FOREWORD

CMR Technical Campus, established in the year 2009, Approved by AICTE, New Delhi, Permanently Affiliated to JNTUH, twice Accredited by NBA and has been bestowed with NAAC 'A' Grade of 3.12 score on 04 scale in February 2019 for its remarkable academic accomplishments accompanied by its unflinching spirit and dedication to impart quality technical education to the deserving aspirants. The institution has commenced functioning independently within the set norms prescribed by UGC and AICTE. The performance of the institution manifests the confidence that the prestigious monitoring body, the UGC has on it, in terms of upholding its spirit and sustenance of the expected standards of functioning on its own consequently facilitating the award of degrees for its students. Thus, an autonomous institution is provided with the necessary freedom to have its own curriculum, examination system and monitoring mechanism, independent of the affiliating University but under its observance.

CMR Technical Campus takes pride for having won the confidence of such distinguished academic bodies meant for monitoring the quality in technology education. Besides, the institution is delighted to sustain the same spirit of discharging the responsibilities that it has been conveying since a decade to attain the current academic excellence, if not improving upon the standards and ethics. Consequently, statutory bodies such as the Academic Council and the Boards of Studies have been constituted under the supervision of the Governing Body of the College and with the recommendations of the JNTU Hyderabad, to frame the regulations, course structure and syllabi for autonomous status.

The autonomous regulations, course structure and syllabi have been framed in accordance with the vision and mission of the institution along with certain valuable suggestions from professionals of various ancillary fields such as the academics, the industry and the research, all with a noble vision to impart quality technical education and contribute in catering full-fledged engineering and management graduates to the society.

All the faculty members, the parents and the students are requested to study all the rules and regulations carefully and approach the Director to seek any clarifications, if needed, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The cooperation of all the stake holders is sought for the successful implementation of the autonomous system in the larger interests of the institution and for brightening the career prospects of engineering and management graduates.

DIRECTOR

CMR TECHNICAL CAMPUS

Vision:

To impart quality education in serene atmosphere thus strive for excellence in Technology and Research.

Mission:

- To create state of art facilities for effective Teaching – Learning process.
- Pursue and Disseminate knowledge based research to meet the needs of Industry & Society.
- Infuse Professional, Ethical and Societal values among Learning Community.

Quality Policy:

- The management is committed in assuring quality service to all its stakeholders like parents, students, alumni, employees, employers and the community.
- Continual quality improvement by establishing and implementing mechanisms and modalities.
- Transparency in procedures and access to information and actions.

Core Values:

The CMR Technical Campus is guided by the following core values in delivering its mission and pursuing its vision.

- **A**ccountability: Demonstrate responsibility for our actions; establish and communicate clearly defined and articulated goals and objectives.
- **B**enchmark: To develop and pursue high standards by encouraging skill development and entrepreneurship to meet industry and society needs.
- **C**ommitment: Focus on students and stakeholders needs; continuously evaluate and improve academics, research and infrastructure.
- **D**ignity: Recognize the expertise of all members of the institute and encourage individual contribution and also include stakeholders in the decisions that affect them.

CMR TECHNICAL CAMPUS
UGC AUTONOMOUS
Kandlakoya (V), Medchal Road, Hyderabad–501401, Telangana State (India)

Academic Regulations [R19]
B.Tech. - Regular Four Year Degree Programme
(For students admitted from the academic year 2019 - 20)
&
B.Tech. - Lateral Entry Scheme
(For students admitted from the academic year 2020 - 21)

CMR Technical Campus (CMRTC) offers a 4-year (8 semesters) Bachelor of Technology (B.Tech.) degree programme, under Choice Based Credit System (CBCS).

1.   **UNDER GRADUATE PROGRAMS OFFERED (E & T)**

         CMRTC (Autonomous), affiliated to JNTUH, offers 4 Year (8 Semesters) **B.Tech.** Degree Programme in the following Branches of Engineering:

         1) Civil Engineering
         2) Mechanical Engineering
         3) Electronics and Communication Engineering
         4) Computer Science and Engineering
         5) Information Technology

2.   **ADMISSION CRITERIA AND MEDIUM OF INSTRUCTION**

2.1.   **Admission into first year of four-year B.Tech. (Regular) Degree Programme:**

2.1.1.   **Eligibility:** A candidate seeking admission into the first year of four-year B. Tech. Degree Programme should have:

         (i)   Passed either Intermediate Public Examination (IPE) conducted by the Board of Intermediate Education, Telangana, with Mathematics, Physics and Chemistry as optional subjects or any equivalent examination recognized by Board of Intermediate Education, Telangana or a Diploma in Engineering conducted by the Board of Technical Education, Telangana or equivalent Diploma recognized by Board of Technical Education for admission as per guidelines defined by the Regulatory bodies of Telangana State Council for Higher Education (TSCHE) and AICTE.

         (ii) Secured a rank in the TSEAMCET examination conducted by TSCHE for allotment of a seat by the Convenor, TSEAMCET.

2.1.2.   **Admission Procedure:** Admissions are made into the first year of four-year B.Tech. Degree Programme as per the stipulations of the TSCHE.

         (a)   Category A: 70% of the seats are filled through TSEAMCET counseling.
         (b)   Category B: 30% of the seats are filled by the Management.
2.2.   **Admission into the second year of four-year B. Tech. (Regular) Degree Programme Under Lateral Entry Scheme.**

2.2.1   **Eligibility**: A candidate seeking admission into the II year I Semester B. Tech. Regular Degree Programme under Lateral Entry Scheme (LES) should have passed the qualifying examination (B.Sc. Mathematics or Diploma in concerned course) and have secured a rank at Engineering

Common Entrance Test TSECET (FDH). Admissions are made in accordance with the instructions received from the Convenor, TSECET and Government of Telangana State.

2.2.2 **Admission Procedure:** Admissions are made into the II year of four-year B.Tech. (Regular) Degree Programme through Convenor, TSECET (FDH) against the sanctioned intake in each Programme of study as lateral entry student.

2.3. **Branch Transfers:** There shall be no Branch transfers after the completion of Admission Process.

2.4. **Medium of Instruction:** The Medium of Instruction and Examinations for the entire B.Tech. programme will be in **English** only.

3. B.Tech. PROGRAMME STRUCTURE

3.1 **Admitted under Four Year B. Tech. (Regular) degree Programme:**

3.1.1 A student after securing admission shall pursue the under graduate programme in B. Tech for a minimum period of **four** academic years (8 semesters), and a maximum period of **eight** academic years (16 semesters) starting from the date of commencement of first year first semester, failing which, students shall forfeit their seat in B. Tech course.

3.1.2 As per AICTE guidelines, a 3-week mandatory **"Induction Programme"** shall be offered to I - B. Tech newly admitted students to get acquainted with the professional environment and prepare them for the academic schedules ahead.

3.1.3 The entire B.Tech. programme is structured for a total of 160 credits. Distribution of credits Semester-wise is available in the respective course structure.

3.1.4 Each student shall register and secure 160 credits (with CGPA ≥ 5) for the completion of the under graduate programme and award of the B. Tech degree.

3.2 **Admitted under Lateral Entry Scheme (LES) into B. Tech. degree Programme:**

3.2.1 After securing admission into II-year B.Tech. I Semester, the LES students shall pursue a course of study for not less than three academic years (6 Semesters) and not more than six academic years (12 Semesters), failing which students shall forfeit their seat in B.Tech. programme.

3.2.2 The student shall register and secure 123 credits (with CGPA ≥ 5) from II year to IV year B.Tech. programme (LES) for the award of B. Tech degree.

3.3 The Course Structure is organized based on the AICTE Model Curriculum (Jan-2018) for Under-Graduate Degree Courses in Engineering & Technology. **UGC / AICTE** specified definitions / descriptions are adopted appropriately for various terms and abbreviations used in these Academic Regulations / Norms, which are listed below:

3.3.1 **Semester Scheme:**
The evaluation of course is on the basis of Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC while the course Curriculum / Course Structure is as suggested by AICTE.

- B.Tech. (Regular) Programme is of 4 Academic Years (8 Semesters)
- B.Tech. (LES) Programme is of 3 Academic Years (6 Semesters),
- Each academic year is divided into two semesters
- Each semester is of 22 weeks (≥ 90 Instructional days per semester)
- Each Semester is having - 'Continuous Internal Evaluation (CIE)' and 'End Semester Examination (ESE).

3.3.2   Credit Courses:

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

Theory		Practical	
1 Hr. Lecture (L)	1 credit	1 Hr. Practical (P)	0.5 credit
1 Hr. Tutorial (T)	1 credit	2 Hrs Practical (Lab)	1.0 credit

All Mandatory Courses, Study Tour, Guest Lecture, etc., will not carry any Credits.

b) **Contact Hours:** Weekly contact hours – maximum of 30 hours per week (1 hour = 60 Minutes) including credit and non-credit courses.

3.3.3   Subject / Course Classification:

CMRTC has followed the guidelines specified by AICTE / UGC / JNTUH. The subjects / courses offered in B.Tech. programme are broadly classified as mentioned below.

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	Foundation Courses	BS – Basic Sciences	Includes mathematics, physics and chemistry subjects
2		ES - Engineering Sciences	Includes fundamental engineering subjects
3		HS – Humanities and Social sciences	Includes subjects related to humanities, social sciences and management
4	Core Courses	PC – Professional Core	Includes core subjects related to the parent discipline/ department/ branch of Engineering.
5	Elective Courses	PE – Professional Electives	Includes elective subjects related to the parent discipline/ department/ branch of Engineering.
6		OE – Open Electives	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering.
7	Core Courses	PR- Project Work	B.Tech. project or UG project or UG major project or Project Stage I & II
8		Industrial training/ Mini- project	Industrial training/ Summer Internship Industrial Oriented Mini-project/ Mini-project
9		Seminar	Seminar/ Colloquium based on core contents related to parent discipline/ department/ branch of Engineering.
10	Minor courses	-	1 or 2 Credit courses (subset of HS)
11	Mandatory Courses	MC	Mandatory courses (non-credit)
12	Audit Courses	AC	

3.3.4   Subject Code Nomenclature:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

1, 2 - Year of implementation of Regulation
3, 4 - Department Code (Course offering department)
5 - Serial No. of Semester (1 to 8)
6, 7 - Serial No. of Subject, Semester wise
8, 9 - Course Group/ Category

Example: - 19EC302PC

4.   COURSE REGISTRATION

4.1   A '**Faculty Advisor/Mentor**' shall be assigned to each student to advise the student about the B.Tech. programme, course structure and curriculum, choice / option for subjects / courses, based on his/her competence, progress, pre-requisites and interest.

4.2   The academic section of the college invites 'registration forms' from students before the beginning of the semester through online submission, ensuring '**date** and **time stamping**'. The online registration requests for any 'current semester' shall be completed **before the commencement of ESEs (End Semester Examinations) of the 'preceding semester'**.

4.3   A student can apply for **online** registration, **only after** obtaining the '**written approval**' from his faculty advisor or Mentor, which should be submitted to the college academic section through the Head of the Department. A copy of it shall be retained with Head of the Department, faculty advisor and the student.

4.4   A student has to register for all subjects/courses in a semester as specified in the course structure and may be permitted to register one additional theory subject / course limited to 3 credits, based on the student's **progress** and SGPA / CGPA, and completion of the '**pre-requisites**' as indicated for various subjects/courses, in the department course structure and syllabus contents.

4.5   If the student submits ambiguous choices or multiple options or erroneous (incorrect) entries during **online** registration for the subject(s) / course(s) under a given / specified course group / category as listed in the course structure, only the first mentioned subject / course in that category will be taken into consideration.

4.6   Subject / course options exercised through **online** registration are final and **cannot** be changed or inter- changed; further, alternate choices also will not be considered. However, if the subject / course that has already been listed for registration by Head of the Department in a semester could not be offered due to any unforeseen or unexpected reasons, then the student shall be allowed to have alternate choice - either for a new subject (subject to offering of such a subject), or for another existing subject (subject to availability of seats), which may be considered. Such alternate arrangements will be made by Head of the Department, with due notification and time-framed schedule, within the **first week** from the commencement of class-work for that semester.

4.7   Dropping of additional registered subject / course (refer 4.4) may be permitted only after obtaining prior approval from the faculty advisor / Mentor, '**within a period of 15 days**' from the commencement of that semester.

