plant and its pollution control methods.

CO4 Demonstrate the knowledge on working principles of non-conventional power generation units and direct energy conversion systems.

CO5. Calculate the cost of power generation for various power plants using different types of tariff systems

DETAILED SYLLABUS:

UNIT I: **THERMAL POWER PLANT**   **(09 Periods)**

Introduction to the sources of energy, Plant layout, selection of site for power plant, Coal handling systems, Overfeed and under feed stoker principles, Traveling grate stokers, Spreader

stokers, Multi retort stokers, Pulverized fuel firing – Pulverized fuel handling, Pulverizing mills, Pulverized fuel burners; Ash handling systems, Dust collectors. Thermal Power plant pollution.

UNIT II: DIESEL ENGINE AND GAS TURBINE POWER PLANTS   **(09 periods)**

Diesel Power Plant: Essential components of diesel powerplant, Operation of diesel power plant, Plant layout with auxiliaries.

Gas Turbine Plant: Requirements, Functions, Classification, Construction, and Layout with auxiliaries.

UNIT III: HYDRO ELECTRIC AND NUCLEAR POWER PLANTS   (9 periods)

Hydro Electric Power Plant: Selection of site for power plant, Typical layouts, Elements of plant, Classification of dams, Spillways, Surge tank, Draft tube, Classification of Hydroelectric

power plants, Hydrology, Hydrological cycle, Hydrographs;

Nuclear Power Plants: Requirements, Functions, Nuclear fuel, Breeding and Fertile materials, Nuclear reactor, React or operation, Types of Reactors - Pressurized water reactor, Boiling water reactor, Sodium-Graphite reactor, Fast breeder reactor, Homogeneous reactor, Gas cooled reactor; Nuclear power plant pollution.

UNIT IV: NON CONVENTIONAL POWER GENERATION ANDDIRECT ENERGY CONVERSION SYSTEMS   (9 periods)

Non-Conventional Power Generation: Solar, Wind, Tidal, Ocean energy conversion, Geothermal, and biogas power plants.

Direct energy conversion systems: Thermoelectric conversion system, Thermionic conversion system, Photovoltaic power systems, Magneto Hydrodynamic systems, Electro static mechanical generators, Electro gas-dynamic generators, and Fuel cells.

UNIT V – POWER PLANT ECONOMICS   (9 periods)

Load curves, Load duration curve, Definitions of connected load, Maximum demand, Demand factor, Load factor, Plant capacity factor, Plant use factor, Diversity factor, Cost Analysis.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. R.K.Rajput, *A Textbook of Power Plant Engineering*, Laxmi Publications, 3rd edition, 2014.

2. Arora and S. Domkundwar, *A Course in Power Plant Engineering*, Dhanpat Rai and Co, 3rd Edition, 2012.

REFERENCE BOOKS:

1. P.K.Nag, *Power Plant Engineering*, TMH, 2nd edition, 2006.

2. K.K Ramalingam, *Power Plant Engineering*, Scitech Publishers, 2nd edition, 2010.

3. Dr.P.C Sharma, *Power Plant Engineering*, Sk Kataria andsons publishers, 8th Edition, 2011.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1				1	1							3	
CO2	3	1				1	1							3	
CO3	3	1				1	1							3	
CO4	3	1				1	1							3	
CO5	3	2				1								3	
Average	3	1.2				1					1			3	
Correlation level	3	1				1	1				1			3	

    Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. I Semester

***(20BT70306)* SUPPLY CHAIN MANAGEMENT**

(Professional Elective - 4)

(Common to ME and CSBS)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Fundamentals of Supply Chain Management; Supply Chain Decisions; Achieving Strategic fit; Drivers and Metrics of Supply Chain; Inventory management in a supply chain; Supply chain integration; Distribution Resources Planning; Bullwhip Effect; Role of information technology in SCM; Designing and planning transportation networks through infrastructure and strategies; International and Contemporary issues in SCM; Demand and Supply planning; Mass customization; Global issues and Outsourcing problems; Supply Chain Operations Reference Model; Third party logistics; Retailer-Supplier Partnership; Emerging trends in SCM.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on the supply chain and supply chain management concepts.

CO2. Analyze and provide strategies for inventory management in SCM

CO3. Develop appropriate and customized strategies and policies for managing the supply chain by leveraging information.

CO4. Design and plan efficient and responsive transportation networks.

CO5. Demonstrate knowledge on international and contemporary issues in managing supply chains effectively and efficiently

DETAILED SYLLABUS

UNIT I: INTRODUCTION TO SCM   **(08 Periods)**

Supply Chain - Definition, Objectives; Global optimization, Importance of Supply Chain Decisions, Decision Phases in a Supply Chain, SCM- objectives, Competitive and Supply Chain Strategies, Achieving Strategic fit, Obstacles to achieve strategic fit, Supply Chan Drivers and Metrics

UNIT II: INVENTORY MANAGEMENT IN SCM   **(09 Periods)**

Role of cycle inventory and safety inventory in a supply chain, Economic lot size model, Effect of demand uncertainty, Risk pooling, centralized and decentralized system, Managing inventory in the supply chain, Distribution Channel Management, Distribution Resource Planning (DRP).

UNIT III: VALUE OF INFORMATION   **(09 Periods)**

Bullwhip effect, Information and supply chain technology, Supply chain integration- Push, Pull and push-pull system; Demand driven strategies, Role of Information Technology in

SCM - Impact of Internet on SCM; Decision support systems for SCM - Goals, Standardization and Infrastructure.

UNIT IV: DESIGNING AND PLANNING TRANSPORATATION NETWORKS

(09 Periods)

The role of transportation in a Supply chain, Modes of transportation and their performance characteristics, Transportation infrastructure and Policies, Design options for a transportation network, Trade-offs in transportation design, Third party logistics and Tailored transportation.

UNIT V: INTERNATIONAL& CONTEMPORARY ISSUES IN SCM   (09 Periods)

Sales and Operations Planning, Mass customization, Global issues and Outsourcing problems, Aligning the Supply Chain with Business Strategy – Supply Chain Operations Reference (SCOR)Model, Retailer-Supplier Partnership, Collaborative Planning, Forecasting and Replenishment (CPFR), Vendor Managed Inventory, Distributors integration, Emerging trends in SCM.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Sunil Chopra & Peter Meindl, *Supply Chain Management - Strategy, Planning & Operation*, 6thEdition, Pearson Education Asia, 2016.

2. Janat Shah, *Supply Chain Management:Text and Cases*, 2ndEdition, Pearson Education, 2016.

REFERENCE BOOKS:

1. Thomas E Vollman and Clay Whybark D, *Manufacturing Planning and Control for Supply Chain Management*, Fifth Edition,Tata McGraw Hill, New Delhi, 2005

2. Simchi – Levi Davi, Kaminsky Philip and Simchi-Levi Edith, *Designing and   Managing the Supply Chain*,Third Edition Tata McGraw Hill, New Delhi, 2007.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1					3				3
CO2	3	3	1			1					3				3
CO3	3	3	3		1	1					3				3
CO4	3	3	3			1					3				3
CO5	3					1					3				3
Average	3	3	2.3	3	1	1					3				3
Correlation level	3	3	3	3	1	1					3				3

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. – I Semester

(20BT70307) SUSTAINABLE MANUFACTURING

(Professional Elective-4)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:--

COURSE DESCRIPTION:

Concept of sustainability; metrics of green manufacturing; economic and social dimensions of sustainability; Principles of green manufacturing; Principles of green manufacturing; Green supply chain

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge of sustainable manufacturing tools and techniques for sustainable product development

CO2. Apply sustainability assessment tools and techniques to infuse and manage the sustainability of a product.

CO3. Analyze the environmental impact of a product through its life cycle encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal.

CO4. Demonstrate the knowledge on green manufacturing techniques for renewal of production processes and the establishment of environmentally-friendly operations within the manufacturing field

CO5. Demonstrate the knowledge on sustainability assessment and green supply chain in infusing sustainability.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO SUSTAINABLE MANUFACTURING   (09 periods)

Concept of sustainability, manufacturing, operations, processes, practices, Resources in manufacturing, five Ms, system approach to manufacturing, environmental, economic and social dimensions of sustainability, Environmental Impact of Manufacturing, Strategies for Green Manufacturing, Metrics for Green Manufacturing, Metrics Development Methodologies.