4.8   **Open electives**: Students can choose open electives, wherever offered, from the list of open electives given for their stream. However, student has to opt for at least one HS Open elective and cannot opt for an open elective subject offered by their own (parent) department, if it is already listed under any category of the subjects offered by parent department in any semester.

4.9   **Professional electives**: Students have to choose professional elective, wherever offered, from the list of professional electives given. However, students may opt for professional

elective subjects offered in the related area.

4.10   **Mandatory Courses (Non-Credit):** All mandatory courses, wherever offered, require prior registration.

5.   SUBJECTS / COURSES TO BE OFFERED

5.1   A typical Section (or Class) Strength for each Semester shall be 60. A subject / course may be offered to the students, **if only** a minimum 1/3 of students register to the course. The Maximum Strength of a Section is limited to 80 (60 + 1/3   of the Section Strength).

i)   More than **one faculty member** may offer the **same subject** (lab / practical's may be included with the corresponding theory subject in the same semester) in any semester.

ii)   However, selection of choice for students will be based on '**first come first serve** basis and CGPA criterion' (i.e. the first focus shall be on early **on-line entry** from the student for registration in that semester, and the second focus, if needed, will be on CGPA of the student).

iii)   If more entries for registration of a subject come into picture, then the concerned Head of the Department shall take necessary decision, whether or not to offer such a subject / course for **two (or multiple) sections**.

6.   ATTENDANCE REQUIREMENTS

6.1   A student shall be eligible to appear for the semester end examinations, if the student acquires a minimum 75% of attendance in aggregate (excluding the days of midterm examinations) for all the subjects / courses, excluding attendance in mandatory courses in that semester.

6.2   Condoning 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 on genuine and valid grounds, based on the student's representation with supporting evidence.

6.3   A stipulated fee shall be payable towards condoning of shortage of attendance.

6.4   Shortage of attendance below 65% in aggregate shall in **no** case be condoned.

6.5   **Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled. They will not be promoted to the next semester.** They may seek re-registration for all those subjects registered in that semester in which student was detained, by seeking re-admission into that semester as and when offered; in case if there are any professional electives and / or open electives, the same may also be re-registered, if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the **same** set of elective subjects offered under that category.

6.6   A student fulfilling the attendance requirement in the present semester shall not be eligible for readmission into the same class.

7.   ACADEMIC REQUIREMENTS

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item no. 6.

7.1   A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course, if student secures not less than 35% marks (24 out of 70 marks) in the End Semester Examination (ESE), and a minimum of 40% of marks (40 out of 100) in the sum total of the Continuous Internal Evaluation (CIE) and End Semester Examination (ESE) taken together; in terms of letter grades, this implies securing **C** grade or above in that subject / course.

7.2   A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to summer internship and project courses, if student secures not less than 40% of the

total marks in each of them. The student would be treated as failed, if student does not submit a report on his project(s), or does not make a presentation of the same before the evaluation committee as per the schedule. Student may reappear once for each of the above evaluations, when they are scheduled again; if he fails in such 'one re-appearance' evaluation also, student has to reappear for the same in the next subsequent semester, as and when it is scheduled.

7.3   Promotion Rules

7.3.1   B.Tech. (Regular):

S. No.	Promotion	Conditions to be fulfilled
1	First Semester to Second Semester	Regular course of study of First Semester
2	Second Semester to Third Semester	**(i)** Regular course of study of Second Semester Must have secured at least 50% credits (18 out of 37 credits) up to Second Semester from all the relevant regular and supplementary examinations whether the student takes those examinations or not.
3	Third Semester to Fourth Semester	Regular course of study of Third Semester
4	Fourth Semester to Fifth Semester	**(i)** Regular course of study of Fourth Semester Must have secured at least 60% credits (47 out of 79 credits) up to Fourth Semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Fifth Semester to Sixth Semester	Regular course of study of Fifth Semester
6	Sixth Semester to Seventh Semester	**(i)** Regular course of study of Sixth Semester Must have secured at least 60% credits (73 out of 123 credits) up to Sixth Semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
7	Seventh Semester to Eighth Semester	Regular course of study of Seventh Semester

7.3.2   B. Tech - Lateral Entry Scheme (LES):

S. No.	Promotion	Conditions to be fulfilled
1	Third Semester to Fourth Semester	Regular course of study of Third Semester
2	Fourth Semester to Fifth Semester	**(i)** Regular course of study of Fourth Semester Must have secured at least 50% credits (21out of 42 credits) up to Fourth Semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Fifth Semester to Sixth Semester	Regular course of study of Fifth Semester
4	Sixth Semester to Seventh Semester	**(i)** Regular course of study of Sixth Semester Must have secured at least 60% credits (51 out of 86 credits) up to Sixth Semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Seventh Semester to Eighth Semester	Regular course of study of Seventh Semester

7.4   A student has to register for all subjects covering 160 credits (123 credits in case of LES) as specified and listed (with the relevant course / subject classifications as mentioned) in the course structure, fulfill all the attendance and academic requirements for 160 credits   (123 credits in case of LES) securing a minimum of **'C'** grade or above in each subject, and 'earn all 160 credits (123 credits in case of LES) securing SGPA $\geq$ 5.0 (in each semester), and CGPA (at the end of each successive semester) $\geq$ 5.0, to successfully complete the under graduate programme.

7.5   If a student registers for '**additional subjects'** (in the parent department or other departments / branches of engineering) other than those listed subjects totaling to 160 credits (123 credits in case of LES) as specified in the course structure of parent department, the performances in those '**additional subjects**' (although evaluated and graded using the same procedure as that of the required 160 credits (123 credits in case of LES)) will not be taken into account while calculating the SGPA and CGPA. For such '**additional subjects'** registered, % of marks and letter grade alone will be indicated in the grade card as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations 6 and 7.1 to 7.4 above.

7.6   A student eligible to appear in the End Semester Examination for any subject / course, but absent from it or failed (thereby failing to secure **'C'** grade or above) may reappear for that subject / course in the supplementary examination as and when conducted. In such cases, internal marks (CIE) assessed earlier for that subject / course will be carried over, and added to the marks to be obtained in the ESE supplementary examination for evaluating performance in that subject.

7.7   A student **detained in a semester due to shortage of attendance may be re-admitted when the same semester is offered in the next academic year for fulfillment of academic requirements**. The academic regulations under which student has been readmitted shall be applicable. However, no grade allotments or SGPA / CGPA calculations will be done for the entire semester in which student has been detained.

7.8   A student detained **due to lack of credits, shall be promoted to the next academic year only after acquiring the required academic credits.** The academic regulations under which student has been readmitted shall be applicable.

8.   EVALUATION - DISTRIBUTION AND WEIGHTAGE OF MARKS

8.1   The performance of a student in each semester shall be evaluated subject-wise / course-wise (irrespective of credits assigned) with a maximum of 100 marks. These evaluations shall be based on 30 marks allotted for CIE (Continuous Internal Evaluation) and 70 marks for ESE (End Semester Examination), and a letter grade corresponding to the percentage of marks obtained shall be given.

8.2   **Evaluation of Theory Subjects / Courses**

A) **Continuous Internal Evaluation:** For each theory subject, during the semester, there shall be 2 Mid-term examinations of 30 marks each. Each Mid-term examination consists of subjective paper for 25 marks & assignment for 5 marks and the final CIE marks (for total of 30) are calculated by taking average of the two Mid-term examinations.

- The first Mid-term examination shall be conducted for the first 50% of the syllabus, and the second mid-term examination shall be conducted for the remaining 50% of the syllabus.

- The subjective paper shall be conducted for duration of 90 minutes. Each subjective paper shall contain 2 parts (Part-A and Part-B). Part-A consists of one compulsory question with five sub questions carrying two marks each. Part-B consists of three questions carrying 5 marks each (may contain sub questions) with internal choice; the student has to answer all the questions.

- First assignment should be submitted before the commencement of the first mid-term examinations, and the second assignment should be submitted before the commencement of the second mid-term examinations. The assignments shall be specified / given by the concerned subject teacher.

B) End Semester Examinations: The duration of ESE is 3 hours. The details of the question paper pattern is as follows:

- The end semester examinations will be conducted for 70 marks consisting of two parts viz. i) **Part- A** for 20 marks, ii) **Part - B** for 50 marks.

- Part-A is compulsory, which consists of one question with ten sub questions (two from each unit) carrying 02 Marks each.

- Part-B consists of five questions (numbered from 02 to 11) carrying 10 marks each. One question from each unit (may contain sub-questions) with internal choice.

8.3   Evaluation of Practical Subjects / Courses: In any semester, a student has to complete at least 08 to 10 experiments / exercises in each laboratory course and get the record certified by the Subject teacher and concerned Head of the Department to be eligible for End Semester Examination.

For practical subjects, there shall be a Continuous Internal Evaluation (CIE) during the Semester for 30 internal marks and 70 marks for End Semester Examination (ESE).

A)   Continuous Internal Evaluation (CIE): Out of the 30 marks, 15 marks are allocated for day-to-day work evaluation and the remaining 15 marks for internal practical examination. There shall be two internal practical examinations of 15 marks each conducted by the concerned laboratory teacher and the average of the two is considered.

B)   End Semester Examination (ESE): The ESE for practical subject / course shall be conducted at the end of the semester with duration of 3 hours by one internal and one external examiner appointed by the Head of the Institution as per the recommendation of the concerned Head of the Department.

8.4   Evaluation of Design / Drawing Subjects / Courses: For the subjects such as Engineering Graphics, Machine Drawing, Production drawing and any such subject, the distribution shall be 30 marks for CIE (15 marks for day-to-day work and 15 marks for Mid-Term examination) and 70 marks for ESE.

A) Continuous Internal Evaluation: There shall be two Mid-Term examinations in a Semester and the Marks for 15 can be calculated taking average of the two Mid-term examinations and these are added to the marks obtained in day to day work evaluation.

B) End Semester Examinations: The duration of ESE is 03 hours consisting of five questions carrying 14 marks each. One question from each unit (may contain sub-questions) with internal choice.

8.5   Evaluation of Summer Internship: The Summer internship (02 - 04 weeks) registered by the students in consultation with course coordinator and carried out in Industries and/or R&D Organizations immediately after their VI semester course work. The completion report will be assessed in VII semester for 'Satisfactory' or 'Unsatisfactory' by a committee consisting of Head of the Department, supervisor and a senior faculty member of the department.

8.6   Evaluation of Project work: Student(s) shall start the Project Work during the VII Semester (IV-B.Tech.–I–Semester) as per the instructions of the Project Guide / Project Supervisor

assigned by the Head of the Department. The topics for Summer Internship, Project Stage – I and Technical seminar shall be different from one another.

a) The Project Work shall be carried out in two stages: Project-I (Stage – I) during VII Semester (IV-B.Tech.–I–Semester), and Project-II (Stage – II) during VIII   Semester (IV-B.Tech.–II–Semester), and the student has to prepare two independent Project Work Reports – *one each during each stage.*   First Report shall include the Project Work carried out under Stage – I, and the Second Report (Final Report) shall include the Project Work carried out under Stage – I and Stage – II put together. Stage – I and Stage – II of the Project Work shall be evaluated for 100 marks each.

b) Out of the total 100 marks allotted for each stage of the Project Work, 30 marks shall be for the Continuous Internal Evaluation(CIE), and 70 marks shall be for the End Semester Viva-voce Examination (ESE). The marks earned under CIE for both the stages of the Project shall be awarded by the Project Guide / Supervisor (based on the continuous evaluation of student's performance during the two Project Work stages); and the marks earned under ESE shall be awarded by the Project Viva-voce Committee / Board (based on the work carried out, report prepared and the presentation made by the student at the time of Viva-voce Examination).

c) For the Project Stage - I, the Viva-voce shall be conducted at the end of the VII Semester, before the commencement of the End semester Examinations, by the Project Evaluation Committee comprising of the Head of the Department or One Senior Faculty member and Supervisor and the Project Stage – II Viva-voce   shall be conducted by the Committee comprising of an External Examiner appointed by the Head of the Institution, Head of the Department and Project Supervisor at the end of the VIII Semester, before the commencement of the End Semester Examinations.

d) If a student does not appear (or fails) for any of the two Viva-voce examinations at the scheduled times as specified above, he may be permitted to reappear for Project Stage - I and/or Project Stage - II Viva-voce examinations, as and when they are scheduled again in that semester; if he fails in such 'one reappearance' evaluation also, he has to reappear for the same in the next subsequent semester(s), as and when they are scheduled, as supplementary candidate.