UNIT II: TOOLS AND TECHNIQUES   (09 periods)

Principles of green manufacturing and its efficiency, Green manufacturing and sustainability, System model architecture and module, Design and planning, control or tools for green manufacturing (Qualitative Analysis), Consumption Analysis, Life Cycle Analysis, Efficiency, Sustainability tools). Standards for green manufacturing (ISO 14000 and OHSAS 18000), Waste stream mapping and application, Design for environment and for sustainability – Discuss the Product Life Cycle of manufactured goods.

UNIT III: LIFE CYCLE ANALYSIS   (09 periods)

Remanufacture and disposal , tools for LCA, Concept of design for recycling, Green manufacturing Lean models, value analysis, carbon footprint, analysis for carbon footprint

Green manufacturing- sustainability framework, Green manufacturing techniques- factors effecting sustainability.

UNIT IV: GREEN MANUFACTURING TECHNIQUES   (09 periods)

Dry and near-dry machining, edible oil based cutting fluids Green manufacturing techniques: cryogenic machining for eco-efficiency Green manufacturing, Lean manufacturing, Lean techniques for green manufacturing, Waste assessment and strategies for waste reduction in green manufacturing.

UNIT V: SUSTAINABILITY ASSESMENT AND GREEN SUPPLY CHAIN   (09 periods)

Methods to infuse sustainability in early product design phases, concept models and various approaches in assessment, product sustainability and risk/benefit assessment, Green supply chain- techniques and implementation, Logistics management, Green Supply Chain as Product Life Cycle Management

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. G.Atkinson,S.Dietz,E.Neumayer,*HandbookofSustainableManufacturing*‖.Edward Elgar Publishing Limited,2007.

2. Klemes, J., 2011. Sustainability in the process industry. McGraw-Hill.2011

3. M.Karpagam, Geetha Jaikumar, *Green Management* , Ane Books Pvt.Ltd.2010

REFERENCE BOOKS:

1. M.K. Ghosh Roy, *Design for Environment: A guide to sustainable Product Development Sustainable Development*, Ane Books Pvt.Ltd,2009.

2. Dornfeld, D.A. ed., *Green manufacturing: fundamentals and applications*. Springer Science & Business Media,2012.

3. Ashby, M. F. *Materials and the environment: eco-informed material choice*. Elsevier, 2012.

4. D. Rodick, Industrial Development for the 21st century, sustainable development perspectives, UN New York, 2007

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	2	-	-	-	-	-	3	-	-
CO2	3	2	1		-	1	2	-	-	-	-	-	3	-	-
CO3	3	2	1	1	-	1	2	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	1	2	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	1	2	-	-	-	-	-	3	-	-
Average	3	2	2	1	-	1	2	-	-	-	-	-	3	-	-
Correlation level	3	2	2	1		1	2						3		

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech – I Semester

(20BT70308) CRYOGENICS

(Program Elective-5)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	0	--	3

PRE-REQUISITES:

A Course on Thermal Engineering-II

COURSE DESCRIPTION:

Necessity of Low temperature, Multi stage refrigeration, Cascade system, Applications of low temperature, Properties of cryogenic fluids, Liquefaction of air, hydrogen and helium, gas separation and gas purification systems, Low temperature insulation, Storage systems and Cryogenic fluid transfer systems

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge of cryogenic systems for low temperature applications.

CO2. Analyze the properties of cryogenic fluids for low temperature application.

CO3. Analyze the various refrigeration and liquefaction systems for low temperature application.

CO4. Analyze the various gas separation and gas purification systems for low temperature application.

CO5. Demonstrate the knowledge of cryogenic insulation for suitable storage and handling systems.

DETAILED SYLLABUS

UNIT I: CRYOGENIC SYSTEMS   (09 periods)

Introduction to Cryogenic Systems, Cryogenics – Definition, Historical development, Necessity of Low temperature, Limitations of vapour compression system for the production of low temperature, Multi stage refrigeration system - Cascade system.

Applications of Cryogenics: Applications in space, Food Processing, super conductivity, Electrical Power, Cryobiology, Medicine-Cryosurgery, Electronics and Cutting Tool Industry.

UNIT II: PROPERTIES OF CRYOGENIC FLUIDS   (09 periods)

Effects on the properties of metals - Low Temperature properties of Engineering Materials-Mechanical properties, Thermal properties, Super conductivity and Super fluidity, Electric and magnetic properties

T-S diagram of a cryogen; Properties of cryogenic fluids - Liquid Methane, Liquid Neon, Liquid Nitrogen, Liquid Oxygen, Liquid Argon, Liquid Air, Liquid hydrogen and helium.

UNIT III: REFRIGERATION AND LIQUEFICATION   (09 periods)

Manufacture of Dry ice, Joule's Thomson effect, Liquefication of air - Linde system, Claude system, Cascaded System, Liquefaction of neon, Hydrogen and Helium, Stirling Cycle Cryo Coolers, Gifford Mcmahon Cryo- refrigerator, Pulse tube refrigerator, Solvay cycle refrigerator, Vuillimier refrigerator.

UNIT IV: GAS SEPARATION AND GAS PURIFICATION SYSTEMS   (09 periods)

The thermodynamically ideal separation system properties of mixtures, Principles of gas separation, air separation systems, Hydrogen, Argon, Helium air separation systems, Gas purification methods.

UNIT V: LOW TEMPERATURE INSULATION   (09 periods)

Types of Insulation - Reflective insulation, Evacuated powders, Rigid foams; Super insulation; Dewar vessels; Hazards in cryogenic engineering. Cryogenic fluid transfer systems. Transfer through un-insulated lines, vacuum insulated lines, porous insulated lines etc.

Total No. of Periods:45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Randal F.Barron, *Cryogenic systems*, McGraw Hill, 2nd edition, 1986

2. Klaus D.Timmerhaus and Thomas M.Flynn, *Cryogenic Process Engineering*, Plenum Press, New York, 1989.

REFERENCE BOOKS:

1. Traugott H.K. Frederking and S.W.K. Yuan, Cryogenics, *Low Temperature Engineering and Applied Sciences*, Yutopian Enterprises, 2005.

2. A. R. Jha, *Cryogenic Technology and Applications*, Butterworth-Heinemann, 2005

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1					1							3	
CO2	3	3					1							3	
CO3	3	3					1							3	
CO4	3	3					1							3	
CO5	3	1					1							3	
Average	3	2.2					1							3	
Correlation level	3	2					1							3	

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. – I Semester

(20BT70309) DESIGN OF AUTOMOTIVE COMPONENTS

(Professional Elective – 5)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Course on Strength of Materials and Design of Machine Elements.

COURSEDESCRIPTION:

Design of cylinder, piston, connecting rod, crank shaft, Center and over hung cranks; Clutch applications in automobile, Working of Fluid Coupling; Propeller Shaft; Differential and Axles; Types of lubrication, Performance parameters of bearings; Classification of brakes; Hydraulic, Pneumatic Brakes and Power Brakes, Anti-Lock Brake system; Performance of gear box in vehicles, traction and tractive effort calculations; design of three and four speed gear box; Types of Front Axle;

COURSEOUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Design Cylinder, Piston, connecting rod, crank shaft and Center and over hung cranks for automobile vehicles considering safety standards.

CO2. Design Power drive lines and calculate performance parameters.

CO3. Design Bearings and Brakes systems for automobile vehicles considering safety standards.

CO4. Design gear box for automobile vehicles and calculate its performance characteristics.

CO5. Design front axle and steering linkages and determine optimum dimensions and proportions for steering linkages ensuring minimum error in steering

DETAILED SYLLABUS:

UNIT I: DESIGN OF IC ENGINE PARTS: (9 Periods)

Introduction to I.C engine parts, design of cylinder, design of piston, piston rings, piston pin; Connecting rod, Working Principle and Essential loads on the connecting rod; Crank shaft, Working Principle and design of Crankshaft, determination of loads at Center and over hung cranks.

UNIT II: POWER DRIVE LINE: (9 Periods)

Introduction to Clutch - Types and Construction, Fluid Coupling, Transmissions, design details of roller and sprag type of clutches - Manual, Semi and Automotive Transmission, Continuously Variable Transmission, Overdrives, Torque Converter, Propeller Shaft, Differential and Axles, Front and All Wheel Drive Vehicles.

UNIT III:DESIGN OF BEARINGS AND BRAKING SYSTEMS : (9 Periods)

Introduction to Lubrication, Viscosity, Classification; Introduction to Bearings , Hydrodynamic & Hydrostatic Lubrication, Pressure distribution - eccentricity and minimum film thickness, Thick & Thin film lubrication, Bearing materials, choice of bearings, determination of loads at kingpin bearings, wheel spindle bearings.