8.7   **Evaluation of Technical Seminar:** The student has to enroll and get approval for technical seminar on a specialized topic from the concerned advisor / Mentor in the beginning of VII semester (IV year I semester). The student should collect the information on a specialized topic, prepare a technical report, give seminar presentation on the topic and submit it to the department as notified by the concerned Head of the Department. It shall be evaluated by the departmental evaluation committee consisting of Head of the Department, seminar supervisor and two senior faculty members. The seminar report and the seminar presentation shall be evaluated for 100 marks. There shall be no End Semester Examination for the seminar.

8.8   **Evaluation of Mandatory Non-Credit Courses:** There shall be only CIE for all mandatory (non-credit) courses, instead of marks or letter grade. '**Satisfactory'** or "**Unsatisfactory'** shall be indicated and this will not be counted for the computation of SGPA / CGPA. The student has to maintain a minimum of 65% attendance and secure not less than 40% in the CIE and then only the student is declared as **pass** and will be qualified for the award of the degree.

8.9   **MOOCs Courses through SWAYAM Portal:** The approved list of SWAYAM courses shall be notified and made available at the beginning of the semester. The students are given option to choose Professional Electives / Open Electives in the curriculum offered by the institute or from the notified list. The maximum number of transferable credits through SWAYAM Courses are capped at 18 (06 Courses).

9. GRADING PROCEDURE

9.1 Grades will be awarded to indicate the performance of the student in each theory subject, lab / practical's, design/drawing practice, Summer Internship, Technical Seminar and Project-I & Project-II based on the percentage of marks obtained in Continuous Internal Evaluation plus End Semester Examination, both taken together, as specified in item 8 above, a corresponding letter grade shall be given.

9.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following letter grades (UGC Guidelines) and corresponding percentage of marks shall be followed.

% of Marks Secured (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
90% and above ($\geq$ 90% , $\leq$ 100%)	O (Outstanding)	10
Below 90% but not less than 80% ($\geq$ 80% , < 90%)	A^+ (Excellent)	9
Below 80% but not less than 70% ($\geq$ 70% , < 80%)	A (Very Good)	8
Below 70% but not less than 60% ($\geq$ 60% , < 70%)	B^+ (Good)	7
Below 60% but not less than 50% ($\geq$ 50% , < 60%)	B (above Average)	6
Below 50% but not less than 40% ($\geq$ 40% , < 50%)	C (Average)	5
Below 40% (< 40%)	F (Fail)	0
Absent	AB	0

9.3 A student obtaining **F** grade or **AB** grade in any subject shall be considered **'failed'** in that subject and will be required to reappear in '**Supplementary Exam**' in the End Semester Examination (ESE), as and when offered. In such cases, Continuous Internal Examination (CIE) in those subject(s) will remain same as those obtained earlier.

9.4 A letter grade does not imply any specific % of marks.

9.5 In general, a student shall not be permitted to repeat any subject/course (s) only for the sake of '**grade improvement**' or 'SGPA / CGPA improvement'. However, student has to repeat all the subjects / courses pertaining to that semester, if detained.

9.6 A student earns grade point (GP) in each subject / course, on the basis of the letter grade obtained in that subject/course (excluding mandatory non-credit courses). Then the corresponding '**credit points**' (CP) are computed by multiplying the grade point with credits for that particular subject/course.

Credit Points (CP) = Grade Point (GP) x Credits

9.7 The student passes the subject / course only when GP $\geq$ 5 (**C** grade or above).

9.8 The Semester Grade Point Average (SGPA) is calculated by dividing the sum of credit points (ΣCP) secured from all subjects / courses registered in a semester, by the total number of credits registered during that semester. SGPA is rounded off to **two** decimal places. SGPA is thus computed as

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

Where C_i is the number of credits of the ith course and G_i is the grade point scored by the student in the ith course.

9.9 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student in all semesters considered for registration. The CGPA is the ratio of the total credit points secured by a student in **all** registered courses in **all** Semesters, and the total number of credits registered in **all** the semesters. CGPA is rounded off to **two** decimal places. CGPA is thus computed from the I year, I semester onwards, at the end of each semester, as per the formula:

$$\text{CGPA} = \sum (C_j \times S_i) / \sum C_j$$

where S_i is the SGPA of the jth semester and C_j is the total number of credits in that semester.

Illustration of calculation of SGPA					Illustration of calculation of CGPA			
Course /Subject	Credits	Letter Grade	Grade Points	Credit Points	Sem.	Credits	SGPA	Credits x SGPA
Course 1	4	A	8	4 x 8 = 32	Sem I	19	7	19 x 7= 133
Course 2	3	O	10	3 x 10 = 30	Sem II	19	6	19 x 6= 114
Course 3	3	C	5	3 x 5 = 15	Sem III	21	6.5	21 x 6.5 =136.5
Course 4	3	B	6	3 x 6 = 18	Sem IV	21	6	21 x 6 = 126
Course 5	1.5	A$^+$	9	1.5x9 = 13.5	Sem V	21	7.5	21 x 7.5 =180
Course 6	1.5	A	8	1.5x8 = 12	Sem VI	21	8	21 x 8 = 157.5
Course 7	1.5	B$^+$	7	1.5x7 = 10.5	Sem VII	21	8.5	21 x 8.5 =178.5
Course 8	1.5	A$^+$	9	1.5x9 = 13.5	Sem VIII	17	8	17 x 8 = 136
Total	19		62	144.5	Total	160		1161.5
SGPA = 144.5/19 = 7.60					CGPA = 1161.5/160 = 7.26			

9.10   For merit ranking or comparison purposes or any other listing, **only** the '**rounded off**' values of the CGPAs will be used.

9.11   For calculations listed in Item 9.6–9.9, performance in failed subjects/courses (securing **F** grade) will also be taken into account, and the credits of such subjects/courses will also be included in the multiplications and summations. However, mandatory courses will not be taken into consideration.

10   PASSING STANDARDS

10.1   A student shall be declared '**successful**' or '**passed**' in a semester, if student secures a GP $\geq$ 5 ('C' grade or above) in every subject/course in that semester (i.e. when student gets an SGPA $\geq$ 5.00 at the end of that particular semester); and a student shall be declared '**successful**' or '**passed**' in the entire under graduate programme, only when a student gets a CGPA $\geq$ 5.00 for the award of the degree as required.

10.2   After the completion of semester, a grade card or grade sheet (or transcript) shall be issued to all the registered students of that semester, indicating the letter grades and credits earned. It will show the details of the courses registered (course code, title, no. of credits, grade earned etc.), credits earned, SGPA, and CGPA.

11   DECLARATION OF RESULTS

11.1   Computation of SGPA and CGPA are done using the procedure listed in 9.6 – 9.9.

11.2   For Final percentage of marks equivalent to the computed final CGPA, the following formula may be used:

$$\text{Percentage of Marks} = (\text{final CGPA} – 0.5) \times 10$$

12   AWARD OF DEGREE

12.1   After a student has satisfied the requirement prescribed for the completion of the program and is eligible for the award of B. Tech. degree the student shall be placed in one of the following four classes based on CGPA:

Class Awarded	Grade to be Secured	Remarks
First Class with Distinction	≥ 8 CGPA	From the aggregate marks secured from 160 Credits for Regular Students and 123 Credits for Lateral Entry Students.
First Class	≥ 6.5 to < 8 CGPA	
Second Class	≥ 5.5 to < 6.5 CGPA	
Pass Class	≥ 5.00 to < 5.5 CGPA	
FAIL	CGPA < 5	

12.2   First class with distinction will be awarded to those students who clear all the subjects during his / her regular course of study by fulfilling the following conditions:

(i) Should have passed all the subjects/courses within the first 4 academic years (or 8 sequential semesters) for B.Tech. (Regular) and first 3 academic years (or 6 sequential semesters) for B.Tech. (LES) from the date of commencement of first year first semester for B.Tech. (Regular) and II year I semester for B.Tech. (LES).

(ii) Should have secured a CGPA $\geq$ 8.00, at the end of each of the 8 sequential semesters (6 sequential semesters for LES), starting from I year I semester (starting from II year I semester for LES) onwards.

(iii) Should not have been detained or prevented from writing the end semester examinations in any semester due to shortage of attendance or any other reason, shall be placed in '**first class with distinction'**.

A Student not fulfilling any of the above condition and having final CGPA $\geq$ 8.00 shall be placed in "First Class".

12.3   **B. Tech (Honors):** The student who accrue 20 credits from NPTEL in addition to their regular course work, will be awarded with Honors Degree.

12.4   **Award of Medals:** Students fulfilling the conditions listed under item 12.2 alone will be eligible for award of '**College Ranks**' and '**Medals**'.

12.5   **Graduation Day:** The College shall have its own Annual Graduation Day for the award of Degrees issued by the University.

12.6   **Transcripts:** After successful completion of prerequisite credits for the award of degree a transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued if required after the payment of requisite fee and also as per norms in vogue.

13   WITHHOLDING OF RESULTS

If the student has not paid the fees to the Institute at any stage, or has dues pending due to any reason whatsoever, or if any case of indiscipline is pending, the result of the student may be withheld, and the student will not be allowed to go into the next higher semester. The award or issue of the degree may also be withheld in such cases.

14   SUPPLEMENTARY EXAMINATIONS

Supplementary examinations for odd semester subjects will be conducted along with even semester regular examinations and vice versa.

15.   TRANSITORY REGULATIONS

a) A student who has discontinued for any reason, or has been detained for want of attendance or lack of required credits as specified, or who has failed after having undergone the degree programme, may be considered eligible for readmission to the same subjects / courses (or equivalent subjects/ courses, as the case may be), and same professional electives / open electives (or from set / category of electives or equivalents suggested, as the case may be) as and when they are offered (within the time-frame of 8 years from the date of commencement of student's first year first semester).

b) A student who has failed in any subject under any regulation has to pass those subjects in the respective regulations.

c) The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including R19 Regulations. The performance evaluation of the student will be done as per the rules and regulations applicable at the time of admission(s) regarding award of grade and/or class as the case may be.

d) If a student readmitted to R19 Regulations, has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in R19 Regulations will be substituted by another subject to be suggested by the CMRTC Academic Council.

e) **Promotion Rule:** Where the credits allotted to a semester/year under the regulations studied in are different from that under R19 regulations for the corresponding semester/year, the promotion rules of R19 vide section 7.3 shall be applied after normalization. Normalization is done by scaling down or up the number of credits of a semester/year under the previous regulations to equal the number of credits of the corresponding semester/year under R19 regulations and revising the secured credits also in the same proportion.

16 STUDENT TRANSFERS

There shall be no transfers from other colleges / streams.

17 RULES OF DISCIPLINE

17.1 Any attempt by any student to influence the teachers, examiners, faculty members and staff of Controller of Examination office for undue favours in the exams, and bribing them either for marks or attendance will be treated as malpractice case and the student can be debarred from the college.

17.2 When the performance of the student in any subject(s) is cancelled as a punishment for indiscipline, student is awarded zero marks in that subject(s).

17.3 When the student's answer book is confiscated for any kind of attempted or suspected malpractice the decision of the Malpractice Prevention Committee is final.

18. MALPRACTICE

18.1 Malpractice Prevention Committee: The committee shall examine the student's malpractice and indiscipline cases occurred, while conducting the examinations and recommend appropriate punishment to the Academic Council after taking explanation from the student and concerned invigilator as per the malpractice rules mentioned below. The committee consists of

a) Controller of Examinations - Chairman
b) Addl. Controller of Examinations.- Convener
c) Subject Expert - Member
d) Head of the Department of which the student belongs to - Member
e) The Invigilator concerned - Member

18.2 Malpractice Rules: Disciplinary Action for Improper Conduct in Examinations

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

	during or after the examination.	be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	Refuses to obey the orders of the 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 addl. 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 addl. 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 subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that

R 19 B. Tech Academic Regulations

		subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Chief Superintendent for further action to award suitable punishment.	

19. SCOPE

i) Wherever the words 'he, him, his' occur in the regulations, they shall include 'she, her'.

ii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.

iii) The above mentioned rules and regulations are applicable in general to both B.Tech. (Regular) and B.Tech. (LES), unless and otherwise specific.

iv) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the College Academic Committee is final.

20. REVISION AND AMENDMENTS TO REGULATIONS

The Academic Council may revise or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made shall be applicable to all students with effect from the dates notified by the Academic Council.

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CMR Technical Campus   **Page 18**

CMR TECHNICAL CAMPUS
UGC AUTONOMOUS
B.Tech. I Year Syllabus (w. e. f. A.Y. 2019-20)

Common for Civil &Mechanical Engineering

I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	19MA101BS	Mathematics - I	3	1	0	4
2	19PH102BS	Engineering Physics	3	1	0	4
3	19CS103ES	Programming for Problem Solving	3	1	0	4
4	19ME104ES	Engineering Graphics	1	0	4	3
5	19PH105BS	Engineering Physics Lab	0	0	3	1.5
6	19CS106ES	Programming for Problem Solving Lab	0	0	3	1.5
7	19MC109ES	Environmental Science	3	0	0	0
		Induction Programme				
		Total Credits	**13**	**3**	**10**	**18**

II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	19MA201BS	Mathematics - II	3	1	0	4
2	19CH202BS	Chemistry	3	1	0	4
3	19ME203ES	Engineering Mechanics	3	1	0	4
4	19ME204ES	Engineering Workshop	1	0	3	2.5
5	19EN205HS	English	2	0	0	2
6	19CH206BS	Engineering Chemistry Lab	0	0	3	1.5
7	19EN207HS	English Language and Communication Skills Lab	0	0	2	1
		Total Credits	**12**	**3**	**8**	**19**

CMR TECHNICAL CAMPUS
UGC AUTONOMOUS
B.Tech. II Year Syllabus (w. e. f. A.Y. 2019-20)

Mechanical Engineering

III SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	19MA301BS	Probability and Statistics & Complex Variables	3	1	0	4
2	19ME302PC	Mechanics of Solids	3	1	0	4
3	19ME303PC	Material Science and Metallurgy	3	0	0	3
4	19ME304PC	Production Technology	3	0	0	3
5	19ME305PC	Thermodynamics	3	1	0	4
6	19ME306PC	Production Technology Lab	0	0	2	1
7	19ME307PC	Machine Drawing Practice	0	0	2	1
8	19ME308PC	Material Science and Mechanics of Solids Lab	0	0	2	1
9	19MC309CI	Constitution of India	3	0	0	0
		Total Credits	**18**	**3**	**6**	**21**

IV SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	19EE401ES	Basic Electrical and Electronics Engineering	3	0	0	3
2	19ME402PC	Kinematics of Machinery	3	1	0	4
3	19ME403PC	Thermal Engineering - I	3	1	0	4
4	19ME404PC	Fluid Mechanics and Hydraulic Machines	3	1	0	4
5	19ME405PC	Instrumentation and Control Systems	3	0	0	3
6	19EE409ES	Basic Electrical and Electronics Engineering Lab	0	0	2	1
7	19ME407PC	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1
8	19ME408PC	Instrumentation and Control Systems Lab	0	0	2	1
10	19MC409GS	Gender Sensitization Lab	0	0	2	0
		Total Credits	**15**	**3**	**8**	**21**

*MC – Satisfactory/Unsatisfactory

CMR TECHNICAL CAMPUS
UGC AUTONOMOUS
B. Tech. III Year Syllabus (w.e.f A.Y.2021-22)
Mechanical Engineering

V SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	19ME501PC	Dynamics of Machinery	3	1	0	4
2	19ME502PC	Design of Machine Members-I	3	0	0	3
3	19ME503PC	Metrology & Machine Tools	3	0	0	3
4	19MB504HS	Business Economics & Financial Analysis	3	0	0	3
5	19ME505PC	Thermal Engineering-II	3	0	0	3
6	19ME506PC	Operations Research	3	0	0	3
7	19ME507PC	Thermal Engineering Lab	0	0	2	1
8	19ME508PC	Metrology & Machine Tools Lab	0	0	2	1
9	19ME509PC	Kinematics & Dynamics Lab	0	0	2	1
10	19MC510IP	Intellectual Property Rights	3	0	0	0
		Total Credits	**21**	**1**	**6**	**22**

VI SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	19ME601PC	Design of Machine Members-II	3	0	0	3
2	19ME602PC	Heat Transfer	3	1	0	4
3	19ME603PC	CAD & CAM	3	0	0	3
4		**Professional Elective - I**	3	0	0	3
5		**Open Elective - I**	3	0	0	3
6	19ME604PC	Finite Element Methods	3	0	0	3
7	19ME605PC	Heat Transfer Lab	0	0	2	1
8	19ME606PC	CAD & CAM Lab	0	0	2	1
9	19EN607HS	Advanced Communication Skills lab	0	0	2	1
10	*19MC608ES	Environmental Science	3	0	0	0
		Total Credits	**21**	**1**	**6**	**22**

*MC - Environmental Science – Should be Registered by Lateral Entry Students Only.
Professional Elective - I

19ME611PE	UNCONVENTIONAL MACHINING PROCESSES
19ME612PE	MACHINE TOOL DESIGN
19ME613PE	PRODUCTION PLANNING AND CONTROL

CMR TECHNICAL CAMPUS
UGC AUTONOMOUS
B. Tech. IV Year Syllabus (w. e. f. A.Y.2022-23)

Mechanical Engineering

VII SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	19ME701PC	Refrigeration & Air Conditioning	3	0	0	3
2		Professional Elective – II	3	0	0	3
3		Professional Elective – III	3	0	0	3
4		Professional Elective – IV	3	0	0	3
5		Open Elective - II	3	0	0	3
6	19ME702PC	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
7	19ME703PC	Seminar	0	0	2	1
8	19ME704PC	Project Stage - I	0	0	6	3
		Total Credits	**15**	**0**	**08**	**21**

VIII SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Professional Elective – V	3	0	0	3
2		Professional Elective – VI	3	0	0	3
3		Open Elective - III	3	0	0	3
4	19ME801PC	Project Stage - II	0	0	14	7
		Total Credits	**9**	**0**	**14**	**16**

*MC – Satisfactory/Unsatisfactory

Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

Professional Elective – II

19ME721PC	Additive Manufacturing
19ME722PC	Automation in Manufacturing
19ME723PC	MEMS

Professional Elective – III

19ME731PC	Power Plant Engineering
19ME732PC	Automobile Engineering
19ME733PC	Renewable Energy Sources

Professional Elective – IV

19ME741PC	Computational Fluid Dynamics
19ME742PC	Turbo Machinery
19ME743PC	Fluid Power Systems

Professional Elective – V

19ME851PC	Industrial Robotics
19ME852PC	Mechanical Vibrations
19ME853PC	Composite Materials

Professional Elective – VI

19ME861PC	Industrial Management
19ME862PC	Production and Operations Management
19ME863PC	Tribology

19MA101BS: MATHEMATICS - I

B.Tech. I SEM

L	T	P	C
3	1	0	4

Course Objectives: To learn
- Types of matrices and theirproperties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linearequations.
- Concept of Eigen values and eigenvectors and to reduce the quadratic form to canonical form
- Concept ofSequence.
- Concept of nature of theseries.
- Geometrical approach to the mean value theorems and their application to the mathematicalproblems
- Evaluation of surface areas and volumes of revolutions ofcurves.
- Evaluation of improper integrals using Beta and Gammafunctions.
- Partial differentiation, concept of totalderivative
- Finding maxima and minima of function of two and threevariables.

Course Outcomes: After learning the contents of this paper the student must be able to
- Write the matrix representation of a set of linear equations and to analyse the solution of the system ofequations
- Find the Eigen values and Eigenvectors
- Reduce the quadratic form to canonical form using orthogonaltransformations.
- Analyse the nature of sequence andseries.
- Solve the applications on the mean valuetheorems.
- Evaluate the improper integrals using Beta and Gammafunctions
- Find the extreme values of functions of two variables with/ withoutconstraints.

UNIT-I: Matrices
Matrices: Types of Matrices, Symmetric; Hermitian; Skew-symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices; rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method; System of linear equations; solving system of Homogeneous and Non-Homogeneous equations. Gauss elimination method; Gauss Seidel Iteration Method.

UNIT-II: Eigen values and Eigen vectors
Linear Transformation and Orthogonal Transformation: Eigen values and Eigenvectors andtheir properties: Diagonalizationof a matrix; Cayley-Hamilton Theorem (without proof); finding inverse and power of a matrix by Cayley-Hamilton Theorem; Quadratic forms and Nature of the Quadratic Forms; Reduction of Quadratic form to canonical forms by OrthogonalTransformation

UNIT-III: Sequences &Series
Sequence: Definition of a Sequence, limit; Convergent, Divergent and Oscillatory sequences. Series: Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test;

logarithmic test. Alternating series: Leibnitz test; Alternating Convergent series: Absolute and ConditionallyConvergence.

UNIT-IV: Calculus

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem. Taylor's Series. Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Definition of Improper Integral: Beta and Gamma functions and their applications.

UNIT-V: Multivariable calculu2s (Partial Differentiation and applications)

Definitions of Limit and continuity.Partial Differentiation; Euler's Theorem; Total derivative; Jacobian; Functional dependence & independence, Maxima and minima of functions of two variables and three variables using method of Lagrangemultipliers.

TEXTBOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition,Pearson, Reprint,2002.

REFERENCES:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint,2010.

19PH102BS: Engineering Physics

B.Tech. I SEM

L	T	P	C
3	1	0	4

Course Objectives:

- The course aims at making students to understand the basic concepts of Principles of Physics in a broader sense with a view to lay foundation for the various engineering courses.
- Students will be able to demonstrate competency and understanding of the concepts found in Mechanics, Harmonic Oscillations, Waves in one dimension, wave Optics, Lasers, Fiber Optics and a broad base of knowledge inphysics.
- The main purpose of this course is to equip engineering undergraduates with an understanding of the scientific method, so that they may use the training beneficially in their higherpursuits.
- Today the need is to stress principles rather than specific procedures, to select areas of contemporary interest rather than of past interest, and to condition the student to the atmosphere of change he will encounter during hiscarrier.

Course outcomes: Upon graduation, the graduates will have:

- The knowledge of Physics relevant to engineering is critical for converting ideas into technology.
- An understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations andimprovements.
- In the present course, the students can gain knowledge on the mechanism of physical bodies upon the action of forces on them, the generation, transmission and the detection of the waves, Optical Phenomena like Interference, diffraction, the principles of lasers and FibreOptics.
- Various chapters establish a strong foundation on the different kinds of characters of several materials and pave a way for them to use in at various technical and engineering applications.

UNIT-I: Introduction to Mechanics

Transformation of scalars and vectors under Rotation transformation, Forces in Nature, Newton's laws and its completeness in describing particle motion, Form invariance of Newton's second law, Solving Newton's equations of motion in polar coordinates, Problems including constraints and friction, Extension to cylindrical and spherical coordinates.

UNIT-II: Harmonic Oscillations

Mechanical and electrical simple harmonic oscillators, Complex number notation and phasor representation of simple harmonic motion, Damped harmonic oscillator: heavy, critical and light damping, Energy decay in a damped harmonic oscillator, Quality factor, Mechanicaland electrical oscillators, Mechanical and electrical impedance, Steady state motion of forced damped harmonic oscillator, Power observed by oscillator.

UNIT-III: Waves in one dimension

Transverse wave on a string , The wave equation on a string , Harmonic waves, Reflection and transmission of waves at a boundary, Impedance matching , Standing waves and their Eigen frequencies , Longitudinal waves and the wave equations for them, Acoustic waves and speed of sound, Standing soundwaves.

UNIT-IV: Wave Optics

Huygen's principle, Superposition of waves and interference of light by wave front splitting and amplitude splitting, Young's double slitexperiment, Newton's rings, Michelson's interferometer, Mach-Zehnder interferometer, Frunhofer diffraction from a single slit and circular aperture, Diffraction grating- resolving power.

UNIT-V: Lasers and Fibre Optics

Lasers: Introduction to interaction of radiation with matter, Coherence, Principle and working of Laser, Population inversion, Pumping, Types of Lasers: Ruby laser, Carbon dioxide (CO_2) laser, He-Ne laser, Applications of laser. Fibre Optics: Introduction, Optical fibre as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Step and Graded index fibres, Losses associated with optical fibres, Applications of optical fibres.