Braking Systems - Hydraulic, Pneumatic Brakes and Power Brakes; Anti-Lock Brake system.

UNIT IV: DESIGN OF GEAR BOX: **(8 Periods)**

Introduction to gear box, Performance of vehicle, total resistance to motion, Forces and Couples, traction and tractive effort, acceleration, calculation of gear ratio, design of three speed gear box, design of four speed gear boxes.

UNIT V: DESIGN OF FRONT AXLE AND STEERING: **(10 Periods)**

Types of Front Axle, Analysis of loads, moments and stresses at different sections of front axle; Differential and Axles, Front and All Wheel Drive Vehicles. Steering Geometry and Types, Steering Linkages, Power Assisted Steering; Determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

Total No. of Periods:45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Bhandari V, *Design of Machine Elements*, 5th Edition, Tata McGraw-Hill Book Co, 2020.

2. Harald Naunheimer , Bernd Bertsche , Joachim Ryborz , Wolfgang Novak "*Automotive Transmission: Fundamentals, Selection, Design and Application*", 2nd Edition, Springer, 2011.

REFERENCE BOOKS:

1. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "*Mechanical Engineering Design"*, 11th Edition, Tata McGraw-Hill, 2020.

2. Judge A. W., "*Modern Transmission*", 3rd ed., Chapman & Hall Std., London, 1989.

3. CDX Automotive, *"Fundamentals of Automotive Technology*, Principles and practice", Jones &Barlett Publishers, 2013.

4. Newton Steeds & Garrot, *"Motor Vehicles",* SAE International and Butterworth Heinemann, 2001.

5. Mahadevan, k, Reddy, K. Balaveera, *"Design Data Handbook* for Mechanical Engineering in SI and Metric Units", CBS; 4th edition,2019.

Data Book: Design data hand book for Mechanical Engineers in SI and Metric units by Balaveera Reddy and Mahadevan.N

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1		1								3	
CO2	3	3	3	1		1								3	
CO3	3	3	3	1		1								3	
CO4	3	3	3	1		1								3	
CO5	3	3	3	1		1								3	
Average	3	3	3	1		1								3	
Correlation level	3	3	3	1		1								3	

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

IV B. Tech – I Semester

(20BT70310) HYBRID AND ELECTRIC VEHICLES

(Professional Elective – 5)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Thermal Engineering-I.

COURSE DESCRIPTION:

History of hybrid and electric vehicles; Drive trains; Configuration and control of electric components; Types of energy storage devices; Sizing the drive systems; Energy management strategies in hybrid and electric vehicles.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the performance characteristics of transmission systems in hybrid and electric vehicle (HEVs).

CO2. Demonstrate the knowledge of electric propulsion incorporated in HEVs.

CO3. Analyze the dimensional features drive systems for optimal matching of electric machine and the internal combustion engine.

CO4. Analyze and select the energy storage devices of hybrid and electric vehicle for the given applications.

CO5. Demonstrate the knowledge of the energy management strategies and implementation issues in hybrid and electric vehicles.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO TRANSMISSION SYSTEMS   (9 periods)

INTRODUCTION: History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Comparison of transmission systems, Impact of modern drive trains on energy supplies.

DRIVE TRAINS FOR HYBRID AND ELECTRIC VEHICLES: Basic concept of traction, Types of drive – train topologies, power flow control, fuel efficiency analysis.

UNIT II: ELECTRIC PROPULSION UNIT   (9 periods)

Introduction to electric components used in hybrid and electric vehicles, Configuration and control - DC motor drives, induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.

UNIT III: SIZING THE DRIVE SYSTEM   (9 periods)

Matching the electric machine and the internal combustion engine, Sizing the propulsion motor, Sizing the power electronics, Selecting the energy storage technology, Supporting sub systems.

UNIT IV: ENERGY STORAGE   (9 periods)

Introduction to energy storage, Requirements in hybrid and electric vehicles, Types of energy storage and its analysis - Battery based, Fuel cell based, Super capacitor based, Fly wheel based, Hybridization of different energy storage devices.

UNIT V: ENERGY MANAGEMENT STRATEGIES   (9 periods)

Introduction to Energy Management Strategies used in hybrid and electric vehicles, Classification of different Energy Management Strategies, Comparison of different Energy Management Strategies, Implementation issues of Energy Management Strategies.

Total No. of Periods:45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. IqbalHussain, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press, 2003.

2. MehrdadEhsani, YimiGao, Sebastain E, Gay, Ali Emadi, *Modern Hybrid Electric and Fuel cell Vehicles: Fundamentals Theory and Design*, CRC Press, 2004.

REFERENCE BOOKS:

1. James Larminie, John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2003.

2. Tom Denton*, Electric and Hybrid Vehicles*, Routledge, 2016.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1				1							3	
CO2	3						1							3	
CO3	3	3	1				1							3	
CO4	3	3	1				1							3	
CO5	3						1								
Average	3	3	1				1							3	
Correlation level	3	3	1				1							3	

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

IV B.Tech - I Semester

(20BT70311) PROJECT MANAGEMENT

(Professional Elective -5)

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		3	-	-	3

PRE-REQUISITES:

A course on Industrial Engineering and Management.

COURSE DESCRIPTION:

Project Characteristics; Project Selection; Economics; Feasibility Assessment and Evaluation; Project integration; Project Implementation; Agile project management; Scrum framework; Project scope management; Project time and cost management; Organizational and Work Breakdown; Scheduling; Budgeting; Project Control; Project Auditing; Financing for projects; Project investment evaluation.

COURSE OUTCOMES:

After completion of this course, a successful student will be able to:

CO1. Demonstrate knowledge of project characteristics, selection, and various stages of a project.

CO2. Apply project implementation strategies involving resource constraints to manage and execute projects in a hassle-free manner.

CO3. Apply information systems to monitor, control and execute the projects effectively.

CO4. Analyze projects for auditing and appraisal with appropriate procedures considering technical, financial, and socio-economic issues.

CO5. Apply project financing concepts and tools to the financing decisions.

DETAILED SYLLABUS:

UNIT I: PROJECT SELECTION AND PLANNING   (9 periods)

Project identification and formulation; Needs analysis: Resource surveys, Market research; Identification of investment opportunities; Feasibility analysis: Technical feasibility; Technology forecasting: Choice of technology, Techno economic analysis, Appropriate technology; Project environment: Nature, and Characteristics of projects; Projects screening: Project selection, Project portfolio process; Project life cycle; Work content: Work breakdown structure; Systems integration; Interface coordination; Social Cost Benefit Analysis.

UNIT II: PROJECT IMPLEMENTATION   (9 periods)

Estimating Project Budgets; Process of cost estimation; Project Scheduling tools; Developing Project Plan (Baseline); Project cash flow analysis; Project scheduling with resource constraints: Resource Leveling and Resource Allocation; Project Execution and Administration; Project contracting: Contract pricing, project time monitoring and cost monitoring, Project over runs, Agile project management, Scrum framework.

UNIT III: MONITORING AND INFORMATION SYSTEMS   (9 periods)

Information needs and the reporting process; computerized project management information system; Earned value analysis; Planning-   Monitoring-Controlling cycle; Project control: types of control processes, design of control systems, control of change and scope.

UNIT IV: PROJECT APPRAISAL AND PROJECT AUDITING   (9 periods)

 Project Appraisal: Objectives, essentials of a project methodology, Market appraisal, Technical appraisal, Financial appraisal, Socio-economic appraisal, Management appraisal; Post-Project analysis: Construction and use of audit report, Project audit life cycle, Essentials of audit and evaluation, Varieties of project termination, the termination process.

UNIT V: PROJECT FINANCING   (9 periods)

Rationale of Project Financing; Essential elements of project financing; Analysis of project viability and risk management; Ownership and Financial Structuring; Legal Documentation; Project financing in India and abroad: Source, schemes, and various incentives for new projects.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Prasanna Chandra, *Projects: Planning, Analysis, Selection, Financing, Implementation and Review*, McGraw Hill Education (India) Private Limited, 8th edition, 2014.

2. Jack R. Meredith, and Samuel J. Mantel Jr., *Project Management - A Managerial Approach*, Wiley India Pvt. Ltd., New Delhi, 8th Edition, 2012.

REFERENCE BOOKS:

1. Harold Kerzner, *Project Management - A Systems Approach to   Planning, Scheduling and Controlling*, Wiley India Pvt. Ltd., New Delhi, 10th Edition, 2013.

2. Larry Richman, *Project Management: Step-by-Step*, PHI Learning Private Limited, 2011.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1				1					3				3
CO2	3	2	1			1					3				3
CO3	3	2	1		1	1					3				3
CO4	3	3	1			1					3				3
CO5	3	2	1			1					3				3
Average	3	2	1		1	1					3				3
Correlation level	3	2	1		1	1					3				3

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT70312) RAPID PROTOTYPING

(Program Elective-5)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Computer Aided Design and Manufacturing and Manufacturing Technology.

COURSE DESCRIPTION:

History of RP systems; Stereo; Datafiles and machine details; Solid Ground Curing; LOM, DMLS, Principle of operation, Machine details; Applications; Thermal jet printer; Indirect Rapid tooling, Direct Tooling; Quick cast process; Rapid Tool; Software For RP; STL files; Rapid manufacturing process optimization; Vacuum Casting, Surface digitizing; data transfer to solid models, Reverse Engineering.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the working of different RPT techniques for producing various products.

CO2. Analyze the functional characteristics of stero lithography systems, SLS and FDM for complex applications.

CO3. Analyze the functional characteristics of SGC, LOM and concept modelers for complex engineering applications.

CO4. Demonstrate the knowledge on rapid tooling to manufacture intricate components.

CO5. Apply software tools for rapid prototyping and reverse engineering concepts in production for Industrial applications.

DETAILED SYLLABUS:

UNIT I: FUNDAMENTALS OF RAPID PROTOTYPING   (9 periods)

Definition, Types of prototypes, Classification of RP Systems, Need for the compression in product Development, History of RP systems, Applications survey, Development of RP industry.

UNIT II: STEREOLITHOGRAPHY SYSTEMS, SLS AND FDM   (9 periods)

Stereolithography: Principle; Process parameters; Process details; Data preparation; Data files and machine details; Application.

Selective laser sintering: Machine types, Operating principle, Process parameters, Data preparation for SLS, Applications.

Fused deposition modeling: Principle, Process parameters, Path generation, Applications

UNIT III: SOLID GROUND CURING (SGC), LOM AND CONCEPT MODELERS

(9 periods)

SGC: Principle, Machine details, Applications.

Laminated Object Manufacturing: Principle, LOM materials, Process details, Application.

Concept modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, GenisysXs printer HP system – 5, Object Quadra systems.

UNIT IV: RAPID TOOLING (9 periods)

Laminate tooling- soft Tooling and Hard tooling.

Indirect Rapid tooling, Silicon rubber tolling, Aluminium filled epoxy tooling, Spray metal tooling, Cast kirksite, 3D Keltool.

Direct Rapid Tooling - Direct AIM, Quick cast process, Copper polyamide, Rapid Tool, Prometal, Sand casting tooling, DMLS

UNIT V: SOFTWARE FOR RAPID PROTOTYPING AND REVERSE ENGINEERING

(9 periods)

STL files, Overview of Solid view, Magics, Magic communicator, Internet based software, Rapid Manufacturing Process Optimization.

Allied processes: Vacuum casting, Surface digitizing, Surface generation from point cloud, Surface modification, Data transfer to solid models.

Reverse Engineering: Capturing and reading the scan data, Align point clouds and simplify data, Polygon meshing and editing, Defining surface boundaries, applying nurbs, Exporting data, Reverse engineering update.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:
1. Paul F. Jacobs, *Stereo lithography and other RP and MTechnologies*, SME, New York, 3rdedition, 1996.
2. Frank W. Liou, *Rapid Prototyping and Engineering Applications*, CRC Press Taylor and Francis Group, New York,Special Indian Edition, 2011.

REFERENCE BOOKS:
1. C. K. Chua, K. F. Leong, C. S. Lim, *Rapid Prototyping -Principles and Applications*, Yesdee publications Pvt. Ltd.,Mumbai, India, 2nd edition, 2010.
2. Hari Prasad, K.S. Badarinarayan, *Rapid Prototyping andTooling*, SIP PageTuners, Bangalore, 1stEdition, 2013.
3. Fiham D.T, Dinjoy S. S, *Rapid Manufacturing*, Verlog, London, 4th edition, 2002.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1	-	-	-	-	-	-	3		
CO2	3	2	1			1	-	-	-	-	-		3		
CO3	3	2	1			1	-	-	-	-	-	-	3		
CO4	3	-	-	-	-	1	-	-	-	-	-	-	3		
CO5	3	2			1	1							3		
Average	3	2	1		1	1							3		
Correlation level	3	2	1		1	1							3		

Correlation Levels: **3– High** **2 - Medium** **1– Low**

IV B. Tech. – I Semester

(20BT70313) SURFACE ENGINEERING

(Professional Elective-5)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Materials Science and Engineering, Strength of Materials and Engineering Metrology and Machine Tools.

COURSE DESCRIPTION:

Mechanisms of wear; Metal cleaning; Techniques for surface modification or deposition of protective coatings; Rationale behind employing coatings; Quality assurance & testing.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1.   Demonstrate the knowledge of surface engineering processes.

CO2.   Analyze functional and operational characteristics of thermal spraying and electro deposited coatings for different applications.

CO3.   Analyze functional and operational characteristics of hot dip and diffusion coatings for engineering applications.

CO4.   Analyze functional and operational characteristics of non-metallic and conversion coatings for different surfaces.

CO5.   Apply testing procedures for qualitative assessment of different coating.

DETAILED SYLLABUS:

UNIT I: **INTRODUCTION TO SURFACE ENGINEERING**   **(10 periods)**

Importance and necessity of surface engineering, past, present and future scenario of surface engineering , classification of surface engineering process, substrates and their pretreatments; coating characteristics: coating thickness, continuity, hardness, adhesion, porosity, and bond strength, General cleaning process for ferrous and non-ferrous metals, selection of cleaning process, alkaline cleaning, emulsion cleaning, ultrasonic cleaning and abrasive bath cleaning.

UNIT II: THERMAL SPRAYING AND ELECTRODEPOSITED COATINGS (9 periods)

Thermal spraying materials, characteristics of thermal spray process, Spray fused coatings, principles of electro plating, properties and applications of electrodeposits, Principles of Non aqueous and electro less deposition, Plasma spraying, flame spraying, detonation spray coating.

UNIT III: HOT DIP COATING AND DIFFUSION COATING   **(9 periods)**

Surface preparation, Batch coating and continuous coating process, coating properties and applications, principles of cementation, cladding-vacuum deposition, sprayed metal coating, structure of diffusion coatings, Chemical vapour deposition (CVD), Physical vapour deposition (PVD),Thin film Characterization techniques- Scanning Electron Microscopy and Energy dispersive X-ray analysis

UNIT IV: NON-METALLIC COATING OXIDE AND CONVERSION COATINGS

(9 periods)

Plating coating, lacquers, rubbers and elastomers, vitreous enamels, anodizing Chromating, application to aluminum, magnesium, tin, zinc, cadmium, copper and silver, Phosphating primers.

UNIT V: TESTING AND SELECTION OF COATINGS   (8 periods)

Quality assurance, the quality plan, design testing and inspection, thickness and porosity measurement, selection of coatings, Industrial applications of engineering coatings, Performance assessment of engineered surfaces- wear and corrosion.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. S. Grainger, *Engineering Coatings-design and application*, Jaico Publishing House,

   2nd Edition, 1998.

2. D.R. Gabe, *Principles of Metals surface treatment and protection*, Pergamon,

   2nd Edition, 2014.

3. K.G Budinski, Surface Engineering for wear resistance, Prentice Hall, 1998.

REFERENCE BOOKS:

1. N.V Parthasarathy, Electroplating Handbooks, Prentice Hall, 1989.

2. Niku-Lavi, *Advances in surface treatment*, Pergamon, 1984.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1				1							3		
CO2	3	3	1			1							3		
CO3	3	3	1			1							3		
CO4	3	3	1			1							3		
CO5	3	1				1									
Average	3	2.2	1			1							3		
Correlation level	3	2	1			1							3		

Correlation Levels: 3– High   2 - Medium   1– Low

(20BT60410) MICROELECTROMECHANICAL SYSTEMS

(Inter Disciplinary Elective - 2)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

A Course on Applied Physics.

COURSE DESCRIPTION:

Overview of Micro Electro Mechanical Systems (MEMS), working principles of microsensors and microactuators, materials, micro fabrication processes, MEMS accelerometers, packaging of Microsystems and applications over different fields.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate MEMS Components like microsensors and microactuators.

CO2. Understand working methodologies of MEMS accelerometers.

CO3. Use micro fabrication techniques and device packaging methods in manufacturing MEMS devices.