TEXT BOOKS:
1. Engineering Mechanics, 2nd ed.- MK Harbola, CengageLearning
2. I. G. Main, "Vibrations and waves in physics', 3^{rd}Edn, Cambridge University Press, 2018.
3. AjoyGhatak, " Optics", McGraw Hill Education,2012

REFERENCES:
1. H. J. Pain, "The physics of vibrations and waves", Wiley,2006
2. O. Svelto, "Principles ofLasers"
3. "Introduction to Mechanics", M.K.Verma, UniversitiesPress

19CS103ES/CS203ES: Programming For Problem Solving

	L	**T**	**P**	**C**
B.Tech. I SEM	**3**	**1**	**0**	**4**

Course Objectives:
- To learn the fundamentals ofcomputers.
- To understand the various steps in programdevelopment.
- To learn the syntax and semantics of C programminglanguage.
- To learn the usage of structured programming approach in solving problems.

Course Outcomes: The student will learn
- To write algorithms and to draw flowcharts for solvingproblems.
- To convert the algorithms/flowcharts to Cprograms.
- To code and test a given logic in C programminglanguage.
- To decompose a problem into functions and to develop modular reusablecode.
- To use arrays, pointers, strings and structures to write Cprograms.
- Searching and sortingproblems.

UNIT - 1: Introduction to Programming
Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers, creating, compiling and executing a program etc., Number systemsIntroduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm,Flowchart/Pseudo code with examples,Program design and structured programmingIntroduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code , Operators, expressions and precedence, Expression evaluation, Storage classes (auto, extern, static and register), type conversion, The main method and command lineargumentsBitwise operations: Bitwise AND, OR, XOR and NOT operatorsConditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do- while loopsI/O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout andstderr.Command line arguments

UNIT - II: Arrays, Strings, Structures and Pointers:
Arrays: one and two dimensional arrays, creating, accessing and manipulating elements of arrays
Strings: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of stringsStructures: Defining structures, initializing structures, unions, Array of structures
Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self referential structures in linked list (no implementation)Enumeration data type

UNIT - III: Preprocessor and File handling in C:
Preprocessor: Commonly used Preprocessor commands like include, define, undef, if, ifdef, ifndef
Files: Text and Binary files, Creating and Reading and writing text and binary files, Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions.

UNIT - IV: Function and Dynamic Memory Allocation:

Functions: Designing structured programs, Declaring a function, Signature of a function, Parameters and return type of a function, passing parameters to functions, call by value, Passing arrays to functions, passing pointers to functions, idea of call by reference, Some C standard functions and libraries

Recursion: Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions

Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different data types

UNIT - V: Introduction to Algorithms:

Algorithms for finding roots of quadratic equations, finding minimum and maximum numbers of a given set, finding if a number is prime number, etc.

Basic searching in an array of elements (linear and binary search techniques),

Basic algorithms to sort array of elements (Bubble, Insertion and Selection sort algorithms),

Basic concept of order of complexity through the example programs

TEXT BOOKS:
1. Byron Gottfried, Schaum'sOutline of Programming with C,McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rdEdition)

REFERENCE BOOKS:
1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language,Prentice Hall ofIndia
2. R.G. Dromey, How to solve it by Computer, Pearson (16thImpression)
3. Programming in C, Stephen G. Kochan, Fourth Edition, PearsonEducation.
4. Herbert Schildt, C: The Complete Reference, Mc GrawHill, 4thEdition

19ME104ES/ME204ES: Engineering Graphics

B.Tech. I SEM

L	T	P	C
1	0	4	3

Pre-requisites: Nil

Course objectives:
- To provide basic concepts in engineeringdrawing.
- To impart knowledge about standard principles of orthographic projection ofobjects.
- To draw sectional views and pictorial views ofsolids.

Course Outcomes: At the end of the course, the student will be able to:
- Preparing working drawings to communicate the ideas andinformation.
- Read, understand and interpret engineeringdrawings.

UNIT – I

Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Scales – Plain & Diagonal.

UNIT- II

Orthographic Projections: Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures.—Auxiliary Planes.

UNIT – III

Projections of Regular Solids – Auxiliary Views - Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere

UNIT – IV

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone, Intersection of Solids: Intersection of – Prism vs Prism- Cylinder Vs Cylinder

UNIT – V

Isometric Projections: Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions.

Introduction to CAD: (For Internal Evaluation Weightage only):

Introduction to CAD Software Package Commands.- Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package

TEXTBOOKS:
1. Engineering Drawing N.D. Bhatt /Charotar
2. Engineering Drawing / N. S. Parthasarathy and Vela Murali/ Oxford

REFERENCE BOOKS:
1. Engineering Drawing / Basant Agrawal and McAgrawal/ McGrawHill
2. Engineering Drawing/ M. B. Shah, B.C. Rane /Pearson.
3. Computer Aided Engineering Drawing – K Balaveera Reddy et al – CBSPublishers

19PH105BS: Engineering Physics Lab

B.Tech. I SEM

L	T	P	C
0	0	3	1.5

List of Experiments:

1. Melde'sexperiment:To determine the frequency of a vibrating bar or turning fork using Melde's arrangement.

2. Torsionalpendulum:
    To determine the rigidity modulus of the material of the given wire using torsional pendulum.

3. Newton'srings:
    To determine the radius of curvature of the lens by forming Newton's rings.

4. Diffractiongrating:
    To determine the number of lines per inch of the grating.

5. Dispersive power:
    To determine the dispersive power of prism by using spectrometer.

6. CoupledOscillator:
    To determine the spring constant by single coupled oscillator.

7. LCRCircuit:
    To determine quality factor and resonant frequency of LCR circuit.

8. LASER:
    To study the characteristics of LASER sources.

9. Opticalfibre:
    To determine the bending losses of Optical fibres.

10. Opticalfibre:
    To determine the Numerical aperture of a given fibre.

    Note: Minimum 8 experiments are to be performed

19CS106ES/CS206ES: Programming For Problem Solving Lab

B.Tech. I SEM

L	T	P	C
0	0	3	1.5

[Note:The programs may be executed using any available Open Source/ Freely available IDE
Some of the Tools available are:
CodeLite: https://codelite.org/ Code::Blocks: http://www.codeblocks.org/
DevCpp :http://www.bloodshed.net/devcpp.html Eclipse: http://www.eclipse.org
This list is not exhaustive and is NOT in any order of preference]

Course Objectives: The students will learn the following:
- To work with an IDE to create, edit, compile, run and debugprograms
- To analyze the various steps in program development.
- To develop programs to solve basic problems by understanding basic concepts in C like operators, control statementsetc.
- To develop modular, reusable and readable C Programs using the concepts like functions, arraysetc.
- To Write programs using the Dynamic Memory Allocationconcept.
- To create, read from and write to text and binaryfiles

Course Outcomes: The candidate is expected to be able to:
- formulate the algorithms for simpleproblems
- translate given algorithms to a working and correctprogram
- correct syntax errors as reported by thecompilers
- identify and correct logical errors encountered duringexecution
- represent and manipulate data with arrays, strings andstructures
- use pointers of differenttypes
- create, read and write to and from simple text and binaryfiles
- modularize the code with functions so that they can bereused

Practice sessions:
a) Write a simple program that prints the results of all the operators available in C (including pre/ post increment , bitwise and/or/not , etc.). Read required operand values from standardinput.
b) Write a simple program that converts one given data type to another using auto conversion and casting. Take the values form standardinput.

Simple numeric problems:
a) Write a program for fiend the max and min from the threenumbers.
b) Write the program for the simple, compoundinterest.

c) Write program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class, >= 70% = Distinction. Read percentage from standardinput.
d) Write a program that prints a multiplication table for a given number and the number of

e) rowsin the table. For example, for a number 5 and rows = 3, the output shouldbe:

f) 5 x 1 = 5

g) 5 x 2 =10

h) 5 x 3 =15

i) Write a program that shows the binary equivalent of a given positive number between 0 to255.

Expression Evaluation:

a) A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8m/s^2)).

b) Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use SwitchStatement)

c) Write a program that finds if a given number is a primenumber

d) Write a C program to find the sum of individual digits of a positive integer and test given number ispalindrome.

e) 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 C program to generate the first n terms of thesequence.

f) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

g) Write a C program to find the roots of a Quadraticequation.
   • Write a C program to calculate the following, where x is a fractional value. i. 1-x/2+x^2/4 x^3/6

h) Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+x^3+   +x^n. For example: if n is 3 and x is5, then the program computes 1+5+25+125.

Arrays and Pointers and Functions:

• Write a C program to find the minimum, maximum and average in an array of integers.

• Write a functions to compute mean, variance, Standard Deviation, sorting of n elements in single dimensionarray.

• Write a C program that uses functions to perform thefollowing:

• Addition of TwoMatrices

• Multiplication of TwoMatrices

• Transpose of a matrix with memory dynamically allocated for the new matrix as row and column counts may not besame.

• Write C programs that use both recursive and non-recursivefunctions

• To find the factorial of a giveninteger.

• To find the GCD (greatest common divisor) of two giveninteger.

• To findx^n

• Write a program for reading elements using pointer into array and display the values usingarray.

• Write a program for display values reverse order from array usingpointer.

• Write a program through pointer variable to sum of n elements fromarray.

Files:

a) Write a C program to display the contents of a file to standard outputdevice.

b) Write a C program which copies one file to another, replacing all lowercase characters

c) with their uppercaseequivalents.

d) Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command linearguments.

e) Write a C program that does thefollowing:

f) It should first create a binary file and store 10 integers, where the file name and 10 values are given in the command line. (hint: convert the strings using atoi function) Now the program asks for an index and a value from the user and the value at that index should be changed to the new value in the file. (hint: use fseek function)The program should then read all 10 values and print them back.

g) Write a C program to merge two files into a third file (i.e., the contents of the firs tfile followed by those of the second are put in the thirdfile).

Strings:

a) Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.

b) Write a C program that converts a number ranging from 1 to 50 to Romanequivalent

c) Write a C program that uses functions to perform the followingoperations:

d) To insert a sub-string in to a given main string from a givenposition.

e) To delete n Characters from a given position in a givenstring.

f) Write a C program to determine if the given string is a palindrome or not (Spelled same in both directions with or without a meaning like madam, civic, noon, abcba, etc.)

g) Write a C program that displays the position of a character chin the string S or – 1 if S doesn't containch.

h) Write a C program to count the lines, words and characters in a giventext.

Miscellaneous:

a) Write a menu driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum, or average. The menu and all thechoicesare to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.

b) Write a C program to construct a pyramid of numbers asfollows:

```
1              *          1          1          *
1 2            * *        2 3        2 2        * *
1 2 3          * * *      4 5 6      3 3 3      * * *
                                     4 4 4 4    * *
                                                *
```

Sorting and Searching:

a) Write a C program that uses non recursive function to search for a Key value in a givenlist of integers using linear searchmethod.

b) Write a C program that uses non recursive function to search for a Key value in a givensorted list of integers using binary searchmethod.

c) Write a C program that implements the Bubble sort method to sort a given listofintegers in ascendingorder.

d) Write a C program that sorts the given array of integers using selection sort in descendingorder

e) Write a C program that sorts the given array of integers using insertion sort in

ascendingorder
f) Write a C program that sorts a given array ofnames

Suggested Reference Books for solving the problems:

i) Byron Gottfried, Schaum'sOutline of Programming with C,McGraw-Hill

ii) B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rdEdition)

iii) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language,Prentice

iv) Hall ofIndia

v) R.G. Dromey, How to solve it by Computer, Pearson (16thImpression)

vi) Programming in C, Stephen G. Kochan, Fourth Edition, PearsonEducation.

vii) Herbert Schildt, C: The Complete Reference, Mc GrawHill, 4thEdition

19MC109ES: Environmental Science

B.Tech. I SEM

	L	**T**	**P**	**C**
	3	**0**	**0**	**0**

Course Objectives:
- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understanding the environmental policies and regulations

Course Outcomes:
- Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainabledevelopment

UNIT-I
Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT-II
Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, casestudies.

UNIT-III
Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversityact.

UNIT-IV
Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics

of e-Waste and its management.

Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary.Overview of air pollution control technologies, Concepts of bioremediation.

Global Environmental Issues and Global Efforts: Climate change and impacts on human environment.Ozone depletion and Ozone depleting substances (ODS).Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

UNIT-V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economicalaspects.Strategies for risk assessment, Concepts of Environmental Management Plan (EMP).