CO4. Analyze various MEMS devices for engineering applications.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO MEMS AND MICROSYSTEMS   (09 Periods)

Introduction to MEMS, Energy domains and transducers, sensors and actuators, Microsystems versus MEMS, miniaturization, MEMS materials.

UNIT II: MICROSENSORS & ACTUATORS   (09 Periods)

Microsensors: Classification of physical sensors, Integrated, Intelligent or Smart sensors, Sensor Principles and Examples: Thermal sensors, Pressure, Flow, Inertial, Gyro sensors, Bio Sensors.

Microactuators: Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotors.

UNIT III: MEMS ACCELEROMETERS   (07 Periods)

Micro accelerometers for MEMS, Temperature and Damping analysis, Piezoelective accelerometer, Piezoresistive accelerometer, Piezocapacitive accelerometer technology.

UNIT IV: MEMS FABRICATIONAND PACKAGING   (12 Periods)

Review of Fabrication process-Photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition, deposition by Epitaxy, Czochralski process.

Micromachining technology of MEMS, Microstereolithography; Introduction to microsystem packaging, objectives and general considerations in packaging design, three levels of microsystem packaging.

UNIT-V: MEMS APPLICATIONS **(08 Periods)**

Applications of MEMS in the automotive industry, avionics and space applications   and commercial applications, RF MEMS, optical MEMS, Introduction to Bio MEMS and microfluidics.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOK:

1. Tai-Ran Hsu, *MEMS & Microsystems, Design and Manufacture*, McGraw Hill Education (India) Pvt. Ltd., 27th reprint, 2018.

REFERENCE BOOKS:

1. G.K.Ananthasuresh, K.J.Vinoy, *Micro and Smart Systems*, New Delhi publication, 1st edition, 2011 Education (India) Pvt. Ltd.

2. Nitaigour Premchand Mahalik, *MEMS*, McGraw Hill Education (India) Pvt. Ltd., 11th reprint, 2016.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-			
CO2	3	2	-	-	-	-	-	-	-	-	-	-			
CO3	3	2	-	-	3	-	-	-	-	-	-	-			
CO4	3	3	-	-	-	3	-	-	-	-	-	-			
Average	3	2.3	-	-	3	3	-	-	-	-	-	-			
Correlation level	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**			

Correlation Levels: **3– High** **2 - Medium** **1– Low**

(**20BT70314) HYDRAULICS AND PNEUMATICS**

(Inter Disciplinary Elective - 2)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Fluid Mechanics and Machines and Basic Electrical and Electronics Engineering

COURSE DESCRIPTION:

Basic fluid power system; Hydraulic components and its use; Hydraulic circuits and its application; Fundamentals of pneumatics; Pneumatic components and its use; Pneumatic circuits; Application; Design of hydraulic and pneumatic systems for various applications; Logic gates, PLC in Pneumatics.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on basic components and mechanisms of fluid power systems.

CO2. Analyze functional characteristics of valves and conditioners used in industrial applications.

CO3. Design the pneumatic and hydraulic circuits for domestic and industrial problems.

CO4. Apply suitable logic gates to control the fluid power system

DETAILED SYLLABUS:

UNIT I : FUNDAMENTALSOF FLUID POWER   (08 Periods)

Fluid power, Fluid power systems, Fluid power physics; **Pumps:** Pumps, pumping theory, pump classification: Rotary, Reciprocating pumps, gear pumps (internal and external Gear pumps) and piston pumps.

Actuators: Cylinders and its classification.

Pressure Control Valves: Relief valves, Pilot operated relief valve, Poppet relief valve, Pressure sequence valve, Pressure reducing valve, unloading valve, Counter balance valve, Brake valve

UNIT II: VALVES & CONDITIONERS   (08 Periods)

Directional control valves (DCVs): Poppet valve, Spool valves, Check valves, Two-way Direction Control Valves, Four-way valves, Pilot operated DCV.

Flow Control valves: Classification of flow control valves, Flow control methods: Meter-in circuit, Meter-out circuit and Bleed-off circuit.

Fluid Conditioner: Filters, Heat exchangers, Reservoirs,

Accessory Components: Accumulators, Pressure switches, Pressure gauges, Flow meters, manifolds, Pressure intensifier.

UNIT III: HYDRAULIC & PNEUMATICS   (12 Periods)

Hydraulic Symbols: Flow lines, Reservoirs, Pumps, Directional Control Valves, Flow control valves, Pressure Control valves, Motors, Check valves, Cylinders, Filters, Heat exchanges and accumulator, Basic hydraulic circuits of single and double acting cylinder circuit.

Pneumatics: Units, Fundamentals of air, Air compressors and its types, Reservoirs or Air receiver, Safety relief valve, Pressure switches, Air dryers, Air distribution, Air filters, Air regulators, Air lubricators.

UNIT IV: PNEUMATIC ACTUATORS AND CIRCUITS (10 Periods)

Pneumatic actuators: Actuators and Output devices, Direction Control Valves(DVC): 2/2 way valve, 3/2 –Way valve, 4/2-Way valve, 4/3- valve, 5/2 –way valve, and 5/3-way valve, Non-Return Valve(NRV), Flow control valves, Mufflers.

Circuits: Control of single acting cylinder, Manual controlled double acting cylinder, Air pilot control of double acting actuator, Semi automatic control of a double acting actuator.

UNIT V: LOGIC CONTROLS IN FLUID POWER SYSTEMS (07 Periods)

Position sensors, Back pressure sensors, Proximity sensors, Pneumatic limit valves, limit switches, pressure sensor, Switching elements - Pneumatic valve functions of AND, NOT, and OR GATE, Applications of Fluidics, Examples of Pneumatic Cylinder sequencing circuit using logic gates.PLC in fluid power applications (block diagram of PLC only)

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Srinivasan.R, *Hydraulic and Pneumatic controls*, McGraw Hill Education, 2nd Edition, 2006.

2. ShanmugaSundaram. K, *Hydraulic and Pneumatic Controls*, S. Chand & Co, 1st Edition, 2019

REFERENCE BOOKS:

1. Majumdar S. R., *Oil Hydraulics Systems Principles and Maintenance*, McGrawHill Education, 1st Edition, 2000.

2. Majumdar S.R., *Pneumatic systems–Principles and Maintenance*, McGraw Hill Education, 2nd Edition, 2001.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	-	-	-	-	-	-	3	-	-
CO2	3	3	1		-	1	-	-	-	-	-	-	3	-	-
CO3	3	3	3	1	-	1	-	-	-	-	-	-	3	-	-
CO4	3	2			-	1	-	-	-	-	-	-	3	-	-
Average	3	2.25	2	1	-	1	-	-	-	-	-	-	3	-	-
Correlation level	3	2	2	1		1							3		

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

IV B. Tech. - I Semester

(20BT70315) INDUSTRIAL INTERNET OF THINGS

(Inter Disciplinary Elective - 2)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

COURSE DESCRIPTION:

Introduction to the Industrial Internet; IIoT Reference Architecture ; Design of Industrial Internet Systems; Modern Communication Protocols, Wireless Communication Technologies, The Access Network, Access Networks Connecting, Defining Industry 4.0,Introducing the Smart Factory, Smart Factories in Action, IOT – A Market Perspective, Technical Design constraints

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the functional, informational, and operational characteristics of IoT and IIOT architectures.

CO2. Design industrial internet systems encompassing access network technology and protocols.

CO3. Apply design principles, characteristics, and building blocks of Industry 4.0. for innovative manufacturing applications.

CO4. Demonstrate knowledge of IoT market perspective and Security issues in smart manufacturing.

CO5. Apply real-world design constraints for solving problems encountered in smart manufacturing.

DETAILED SYLLABUS:

UNIT I: IOT AND IIOT REFERENCE ARCHITECTURE   **(09 Periods)**

Introduction: Introduction to the Internet of Things (IoT). Architecture, Enabling Technologies, Applications.

IIoT Reference Architecture: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT II: DESIGN OF INDUSTRIAL INTERNET SYSTEMS AND ACCESS NETWORK TECHNOLOGY & PROTOCOLS   **(09 Periods)**

Design of Industrial Internet Systems: The Concept of the IIoT, The Proximity Network, WSNEdge Node, Legacy Industrial Protocols, Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, Gateways.

Access Network Technology and Protocols: The Access Network, Access Networks Connecting Remote Edge Networks.

UNIT III: INDUSTRY 4.0 AND SMART FACTORIES   **(09 Periods)**

Industry 4.0: Defining Industry 4.0, Four Main Characteristics of Industry 4.0, The Value Chain, Industry 4.0 Design Principles, Building Blocks of Industry 4.0, Smart Manufacturing.

Smart Factories: Introducing the Smart Factory, Smart Factories in Action, Importance of Smart Manufacturing, Real-World Smart Factories - GE's Brilliant Factory, Airbus: Smart

Tools and Smart Apps, Siemens' Amberg Electronics Plant (EWA), Industry 4.0: The Way Forward

UNIT IV:IOT MARKET PERSPECTIVE AND SECURITY ISSUES IN MANUFACTURING

(09 Periods)

IoT Market perspective: M2M to IoT – A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, emerging industrial structures for IoT, The international driven global value chain and global information monopolies.

Security issues in Manufacturing: PLCs and DCS, Securing the OT, Network Level: Potential Security Issues, System Level: Potential Security Issues, Identity Access Management

UNIT V: REAL WORLD IOT DESIGN CONSTRAINTS AND INDUSTRIAL AUTOMATION

(09 Periods)

Real-World IOT Design Constraints- Introduction, Technical Design constraints-hardware components, Data representation and visualization, Interaction and remote control.

Industrial Automation- Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things,

Total Periods: 45

Topics for self-study are provided in the lesson plan.
TEXTBOOK:

1. Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Apress Publications, 2016.

2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "*From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence*", 1st Edition, Academic Press, 2014.

REFERENCE BOOKS:

1. Giacomo Veneri and Antonio Capasso, *Hands-on Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0*,Ingram Academic Services, 2018.

2. Vijay Madisetti and Arshdeep Bahga, *Internet of Things A Hands-On- Approach*, Orient Blackswan Private Limited, 2015.

3. Francis daCosta, *Rethinking the Internet of Things: A Scalable Approach toConnecting Everything*", 1st edition, Apress Publications, 2014.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1									
CO2	3	3	2	1	1	1									
CO3	3	3	2	1	1	1									
CO4	3	1	1	1	1	1									
CO5	3	3	3	1	1	1									
Average	3	2.6	1.8	1	1	1									
Correlation level	3	3	2	1	1	1									

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

IV B. Tech. – I Semester

(20BT70316) INSTRUMENTATION AND CONTROL SYSTEMS

(Inter Disciplinary Elective - 2)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Engineering Physics, Manufacturing Technology and Engineering Metrology and Machine Tools.

COURSE DESCRIPTION:

Basic Principles of Measurement, Measurement of Displacement, Measurement of Temperature and Pressure, Measurement of Speed, Acceleration, Vibration, force, torque, Power, Stress, Strain, Level And Flow Measurement, Elements of Control systems

COURSE OUTCOMES:

After successful completion of this course, the students will be able to

- CO1. Demonstrate the knowledge on methods and instruments used for the measurement of Displacement
- CO2. Demonstrate the knowledge on methods and instruments used for the measurement of Temperature and Pressure
- CO3. Demonstrate the knowledge on methods and instruments used for the measurement of Speed, Acceleration, Force, Torque and Power
- CO4. Demonstrate the knowledge on stress and strain measurements Level and Flow measurements.
- **CO5.** Demonstrate the knowledge of control systems.

DETAILED SYLLABUS:

UNIT I: BASIC PRINCIPLES OF MEASUREMENT   (09 periods)

Measurement: Definition - Basic principles of measurement - Measurement systems, generalized configuration and functional descriptions of measuring instruments - examples. Dynamic performance characteristics - sources of error and uncertainity analysis, Classification and elimination of error.

Measurement of Displacement: Theory and construction of various transducers to measure displacement - Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

UNIT II: MEASUREMENT OF TEMPERATURE AND PRESSURE   (09 periods)

MEASUREMENT OF TEMPERATURE: Classification - Ranges - Various Principles of measurement - Expansion, Electrical Resistance - Thermistor - Thermocouple - Pyrometers - Temperature Indicators.

MEASUREMENT OF PRESSURE: Units - classification - different principles used- Manometers, Piston, Bourdon pressure gauges, Bellows - Diaphragm gauges. Low pressure measurement - Thermal. conductivity gauges - ionization pressure gauges, McLeod pressure gauge.

UNIT III: SPEED, ACCELERATION, VIBRATION, FORCE, TORQUE AND POWER MEASUREMENT   (09 periods)

Measurement of Speed: Mechanical Tachometers - Electrical tachometers - Stroboscope, Noncontact type of tachometer   .

Measurement of Acceleration and Vibration: Different simple instruments - Principles of Seismic instruments - Vibrometer and accelerometer.

Measurement of Force, Torque and Power: Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT IV: STRESS, STRAIN, LEVEL AND FLOW MEASUREMENT   (09 Periods)

Stress & Strain Measurements: Various types - electrical strain gauge - gauge factor - method of usage of resistance strain gauge for bending, compressive and tensile strains - usage for measuring torque, Strain gauge Rosettes.

Measurement of Level: Direct method - Indirect methods - capacitative, ultrasonic, magnetic, cryogenic fuel level indicators - Bubler level indicators.

Flow Measurement: Magnetic, Ultrasonic, Turbine flow meter, Hot - wire anemometer Laser Doppler Anemometer (LDA).

UNIT V: SYSTEMS AND THEIR REPRESENTATION   (09 periods)

ELEMENTS OF CONTROL SYSTEMS: Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Temperature, speed & position control system

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. D. S. Kumar, *Mechanical Measurements and Control*, Metropollitan Book, 5th edition, 2015.

2. S. Bhaskar, *Basic Principles Measurements, Instrumentation and control systems*, Anuradha Agencies, 2014.

REFERENCE BOOKS:

1. R.K. Jain, *Mechanical and Industrial Measurements*, Khance Publications, 12th edition, 2015.

2. Ernesto. Doebelin, *Measurement systems application and design*, Mc Grawhill Companies, 5th edition, 2003.

3. Bechwith, Marangoni, Lienhard, *Mechanical Measurements*, Pearson, 6th edition, 2006.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	1	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	1	1	-	-	-	-	-	-	-	3	-
CO3	3	2	-	-	1	1	-	-	-	-	-	-	-	3	-
CO4	3	2	-	-	1	1	-	-	-	-	-	-	-	3	-
CO5	3	2	-	-	1	1	-	-	-	-	-	-	-	3	-
Average	3	2			1	1	-	-	-	-	-	-	-	3	-
Correlation level	3	2			1	1								3	

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. – I Semester

(20BT70317) MECHATRONICS

(Inter Disciplinary Elective - 2)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES:

Courses on Basic Electrical and Electronics Engineering and kinematics of machinery

COURSE DESCRIPTION:

Mechatronics system; Sensors; Transducers; Pneumatic and hydraulic actuation system, Mechanical and electrical actuation systems, signal conditioning and process controllers

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Design mechatronic systems   considering components, control systems and ethics as design constraints.

CO2. Demonstrate the knowledge on hydraulic, pneumatic actuation systems used in automation circuits.

CO3. Demonstrate the knowledge on mechanical and electrical actuation systems

CO4. Demonstrate the knowledge of sensors and transducers to monitor and control the behavior of a process.

CO5. Demonstrate the knowledge on signal conditioning and process controllers used in mechatronics.

DETAILED SYLLABUS:

UNIT I: MECHATRONICS SYSTEMS   **(07 periods)**

Definition, Elements of mechatronics System, Difference between   Traditional and mechatronics system, Measurement systems, Control systems, Examples of Automatic control systems: Examples - Automatic car parking gate system, Washing machine, Automatic Camera, Pick and Place Robot arm, Advantages and Disadvantages of mechatronics systems. Mechatronics approach to design, Ethics as design constraint.

UNIT II: PNEUMATIC AND HYDRAULIC ACTUATION SYSTEMS   **(09 Periods)**

Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure control valves, Cylinders, Process control valves, Rotary actuators

UNIT III: MECHANICAL AND ELECTRICAL ACTUATION SYSTEMS   **(09 Periods)**

Mechanical Actuation systems-Mechanical Systems, Types of motion, Kinematic chains, CAMS, Gear Trains, Ratchet and Pawl, belt and Chain drives, bearingss.

Electrical Actuation systems - Switches, Solenoids, Relays, DC motors, AC motors, Stepper motors.

UNIT IV: SENSORS AND TRANSDUCERS   **(09 periods)**

Sensors: Introduction, Types of and sensors and transducers, Performance terminology: Range, span, error, accuracy, sensitivity, hysteresis error, non linear error, repeatability, stability and resolution. Static and dynamic Characteristics; Displacement sensors-Potentiometer, Strain gauge, Linear Variable Differential Transformer; Position sensors- Hall

effect sensor, Optical Encoder; Proximity- Inductive, Capacitive; Acceleration-Piezoelectric accelerometer; Temperature- Bimetallic strips, Resistance Temperature Detectors (RTD); Light sensors- photo diodes, photo electric transducer; Selection of Sensors.