Towards Sustainable Future: Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon lifestyle.

TEXT BOOKS:
1. Textbook of Environmental Studies for Undergraduate Courses by ErachBharucha for University GrantsCommission.
2. Environmental Studies by R. Rajagopalan, Oxford UniversityPress.

REFERENCE BOOKS:
1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. NewDelhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt.Ltd.
3. Environmental Science by Daniel B. Botkin& Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by AnubhaKaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu,BS.Publications.

19MA201BS: Mathematics - II

	L	**T**	**P**	**C**
B.Tech. II SEM	**3**	**1**	**0**	**4**

Course Objectives:
- To learnMethods of solving the differential equations of first and higherorder.
- Evaluation of multiple integrals and theirapplications
- The physical quantities involved in engineering field related to vector valuedfunctions
- The basic properties of vector valued functions and their applications to line, surface and volumeintegrals

Course Outcomes:
- After learning the contents of this paper the student must be able toIdentify whether the given differential equation of first order is exact or not
- Solve higher differential equation and apply the concept of differential equation to real worldproblems
- Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and Gravity for cubes, sphere and rectangularparallel piped
- Evaluate the line, surface and volume integrals and converting them from one to another

UNIT-I: First Order ODE

Exact, linear and Bernoulli's equations; Applications: Newton's law of cooling, Law of natural growth and decay; Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT-II: Ordinary Differential Equations of Higher Order

Second order linear differential equations with constant coefficients: Non-Homogeneous termsof the type e^{ax}, $\sin ax$, $\cos ax$, polynomialsin x, $e^{ax}V(x)$ and $xV(x)$; method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Eulerequation.

UNIT-III: Multivariable Calculus (Integration)

Evaluation of Double Integrals (Cartesian and polar coordinates); change of order of integration (only Cartesian form); Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals.
Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals), Centre of mass and Gravity (constant and variable densities) by double and triple integrals (applications involving cubes, sphere and rectangular parallel piped).

UNIT-IV: VectorDifferentiation

Vectorpoint functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal lineVector Identities. Scalar potential functions. Solenoidal and Irrotationalvectors

UNIT-V: Vector Integration

Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

TEXT BOOKS:
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint,2002.

REFERENCES:
1. Paras Ram, Engineering Mathematics, 2nd Edition, CBSPublishes
2. S. L. Ross, Differential Equations, 3rd Ed., Wiley India,1984.

19CH102BS/19CH202BS: Chemistry

B.Tech. II SEM

L	T	P	C
3	1	0	4

Course Objectives:
- To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfectengineer.
- To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based onthem.
- To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and inindustry.
- To acquire the skills pertaining to spectroscopy and to apply them for medical and other fields.
- To impart the knowledge of stereochemistry and synthetic aspects useful for understanding reactionpathways.

Course Outcomes:
- The basic concepts included in this course will help the student to gain the knowledge of atomic, molecular and electronic changes, band theory related to conductivity.
- The required principles and concepts of electro chemistry, corrosion andin understanding the problem of water and itstreatments.
- The required skills to get clear concepts on basic spectroscopy and application to medical and otherfields.
- The knowledge of configurational and conformational analysis of molecules and reactionmechanisms.

UNIT - I:

Molecular structure and Theories of Bonding: Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N_2, O_2 and F_2 molecules. π molecular orbitals of butadiene and benzene.Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance.

UNIT - II:

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Boiler feed water and its treatment – Calgon conditioning, Phosphate conditioning and Colloidal conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis. Numericalproblems.

UNIT - III:

Electrochemistry and corrosion: Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and

Lithium ion battery).Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection– Sacrificial anode and impressed current cathodic methods. Surface coatings – metallic coatings – methods of application. Electroless plating of Nickel.

UNIT - IV:

Stereochemistry, Reaction Mechanism and synthesis of drug molecules: Introduction to representation of 3-dimensional structures, Structural and stereoisomers, configurations, symmetry and chirality. Enantiomers, diastereomers, optical activity and Absolute configuration. Conformation alanalysisof n- butane.Substitution reactions: Nucleophilic substitution reactions: Mechanism of S_N1, S_N2 reactions. Electrophilic and nucleophilic addition reactions: Addition of HBrto propene. Markownikoff and anti Markownikoff's additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydro halogenation of alkylhalides. Saytzeff rule. Oxidation reactions: Oxidation of alcohols using $KMnO_4$ and chromicacid.Reduction reactions: reduction of carbonyl compounds using $LiAlH_4$& $NaBH_4$. Hydroboration of olefins. Structure, synthesis and pharmaceutical applications of Paracetamol andAspirin.

UNIT - V:

Spectroscopic techniques and applications: Principles of spectroscopy, selection rules and applications of electronic spectroscopy. vibrational and rotational spectroscopy. Basic concepts of Nuclear magnetic resonance Spectroscopy, chemical shift. Introduction to Magnetic resonance imaging.

Suggested Text Books:
1. Physical Chemistry, by P.W.Atkins
2. Engineering Chemistry by P.C.Jain&M.Jain; DhanpatRai Publishing Company (P) Ltd., NewDelhi.
3. Fundamentals of Molecular Spectroscopy, by C.N.Banwell
4. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.
5. University Chemistry, by B.M. Mahan, Pearson IVEdition.
6. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan

19ME203ES: Engineering Mechanics

B.Tech. II SEM

L	T	P	C
3	1	0	4

Course Objectives: The objectives of this course are to
- Explain the resolution of a system of forces, compute their resultant and solve problems using equations ofequilibrium
- Perform analysis of bodies lying on roughsurfaces.
- Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and compositesections
- Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigidbodies.
- Explain the concepts of work-energy method and its applications to translation, rotation and plane motion and the concept ofvibrations.

Course Outcomes:
- At the end of the course, students will be able todetermine resultant of forces acting on a body and analyzeequilibrium of a body subjected to a system offorces.
- Solve problem of bodies subjected tofriction.
- Find the location of centroid and calculate moment of inertia of a givensection.
- Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid bodymotion.
- Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems ofvibration.

UNIT-I:
Introduction to Engineering Mechanics - Force Systems :Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

UNIT-II:
Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;Centroid and Centre of Gravity -Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications. – Theorem of Pappus

UNIT-III:
Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem

Mass Moment of Inertia : Moment of Inertia of Masses - Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

UNIT-IV:
Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path,

and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

UNIT-V:

Kinetics of Rigid Bodies -Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work Energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

TEXT BOOKS:
1. Shames and Rao (2006) , Engineering Mechanics, PearsonEducation
2. ReddyVijay KumarK. andJ. Suresh Kumar (2010), Singer's Engineering Mechanics – Statics &Dynamics

REFERENCE BOOKS:
1. Timoshenko S.Pand Young D.H., "Engineering Mechanics",McGrawHill International Edition,1983.
2. Andrew Pytel, JaanKiusalaas, "Engineering Mechanics", Cengage Learning,2014.
3. Beer F.P & Johnston E.R Jr. Vector, "Mechanics for Engineers", TMH,2004.
4. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", Pearson Education,2010.
5. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", Umesh Publications, 2011.
6. Basudeb Bhattacharyya, "Engineering Mechanics", Oxford University Press, 2008.
7. Meriam. J. L., "Engineering Mechanics", Volume-II Dynamics, John Wiley & Sons, 2008.

19ME104ES/ME204ES: Engineering Workshop

	L	**T**	**P**	**C**
B.Tech. II SEM	**1**	**0**	**3**	**2.5**

Pre-requisites: Practical skill

Course Objectives:

- To Study of different hand operated power tools, uses and theirdemonstration.
- To gain a good basic working knowledge required for the production of various engineeringproducts.
- To provide hands on experience about use of different engineering materials,tools, equipments and processes those are common in the engineeringfield.
- To develop a right attitude, team working, precision and safety at work place.
- It explains the construction, function, use and application of different workingtools, equipment andmachines.
- To study commonly used carpentryjoints.
- To have practical exposure to various welding and joiningprocesses.
- Identify and use marking out tools, hand tools, measuring equipment and to work to prescribedtolerances.

Course Outcomes: At the end of the course, the student will be able to:

- Study and practice on machine tools and their operations
- Practiceonmanufacturing of componentsusingworkshoptradesincludingpluming, fitting, carpentry, foundry, house wiring andwelding.
- Identify and apply suitable tools for different trades of Engineeringprocesses including drilling, material removing, measuring,chiseling.
- Apply basic electrical engineering knowledge for house wiringpractice.

1) **TRADES FOREXERCISES:**

   At least two exercises from each trade:

I.   Carpentry – (T-Lap Joint, Dovetail Joint, Mortise &TenonJoint)

II.   Fitting – (V-Fit, Dovetail Fit & Semi-circularfit)

III. Tin-Smithy – (Square Tin, Rectangular Tray & ConicalFunnel)

IV. Foundry – (Preparation of Green Sand Mould using Single Piece and SplitPattern)

V. Welding Practice – (Arc Welding & GasWelding)

VI. House-wiring – (Parallel & Series, Two-way Switch and TubeLight)

VII.Black Smithy – (Round to Square, Fan Hook andS-Hook)

2) **TRADES FOR DEMONSTRATION &EXPOSURE:**

   Plumbing, Machine Shop, Metal Cutting (Water Plasma), Power tools in construction and Wood Working

TEXT BOOKS:

1. Workshop Practice /B. L. Juneja /Cengage
2. Workshop Manual / K. Venugopal /Anuradha.

REFERENCE BOOKS:

1. Work shop Manual - P. Kannaiah/ K. L. Narayana/SciTech
2. Workshop Manual / Venkat Reddy/BSP

19EN105HS/EN205HS: English

	L	**T**	**P**	**C**
B.Tech. II SEM	**2**	**0**	**0**	**2**

INTRODUCTION

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students.

In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures.

Learning Objectives:
    a) The course will help toImprove the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writingskills.
    b) Equip students to study academic subjects more effectively and critically using the theoretical and practical components of Englishsyllabus.
    c) Develop study skills and communication skills in formal and informalsituations.

Course Outcomes:
    1. Students should be able toUse English Language effectively in spoken and writtenforms.
    2. Comprehend the given texts and respondappropriately.
    3. Communicate confidently in various contexts and differentcultures.
    4. Acquire basic proficiency in English including reading and listening comprehension, writing and speakingskills.

SYLLABUS
UNIT –I
'The Raman Effect' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.
Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes.
Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.
Reading: Reading and Its Importance- Techniques for Effective Reading.
Basic Writing Skills: Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for writing precisely – **Paragraph writing** – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT –II
'Ancient Architecture in India' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.
Vocabulary: Synonyms and Antonyms.
Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Improving Comprehension Skills – Techniques for Good Comprehension

Writing: Format of a Formal Letter-**Writing Formal Letters** E.g.., Letter of Complaint, Letter of Requisition, Job Application with Resume.

UNIT –III

'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.

Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

Reading: Sub-skills of Reading- Skimming and Scanning

Writing: Nature and Style of Sensible Writing- **Defining- Describing** Objects, Places and Events – **Classifying**- Providing Examples or Evidence

UNIT –IV

'What Should You Be Eating' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension- Intensive Reading and Extensive Reading

Writing: Writing Practices--Writing Introduction and Conclusion - Essay Writing-Précis Writing.

UNIT –V

'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge UniversityPress.

Vocabulary: Technical Vocabulary and their usage

Grammar: Common Errors inEnglish

Reading: Reading Comprehension-Exercises forPractice

Writing:Technical Reports- Introduction – Characteristics of a Report – Categories of ReportsFormats- Structure of Reports (Manuscript Format) -Types of Reports - Writing aReport.

Prescribed Textbook:
1. **Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.**

References:
1. Swan, M. (2016). Practical English Usage. Oxford UniversityPress.
2. Kumar, S and Lata, P.(2018). Communication Skills. Oxford UniversityPress.
3. Wood, F.T. (2007).Remedial English Grammar.Macmillan.Zinsser, William. (2001). On Writing Well. Harper ResourceBook.Hamp-Lyons, L. (2006).Study Writing. Cambridge UniversityPress.
4. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

19CH106BS/CH206BS: Engineering Chemistry Lab

B.Tech. II SEM	**L**	**T**	**P**	**C**
	0	**0**	**3**	**1.5**

Course Objectives:
- The course consists of experiments related to the principles of chemistry required for engineering student. The student willlearn Estimation of hardness and chloride content in water to check its suitability for drinking purpose.
- To determine the rate constant of reactions from concentrations as an function oftime.
- The measurement of physical properties like adsorption andviscosity.
- To synthesize the drug molecules and check the purity of organic molecules by thin layer chromatographic (TLC)technique.