UNIT V: SIGNAL CONDITIONG AND PROCESS CONTROLLERS   (11 Periods)

Signal conditioning - Operation Amplifiers : Inverting and non-inverting amplifier, Filtering: Ideal filter characteristic, Low Pass, High Pass, Band pass, Band stop filters and notch filter, Bridge circuits, Analog to digital converter, Digital to analog Converter, Data Acquisition System.

Process Controller - Principles, Two position controller, Proportional (P) controllers, Integral (I) controllers, Derivative (D) controllers; Composite controller Modes – Proportional Integral (PI), Proportional Derivative (PD), Three mode controller (PID); Selection of controllers, Syllabus

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. K.P.Ramachandran, *Mechatronics Integrated Mechanical Electronic Systems*, Wiley, 2012.

2. W. Bolton, *Mechatronics Electronics Control systems in Mechanical and Electrical Engineering*, Pearson, 4th edition, 2005.

REFERENCE BOOKS:

1. N.P. Mahalik, *Mechatronics Principles Concepts and Applications*, McGraw Hill Education (India) Private Limited, 2012.

2. Devdas Shetty, Richard, *Mechatronic System Design*, Cengage Learning, 2nd edition, 2012.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3			1		3					3		
CO2	3	1				1							3		
CO3	3	1				1							3		
CO4	3	1				1							3		
CO5	3	1				1							3		
Average	3	1.4	3			1		3					3		
Correlation level	3	1	3			1		3					3		

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. – I Semester

(20BT70318) SOFT COMPUTING TECHNIQUES IN MECHANICAL ENGINEERING

(Inter disciplinary elective – 1)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

PRE-REQUISITES: --

COURSE DESCRIPTION:

Introduction to Soft computing techniques; Genetic Algorithm; Fuzzy Logic; neural Network; Hybrid soft computing techniques; Application in Mechanical Engineering.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1.   Demonstrate the knowledge on soft computing techniques and their applications.

CO2.   Apply the genetic algorithms and their applications in Mechanical Engineering.

CO3.   Model the fuzzy systems.

CO4.   Analyze various neural network architectures.

CO5.   Apply the hybrid soft computing techniques in real life applications.

.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO SOFT COMPUTING   (08 periods)

Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics

UNIT II: GENETIC ALGORITHM   (10 periods)

Introduction, Working cycle of a Genetic Algorithm, Basic operators and Terminologies like individual, gene, encoding, fitness function and reproduction, Genetic modeling: Significance of Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, GA optimization problems, JSPP (Job Shop Scheduling Problem), TSP (Travelling Salesman Problem), Differences& similarities between GA & other traditional methods, Applications of GA.

UNIT III: FUZZY LOGIC   (09 periods)

Introduction, Crisp Sets, Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions- Fuzzy Rules and Fuzzy Reasoning – Fuzzy Clustering, C-Means clustering, Entropy-based Fuzzy Clustering.

UNIT IV: NEURAL NETWORKS   (09 periods)

Introduction, Static Vs Dynamic Neural Networks, training of neural networks, Multi-Layer Feed-Forward Neural Network (MLFFNN), Radial Basis Function Network (RBFN), Self Organizing Map (SOP), Recurrent Neural Networks (RNN).

UNIT V:HYBRID SOFT COMPUTING TECHNIQUES   (09 periods)

Working principle of Genetic-Fuzzy systems, Genetic-Neural system, Neuro-fuzzy hybrid systems based on Mamdani Approach, Takagi and Sugeno's approach.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

SVEC-20 – B.TECH – MECHANICAL ENGINEERING   310

TEXTBOOKS:

1. D. K. Pratihar, *Soft Computing*, Narosa Publications, Revised Edition, 2018
2. S, Rajasekaran& G.A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications*, PHI Publication, 1st Edition, 2009.

REFERENCE BOOKS:

1. S.N.Sivanandam, S.N.Deepa, *"Introduction To Genetic Algorithms",* Springer, 2007.
2. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1 st Edition, 2009.

ADDITIONAL LEARNING RESOURCES:

http://nptel.ac.in/courses/106106046/

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1		2								3		
CO2	3	3			3								3		
CO3	3	3	3	1	1								3		
CO4	3	3	1		1								3		
CO5	3	3	1		3								3		
Average	3	2.6	1.5	1	2								3		
Correlation level	3	3	2	1	2								3		

Correlation Levels: 3– High   2 - Medium   1– Low

IV B. Tech. – I Semester

(20BT70331) INDUSTRIAL AUTOMATION AND ROBOTICS LAB

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		-	-	3	1.5

PRE-REQUISITES:

A course on Computer Aided Design and Manufacturing

COURSE DESCRIPTION:

This laboratory is intended to provide hands-on experience on industrial robotics, manufacturing automation, mobile robotics, and dynamics and control of field robots. The students experiment with various automation systems, learn to program, implement planning and control algorithms.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Apply different motion commands of various configurations of robot and perform different tasks relative to its degrees of freedom using programming.

CO2. Design various combinations of gripper design with the robot configuration suitable for industrial applications.

CO3. Develop virtual robot in the Robot simulation software , which will perform all the functions of a 3R Manipulator in real-time.

CO4. Demonstrate the knowledge of automation process , robotic end effectors and robotic arm configurations.

CO5. Work independently or in teams to solve problems with effective communication

List of Exercises/List of Experiments: (9)

1. Demonstration of robot configuration

2. Demonstration of robot with 2 dof, 3 dof, 4 dof etc.

3. Design/modeling of any two different types of grippers.

4. Two assignments on programming the robot for applications

5. Two programming exercises for robots

6. Exercise on welding robot in robot simulation software

7. Exercise on pick and place robot in robot simulation software

8. Exercise on robotic simulation software

9. Two case studies of applications in industry

10. Study of automation processes such as Distribution station, Testing station, Pick and place, Fluidic muscle press, and Storing.

11. Study of PLC on Automation production system

12. Study of robotic end effectors, robotic arm and its configurations.

13. Design and testing of hydraulic circuits

14. Design and testing of pneumatic circuits

15. Simulation of basic hydraulic and pneumatic circuits

SOFTWARE/Tools used:

- Offline robot programming software
- Aristo Robotic Simulation Software

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	-	-	-	-	-	-	3		
CO2	3	2	2	1	3	1	-	-	-	-	-		3		
CO3	3	2	2	1	3	1	-	-	-	-	-	-	3		
CO4	3	2			3	1							3		
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-		
Average	3	2	2	1	3	1			3	3			3		
Correlation level	3	2	2	1	3	1			3	3			3		

Correlation Levels: **3– High** **2 - Medium** **1– Low**

IV B. Tech. – I Semester

(20BT70332) MANUFACTURING SYSTEMS AND OPERATIONS MANAGEMENT LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	-	-	3	1.5

PRE-REQUISITES:

Courses on Numerical Methods, Probability and Statistics, Operations Research and Industrial Engineering and Management.

COURSE DESCRIPTION:

Exercises on Regression and Hypothesis Testing; ANOVA; DOE; Simplex method; Transportation and assignment problems; Inventory models; Network models; Statical analysis.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Apply simulation tools for operations management.

CO2. Apply software tools in solving operation research problem.

CO3. Develop codes and use software tools in solving statical problems.

CO4. Work independently or in teams to solve problems with effective communication

LIST OF EXPERIMENTS

Any **twelve** experiments are to be conducted.

Operation Management Exercises:

1. Exercises on job scheduling using simulation software.

2. Design and simulation of a simple manufacturing system

3. Build simulation models for manufacturing operations with layout and transport system

4. Line balancing using manufacturing systems simulation software

5. Simulation of Service Operations

6. Develop a JIT model using Kanban tool.

Operations Research:

7. Solve linear programming problem using simplex method.

8. Solve Transportation and assignment problems

9. Solve Inventory Models

10. Solve Network Models

Statistical Exercises:

11. Correlation: How to calculate the correlation between two variables. How to make scatter plots. Use the scatter plot to investigate the relationship between two variables with R programming

12. Estimating a Linear Relationship: A Statistical Model for a Linear Relationship, Least Squares Estimates, The R Function lm and Scrutinizing the Residuals with R programming.