Course Outcomes: The experiments will make the student gain skills on:
- Determination of parameters like hardness and chloride content inwater.
- Estimation of rate constant of a reaction from concentration – timerelationships.
- Determination of physical properties like adsorption andviscosity.
- Calculation of R_f values of some organic molecules by TLCtechnique.

List of Experiments:
1. Determination of total hardness of water by complexometric method usingEDTA
2. Determination of chloride content of water byArgentometry
3. Estimation of an HCl by Conductometrictitrations
4. Estimation of Acetic acid by Conductometrictitrations
5. Estimation of HCl by Potentiometrictitrations
6. Estimation of Fe^{2+} by Potentiometry usingKMnO$_4$
7. Determination of rate constant of acid catalysed hydrolysis of methylacetate
8. Synthesis of Aspirin andParacetamol
9. Thin layer chromatography calculation of R_f values. egortho and para nitrophenols
10. Determination of acid value of coconutoil
11. Verification of freundlich adsorption isotherm-adsorption of acetic acid oncharcoal
12. Determination of viscosity of castor oil and ground nut oil by using Ostwald's viscometer.
13. Determination of partition coefficient of acetic acid between n-butanol andwater.
14. Determination of surface tension of a give liquid usingstalagmometer.

References
1. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co.,Delhi)
2. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N.Delhi)
3. Vogel's text book of practical organic chemistry 5thedition
4. Text book on Experiments and calculations in Engineering chemistry – S.S.Dara

19EN107HS/EN207HS: English Language and Communication Skills Lab

	L	**T**	**P**	**C**
B.Tech. II SEM	**0**	**0**	**2**	**1**

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:
- To facilitate computer-assisted multi-media instruction enabling individualized and independent languagelearning
- To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking and interviews

Learning Outcomes:
- Students will be able to attainBetter understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills

Syllabus

English Language and Communication Skills Lab (ELCS) shall have two parts:
a) Computer Assisted Language Learning (CALL)Lab
b) Interactive Communication Skills (ICS)Lab

Listening SkillsObjectives:
1. To enable students develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve theirpronunciation
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds andregions

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation insentences.

- Listening for generalcontent
- Listening to fill upinformation
- Intensivelistening
- Listening for specificinformation

Speaking SkillsObjectives:
1. To involve students in speaking activities in variouscontexts
2. To enable students express themselves fluently and appropriately in social and professionalcontexts

- Oral practice: Just A Minute (JAM) Sessions
- Describingobjects/situations/people
- Role play – Individual/Groupactivities

➢ The following course content is prescribed for the English Language and Communication Skills Lab based on Unit-6 of AICTE Model Curriculum 2018 for B.Tech First English. As the syllabus is very limited, it is required to prepare teaching/learning materials by the teachers collectively in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning and timesaving in theLab)

Exercise – I CALL Lab:
Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.
ICS Lab:
Understand: Communication at Work Place- Spoken vs. Written language.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II CALL Lab:
Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
*Practice:*Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - TelephoneEtiquette.

Exercise - III CALL Lab:
Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.
ICS Lab:
Understand: How to make Formal Presentations.
Practice: Formal Presentations.

Exerrcise-IV
CALL Lab:
Understand: Listening for General Details. *Practice:* Listening Comprehension Tests.
ICS Lab:
Understand: Public Speaking – Exposure to Structured Talks.
Practice: Making a Short Speech – Extempore.

Exercise – V CALL Lab:
Understand: Listening for Specific Details. *Practice:* Listening Comprehension Tests.

ICS Lab:
   Understand: Interview Skills. *Practice:* Mock Interviews.

Minimum Requirement of infrastructural facilities for ELCS Lab:
1. **Computer Assisted Language Learning (CALL)Lab:**
   The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

2. **System** Requirement (Hardware component):
   Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:
   i). Computers with SuitableConfiguration
   ii).High FidelityHeadphones
3. **Interactive Communication Skills (ICS) Lab:**
   The **Interactive Communication Skills Lab:** A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc.

19MA301BS: PROBABILITY AND STATISTICS & COMPLEX VARIABLES

B.Tech. III SEM

L	T	P	C
3	1	0	4

Pre-requisites: Mathematical Knowledge at pre-university level

Course Objectives: To learn

➢ The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
➢ The basic ideas of statistics including measures of central tendency, correlation and regression.
➢ The statistical methods of studying data samples.
➢ Differentiation and integration of complex valued functions.
➢ Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
➢ Expansion of complex functions using Taylor's and Laurent's series.

Course outcomes: After learning the contents of this paper the student must be able to
➢ Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.
➢ Analyse the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
➢ Taylor's and Laurent's series expansions of complex function.

UNIT - I: Basic Probability
Probability spaces, conditional probability, independent events, and Bayes' theorem.
Random variables: Discrete and continuous random variables, Expectation of Random Variables, Moments, Variance of random variables

UNIT - II: Probability distributions
Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution. Continuous random variables and their properties, distribution functions and density functions, Normal and exponential, evaluation of statistical parameters for these distributions.

UNIT - III: Testing of Hypothesis
Test of significance: Basic of testing of Hypothesis. Null and alternate Hypothesis, types of errors, level of significance, critical region. Large sample test for single proportion, difference of proportions, single mean, difference of means; small sample tests: Test for single mean, difference of means and test for ratio of variances

UNIT - IV: Complex Variables (Differentiation)
Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT - V: Complex Variables (Integration)
Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties.

TEXT BOOKS:
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

REFERENCES:
1. Fundamentals of Mathematical Statistics, Khanna Publications, S. C. Gupta and V. K. Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, 8th Edition, Pearson Educations
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

19ME302PC: MECHANICS OF SOLIDS

B.Tech. III SEM	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

Course Objectives:
The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force-deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.

This course will advance the students' development of the following broad capabilities:
➢ Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
➢ Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
➢ Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations
➢ Students will understand how to calculate normal and shear stresses

Course Outcomes:
➢ Analyze the behavior of the solid bodies subjected to various types of loading;
➢ Apply knowledge of materials and structural elements to the analysis of simple structures;
➢ Undertake problem identification, formulation and solution using a range of analytical methods;
➢ Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.
➢ Expectation and capacity to undertake lifelong learning

UNIT – I
Simple Stresses & Strains: Elasticity and plasticity – Types of stresses & strains–Hooke's law– stress– strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section –composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT – II
Shear Force and Bending Moment: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – III
Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.
Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT - IV
Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses.Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses Principal stresses and strains – Analytical and graphical solutions.
Theories of Failure: Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

UNIT - V
Torsion of Circular Shafts: Theory of pure torsion – Derivation of Torsion equations: $T/J = q/r = N\theta/L$ Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.
Thin Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells.

TEXT BOOKS:
  1. Strength of materials – R.S. Kurmi and Gupta.
  2. Solid Mechanics, by Popov
  3. Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
  4. Strength of Materials – W.A. Nash, TMH

REFERENCES:
  1. Strength of Materials -By Jindal, Umesh Publications.
  2. Analysis of structures by Vazirani and Ratwani.
  3. Mechanics of Structures Vol –I by H. J. Shah and S. B. Junnarkar, Charotar
      Publishing House Pvt. Ltd.
  4. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
  5. Strength of Materials by S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd.
  6. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt. Ltd
  7. Strength of Materials by R.K Rajput, S. Chand & Company Ltd.

19ME303PC: MATERIAL SCIENCE AND METALLURGY

	L	T	P	C
B.Tech. III SEM	3	0	0	3

UNIT – I
Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

UNIT – II
Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron

UNIT –III
Heat treatment of Steel: Annealing, Normalizing, Hardening, Tempering and Spheroidising, Isothermal transformation diagrams for Fe-C alloys and microstructures development.

UNIT – IV
Continuous cooling curves and interpretation of final microstructures and properties-austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

UNIT – V
Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys (Brass, bronze and cupro-nickel)- Aluminium and Al-Cu – Mg alloys- Titanium alloys

TEXT BOOKS:
1. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
2. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.

REFERENCE BOOKS:
1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
2. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

19ME304PC: PRODUCTION TECHNOLOGY

	L	**T**	**P**	**C**
B.Tech. III SEM	**3**	**0**	**0**	**3**

Pre-requisites: None

Course Objectives:
➢ To teach the process-level dependence of manufacturing systems through tolerances
➢ To expose the students to a variety of manufacturing processes including their suitability and capabilities.
➢ To teach the important effects that manufacturing processes may have on the material properties of the processed part with a focus on the most common processes.
➢ To teach the thermal and mechanical aspects, such as force, stress, strain and temperature of the most common processes.
➢ To provide a technical understanding of common processes to aid in appropriate process selection for the material and required tolerances
➢ To provide a technical understanding of common processes to aid in appropriate material selection for a predetermined process.

Course Outcomes: Student will be able to :
➢ Understand the idea for selecting materials for patterns.
➢ Know Types and allowances of patterns used in casting and analyze the components of moulds.
➢ Design core, core print and gating system in metal casting processes
➢ Understand the arc, gas, solid state and resistance welding processes.
➢ Develop process-maps for metal forming processes using plasticity principles.
➢ Identify the effect of process variables to manufacture defect free products.

UNIT – I
Casting: Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances; Properties of moulding sands. Methods of Melting - Crucible melting and cupola operation – Defects in castings; Principles of Gating
– Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design. Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Solidification of casting – Solidification of pure metal, Directional Solidification.

UNIT – II
Welding: Classification – Types of welds and welded joints; Welding Positions - Gas welding - Types, oxy-fuel gas cutting – standard time and cost calculations. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

UNIT – III
Inert Gas Welding _ TIG Welding, MIG welding, Friction welding, Friction Stir Welding, induction welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

UNIT – IV
Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth. Sheet metal Operations: Stamping, Blanking and piercing, Coining, Strip layout, Hot and cold spinning – Bending and deep drawing. Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements. Drawing and its types – wire drawing and Tube drawing –. Types of presses and press tools. Forces and power requirement in the above operations.

UNIT – V
Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion- Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion, Hydrostatic extrusion. Forces in extrusion
Forging Processes: Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.
High Energy Rate Forming Processes: Limitations, Principles of Explosive Forming, Electro-hydraulic Forming, Electro-magnetic forming and rubber pad Forming.

TEXT BOOKS:
1. Manufacturing Technology / P.N. Rao Vol.1 & 2 / Mc Graw Hill
2. Manufacturing Engineering & Technology / Serope Kalpakjian / Steven R. Schmid / Pearson

REFERENCE BOOKS:
1. Metal Casting / T.V Ramana Rao / New Age
2. Production Technology / G. Thirupathi Reddy / Scitech
3. Manufacturing Processes/ J.P. Kaushish / PHI Publications

19ME305PC: THERMODYNAMICS

B.Tech. III SEM

L	T	P	C
3	1	0	4

Pre-requisite: Engineering Chemistry and Physics

Course Objective: To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

Course Outcomes: At the end of the course, the student should be able to Understand and differentiate between different thermodynamic systems and processes. Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes and to perform thermodynamic analysis. Understand and analyze the Thermodynamic cycles and evaluate performance parameters.

Tables/Codes: Steam Tables and Mollier Chart, Refrigeration Tables

UNIT – I
Introduction: Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics– Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

UNIT - II
PMM I - Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation.Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump , Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

UNIT – III
Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes

UNIT - IV
Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. And

Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour, Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Carrier's Equation – Psychrometric chart.