13. Solve a problem on regression, ANOVA and hypothesis testing.

14. Test the Goodness of fit for the given quality characteristic

15. Analysis of DoE results using statistical software

Software's used:

Promodel, Matlab, Arena, Quest, Witness, Extend, Simio, Opensource ware, ARENA, Minitab; SPSS, SYSTAT, Kanban, Excel, FlexSim and Simcad

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	-	-	-	-	-	-	3	-	-
CO2	3	3	2	3	3	2	-	-	-	-	-		3	-	-
CO3	3	2	2	2	3	2	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Average	3	2.3	2.3	2.3	3	2			1	1			3		
Correlation level	3	3	3	3	3	2			1	1			3		

Correlation Levels: 3– High   2 - Medium   1– Low

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IV B. Tech – I Semester

(20BT70333) HEATING, VENTILATION AND AIR CONDITIONING LAB

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Int. Marks	Ext. Marks	Total Marks		L	T	P	C
30	70	100		-	1	2	2

PRE-REQUISITES:

A course on Thermal Engineering -II

COURSE DESCRIPTION:

Performing fundamental operations required for refrigeration and Air conditioning, getting knowledge of principles of refrigeration and Air Conditioning, Determining the coefficient of performance of refrigerator, vapor absorption system, Ice plant, cooling tower and Air Conditioning System

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Analyze the refrigeration systems for performance characteristics.

CO2. Design and simulate HVAC systems and assess their performance.

CO3. Work independently or in teams to solve problems with effective communication

LIST OF EXPERIMENTS:

1. Perform fundamental operations like Cutting, bending and joining of copper tubing by brazing.

2. Perform Fundamental operations Flaring, Swaging and silver soldering.

3. Study the mechanical components of refrigerator and their types (Compressor/ Expansion devices/heat exchangers/evaporators).

4. Study different control devices of a refrigeration system.

5. Performance test on vapor compression refrigeration system by using different expansion devices.

6. Performance test on Water cooler.

7. Performance test on vapor absorption test rig

8. Study various components of room/central air conditioning system.

9. Study electrical circuits, leak testing, gas charging, Trouble shooting of refrigeration & air-conditioning system

10. Study the Complete Guide to ASHRAE Standards for Commercial HVAC Manufacturers

11. Find the performance parameters of Ice Plant.

12. Performance test on Air conditioning system.

13. Find the performance parameter of cooling tower.

14. Perform the experiment & calculate various Performance parameters on a blower apparatus (Air handling unit)

15. Design of Air conditioning Systems and ducts for a given space

16. Simulate air conditioning systems for the given application.

Software's used:

NOTE: Student shall perform minimum of twelve experiments

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		1	1	1								
CO2	3	3	3		1	1	1								
CO3									3	3					
Average	3	3	2.5		1	1	1		3	3					
Correlation level	3	3	3		1	1	1		3	3					

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

IV B.Tech. - I semester

(20BT70334) SUMMER INTERNSHIP-II

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
-	100	100		-	-	-	1.5

PRE-REQUISITES: -

COURSE DESCRIPTION:

Expose students to the industrial environment; Create competent professionals for the industry; sharpen the real time technical / managerial skills required at the job; Gain professional experience and understand engineer's responsibilities and ethics; Familiarize with latest equipment, materials and technologies; Gain exposure to technical report writing; Gain exposure to corporate working culture.

COURSE OUTCOMES:

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

CO1. Analyze latest equipment, materials and technologies that are used in industry to solve complex engineering problems following relevant standards, codes, policies and regulations.

CO2. Analyze safety, health, societal, environmental, sustainability, economical and managerial factors considered in industry in solving complex engineering problems.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on practicing engineering.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	-	-	3	-	-	-	3	3	3	3
CO2	-	3	-	-	-	3	3	-	-	-	3	-	3	3	3
CO3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Average	3	3	--	3	3	3	3	3	3	3	3	3	3	3	3
Correlation level	3	3	--	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Levels: **3– High**   **2 - Medium**   **1– Low**

IV B. Tech. – I Semester

(20BT703AC) 3D Printing and Design

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	2	-	-	-

PRE-REQUISITES:

Courses on Manufacturing Technology and Computer Aided Design and Manufacturing.

COURSE DESCRIPTION:

Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications, Material science aspects in additive manufacturing, CAD Data formats, Data translation, Data loss, STL format, Additive Manufacturing Application Domains, Stereolithography, LOM, DMLS, Principle of operation, Machine details; Applications; Thermal jet printer; Indirect Rapid tooling, Direct Tooling; Quick cast process; Rapid Tool; Software For RP; STL files; Rapid manufacturing process optimization; Vacuum Casting, Surface digitizing; data transfer to solid models, Reverse Engineering.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge on 3D printing for developing complex components.

CO2. Develop CAD models for 3D printing and generate .stl files for simple to complex components.

CO3. Demonstrate the knowledge on additive manufacturing techniques, and processes for various applications.

CO4. Apply material selection techniques for specific processes considering post processing and quality challenges.

CO5. Analyze the functional characteristics of 3D printing and reverse engineering techniques for engineering applications.

DETAILED SYLLABUS:

UNIT I:**3D PRINTING** (6 periods)

Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications, Material science aspects in additive manufacturing.

UNIT II: CAD FOR ADDITIVE MANUFACTURING (6 periods)

CAD Data formats, Data translation, Data loss, STL format.

Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools

UNIT III: ADDITIVE MANUFACTURING TECHNIQUES (6 periods)

Introduction, Types- Stereo- Lithography, LOM, FDM, SLS, SLM and Binder Jet technology-Design and Process parameters, Process Selection for various applications.

UNIT IV: MATERIALS, POST PROCESSING AND PRODUCT QUALITY   (6 periods)

Materials: Polymers, Metals, Non-Metals, Ceramics Process, Process parameter, Process Selection for various applications, Support Materials

Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties.

Post Processing: Support Removal, Sanding, Acetone treatment, polishing

Product Quality: Inspection and testing, Defects and their causes

UNIT-V: REVERSE ENGINEERING WITH 3D PRINTING TECHNOLOGY   (6 periods)

3D printing software: STL files, Overview of Solid view, Magics, Magic communicator, Internet based software.

Allied processes: Vacuum casting, Surface digitizing, Surface generation from point cloud, Surface modification, Data transfer to solid models.

Reverse Engineering: Capturing and reading the scan data, Align point clouds and simplify data, Polygon meshing and editing, Defining surface boundaries, applying nurbs, Exporting data, Reverse engineering update.

Total Periods: *30*

Topics for self-study are provided in the lesson plan.

TEXTBOOKS:

1. Paul F. Jacobs, *Stereo lithography and other RP and M Technologies*, SME, New York, 3rd edition, 1996.

2. Frank W. Liou, *Rapid Prototyping and Engineering Applications*, CRC Press Taylor and Francis Group, New York, Special Indian Edition, 2011.

REFERENCE BOOKS:

1. C. K. Chua, K. F. Leong, C. S. Lim, *Rapid Prototyping - Principles and Applications*, Yesdee publications Pvt. Ltd., Mumbai, India, 2nd edition, 2010.

2. Hari Prasad, K.S. Badarinarayan, *Rapid Prototyping and Tooling*, SIP PageTuners, Bangalore, 1st Edition, 2013.

3. Fiham D.T, Dinjoy S. S, *Rapid Manufacturing*, Verlog, London, 4th edition, 2002.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1								3		
CO2	3	3	3	1	2								3		
CO3	3	1											3		
CO4	3	2	1										3		
CO5	3	3	1	1	2	2		1					3		
Average	3	1.8	1.5	1	1.6	2		1					3		
Correlation level	3	2	2	1	2	2		1					3		

Correlation Levels: 3– High   2 - Medium   1– Low

IV B.Tech. - II semester

(20BT80331) PROJECT WORK

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
100	100	200		-	-	-	12

PREREQUISITES: -

COURSE DESCRIPTION:

Identification of topic for the project work; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the project work; Preparation of thesis and presentation.

COURSE OUTCOMES:

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

CO1. Create/Design mechanical engineering systems or processes to solve complex mechanical engineering and allied problems using appropriate tools and techniques following relevant standards, codes, policies, regulations and latest developments.

CO2. Consider society, health, safety, environment, sustainability, economics and project management in solving complex mechanical engineering and allied problems.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on mechanical engineering systems or processes.

CO-PO-PSO Mapping Table :

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	-	3	-	-	-	3	3	3	3
CO2	-	-	-	-	-	-	3	-	-	-	3	-	3	3	3
CO3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Average	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Correlation level	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Levels: 3– High   2 - Medium   1– Low