UNIT - V
Power Cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.
Refrigeration Cycles:
Brayton and Rankine cycles – Performance Evaluation – combined cycles, Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

TEXT BOOKS:
1. Engineering Thermodynamics / PK Nag / Mc Graw Hill
2. Thermodynamics for Engineers / Kenneth A. Kroos ; Merle C. Potter/ Cengage

REFERENCE BOOKS:
1. Engineering Thermodynamics / Chattopadhyay/ Oxford
2. Engineering Thermodynamics / Rogers / Pearson

19ME306PC: PRODUCTION TECHNOLOGY LAB

	L	**T**	**P**	**C**
B.Tech. III SEM	0	0	2	1

Pre-requisites: Production Technology
  Course Objectives:
  ➢ Know about the basic Physical, Chemical Properties of materials
  ➢ Explain why some material(s) are better to be used in a product for given design requirements
  ➢ Learn the basic operation of various manufacturing processes
  ➢ Learn how various products are made using traditional, non-traditional, or Electronics manufacturing processes
  ➢ Design simple process plans for parts and products
  ➢ Understand how process conditions are set for optimization of production
  ➢ Learn how CNC machines work
  ➢ Write and execute CNC machining programs to cut parts on a milling machine
  ➢ Measure a given manufactured part to evaluate its size, tolerances and surface finish
  ➢ Design and fabricate a simple product

Course Outcomes: Understanding the properties of moulding sands and pattern making. Fabricate joints using gas welding and arc welding. Evaluate the quality of welded joints. Basic idea of press working tools and performs moulding studies on plastics.
Minimum of 12 Exercises need to be performed
 I. Metal Casting Lab:
  1. Pattern Design and making - for one casting drawing.
  2. Sand properties testing - Exercise -for strengths, and permeability – 1
  3. Moulding Melting and Casting - 1 Exercise
II. Welding Lab:
1. ARC Welding Lap & Butt Joint - 2 Exercises
2. Spot Welding - 1 Exercise
3. TIG Welding - 1 Exercise
4. Plasma welding and Brazing - 2
   Exercises (Water Plasma Device)
III. Mechanical Press Working:
1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations
IV. Processing Of Plastics
1. Injection Moulding
2. Blow Moulding

REFERENCE BOOK:
1. Dictionary of Mechanical Engineering – G.H.F. Nayler, Jaico Publishing House.

19ME307PC: MACHINE DRAWING PRACTICE

	L	T	P	C
B.Tech. III SEM	0	0	2	1

Pre-requisites: Engineering graphics

Course objectives: To familiarize with the standard conventions for different materials and machine parts in working drawings. To make part drawings including sectional views for various machine elements. To prepare assembly drawings given the details of part drawings.

Course Outcomes:
 ➢ Preparation of engineering and working drawings with dimensions and bill of material during design and development. Developing assembly drawings using part drawings of machine components.
 ➢ Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
 ➢ Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
 ➢ Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
 ➢ Title boxes, their size, location and details - common abbreviations and their liberal usage
 ➢ Types of Drawings – working drawings for machine parts.

Drawing of Machine Elements and simple parts
Selection of Views, additional views for the following machine elements and parts with every drawing proportion.
 1. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
 2. Keys, cottered joints and knuckle joint.
 3. Riveted joints for plates
 4. Shaft coupling, spigot and socket pipe joint.
 5. Journal, pivot and collar and foot step bearings.

Assembly Drawings:
Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.
 1. Steam engine parts – stuffing boxes, cross heads, Eccentrics.
 2. Machine tool parts: Tail stock, Tool Post, Machine Vices.
 3. Other machine parts - Screws jacks, Petrol engine connecting rod, Plummer block, Fuel Injector
 4. Valves - Steam stop valve, spring loaded safety valve, feed check valve and air cock.

NOTE: First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

TEXT BOOKS:
 1. Machine Drawing / N.D. Bhatt / Charotar
 2. Machine Drawing with Auto CAD / Goutham Pohit, Goutam Ghosh / Pearson

REFERENCE BOOKS:
1. Machine Drawing by / Bhattacharyya / Oxford
2. Machine Drawing / Ajeet Singh / Mc Graw Hill

19ME308PC: MATERIAL SCIENCE & MECHANICS OF SOLIDS LAB

B.Tech. III SEM	L	T	P	C
	0	0	2	1

MATERIAL SCIENCE:
Course Objective: The purpose of this course is to make the students learn the concepts of Metallurgy and Material Science role in all manufacturing processes which convert raw materials into useful products adapted to human needs.

Course Outcomes: The Primary focus of the Metallurgy and Material science program is to provide undergraduates with a fundamental knowledge based associated materials properties, and their selection and application. Upon graduation, students would have acquired and developed the necessary background and skills for successful careers in the materials-related industries. Furthermore, after completing the program, the student should be well prepared for management positions in industry or continued education toward a graduate degree.

List of Experiments:
1. Preparation and study of crystal models for simple cubic, body centred cubic, face centred cubic and hexagonal close packed structures.
2. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
3. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
4. Study of the Microstructures of Cast Irons.
5. Study of the Microstructures of Non-Ferrous alloys.
6. Hardenability of steels by Jominy End Quench Test.

MECHANICS OF SOLIDS:
Course Objectives: The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force- deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.
The students will advance the students' development of the following broad capabilities:
➢ Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
➢ Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
➢ Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations
➢ Students will understand how to calculate normal and shear stresses on any cross-section of a beam. Different cross-sections (including I-beam) will be discussed and applied Continuous Assessment Test 10 marks Mid Semester Test 15 marks End

Course Outcomes
- ➢ Analyze the behavior of the solid bodies subjected to various types of loading.
- ➢ Apply knowledge of materials and structural elements to the analysis of simple structures.
- ➢ Undertake problem identification, formulation and solution using a range of analytical methods
- ➢ Analyze and interpret laboratory data relating to behavior of structures and the materials they Are made of, and undertake associated laboratory work individually and in teams.
- ➢ Expectation and capacity to undertake lifelong learning.

List of Experiments:
1. Direct tension test
2. Bending test on Simple supported beam
3. Bending test on Cantilever beam
4. Torsion test
5. Brinell hardness test/ Rockwell hardness test
6. Test on springs
7. Izod Impact test/ Charpy Impact test

19MC309CI: CONSTITUTION OF INDIA

	L	**T**	**P**	**C**
B.Tech. III SEM	**3**	**0**	**0**	**0**

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content
1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India

13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

19EE401ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

	L	T	P	C
B.Tech. IV SEM	3	0	0	3

Course Objectives:
- ➢ To introduce the concepts of electrical circuits and its components
- ➢ To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
- ➢ To study and understand the different types of DC/AC machines and Transformers.
- ➢ To import the knowledge of various electrical installations.
- ➢ To introduce the concept of power, power factor and its improvement.
- ➢ To introduce the concepts of diodes & transistors, and
- ➢ To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:
- ➢ To analyze and solve electrical circuits using network laws and theorems.
- ➢ To understand and analyze basic Electric and Magnetic circuits
- ➢ To study the working principles of Electrical Machines
- ➢ To introduce components of Low Voltage Electrical Installations
- ➢ To identify and characterize diodes and various types of transistors.

UNIT - I:
D.C. CIRCUITS
Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation.
A.C. CIRCUITS
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits , Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT - II:
ELECTRICAL INSTALLATIONS
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

UNIT - III:
ELECTRICAL MACHINES
Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three-phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three-phase Induction motor, Torques equations and Speed control of Three-phase induction motor. Construction and working principle of synchronous generators.

UNIT - IV:
JUNCTION AND ZENER DIODE: Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances,

Equivalent circuit, Zener diode characteristics and applications.

RECTIFIERS AND FILTERS: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters

UNIT - V:

BIPOLAR JUNCTION TRANSISTOR (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations.

FIELD EFFECT TRANSISTOR (FET): Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

TEXT BOOKS:

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

REFERENCES:

1. Electronic Devices and Circuits – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
7. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
8. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
9. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

19ME402PC: KINEMATICS OF MACHINERY

B.Tech. IV SEM

L	T	P	C
3	1	0	4

Prerequisites: Basic principles of Mechanics

Course Objectives: The objective is to study the relative motion, velocity, and accelerations of the various elements in a mechanism. In mechanical Engineering we come across number of mechanisms such as four bar/slider crank/double slider crank/straight line motion mechanism etc. Mechanism deals with only relative motions. Once we make a study considering for us also there it is called kinetics. The first course deals with mechanisms, their inversions straight line motion mechanisms steering mechanisms etc. Also study of cams/gears & gear trains & belts are also introduced.

Course Outcomes: The main purpose is to give an idea about the relative motions obtained in all the above type of components used in mechanical Engineering.

UNIT – I
Mechanisms: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained.
Mechanism and Machines – Mobility of Mechanisms: Grubler's criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage.

UNIT – II
Kinematics: Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method.
Plane motion of body: Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.
Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration
Analysis of Mechanisms: Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

UNIT – III
Straight-line motion mechanisms: Exact and approximate copied and generated types – Peaucellier-Hart - Scott Russel – Grasshopper – Watt -Tchebicheff's and Robert Mechanism - Pantographs **Steering gears:** Conditions for correct steering – Davis Steering gear, Ackerman's steering gear. **Hooke's Joint:** Single and double Hooke's joint –velocity ratio – application – problems.

UNIT – IV
Cams: Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

Analysis of motion of followers: Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

UNIT – V
Higher pair: Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding Forms of teeth, cyclical and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical – Bevel and worm gearing
Gear Trains: Introduction – Types – Simple – compound and reverted gear trains – Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box - Differential gear for an automobile.

TEXT BOOKS:
1. Theory of Machines and Mechanisms/JOSEPH E. SHIGLEY/ Oxford
2. Theory of Machines / S. S. Rattan / Mc Graw Hill Publishers.

REFERENCE BOOKS:
1. Theory of Machines / Sadhu Singh / Pearson.
2. Theory of Machines / Thomas Bevan/CBS.

19ME403PC: THERMAL ENGINEERING – I

	L	T	P	C
B.Tech. IV SEM	3	1	0	4

Pre-requisite: Thermodynamics

Course Objective: To apply the laws of Thermodynamics to analyze air standard cycles and to understand and evaluate the perform analysis of the major components and systems of IC engines, refrigeration cycles and their applications.

Course Outcomes: At the end of the course, the student should be able to evaluate the performance of IC engines and compressors under the given operating conditions. Apply the laws of Thermodynamics to evaluate the performance of Refrigeration and air-conditioning cycles. Understand the functionality of the major components of the IC Engines and effects of operating conditions on their performance

UNIT – I
I.C. Engines: Classification - Working principles of Four & Two stroke engine, SI & CI engines, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles - Engine systems – Carburetor and Fuel Injection Systems for SI engines, Fuel injection systems for CI engines, Ignition, Cooling and Lubrication system, Fuel properties and Combustion Stoichiometry.

UNIT – II
Normal Combustion and abnormal combustion in SI engines – Importance of flame speed and effect of engine variables – Abnormal combustion, pre-ignition and knocking in SI Engines – Fuel requirements and fuel rating, anti-knock additives – combustion chamber – requirements, types of SI engines.Four stages of combustion in CI engines – Delay period and its importance – Effect of engine variables-Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence in Diesel engine – open and divided combustion chambers and fuel injection– Diesel fuel requirements and fuel rating

UNIT - III
Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart Classification of compressors – Fans, blowers and compressors – positive displacement and dynamic types – reciprocating and rotary types.
Reciprocating Compressors: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work, minimum work condition for staged compression

UNIT – IV
Rotary Compressor (Positive displacement type): Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.
Dynamic Compressors: Centrifugal compressors: Mechanical details and principle of

operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

Axial Flow Compressors: Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency-pressure rise calculations
– Polytropic efficiency.

UNIT – V
Gas Turbines: Simple Gas Turbine Plant – Ideal Cycle – Closed Cycle and Open Cycle for Gast Turbines, Constant Pressure Cycle, Constant Volume Cycle, Efficiency – Work Ratio and Optimum Pressure Ration for Simple Gas Turbine Cycle. Parameters of Performance, Actual Cycle, Regeneration , Intercooling and Reheating – Closed and Semi-Closed Cycle

TEXT BOOKS:
1. I.C. Engines / V. Ganesan / Mc Graw Hill
2. Thermal Engineering / Mahesh M Rathore / Mc Graw Hill

REFERENCE BOOKS:
1. Applied Thermodynamics for Engineering Technologists / Eastop / Pearson
2. Fundamentals of Classical Thermodynamics / Vanwylen G.J., Sonntag R.E. / Wiley Eastern
3. Internal Combustion Engines Fundamentals – John B. Heywood – McGraw Hill Ed.

19ME404PC: FLUID MECHANICS AND HYDRAULIC MACHINES

	L	T	P	C
B.Tech. IV SEM	3	1	0	4

Course Objectives: The objectives of the course are to enable the student;
  - To understand the basic principles of fluid mechanics
  - To identify various types of flows
  - To understand boundary layer concepts and flow through pipes
  - To evaluate the performance of hydraulic turbines
  - To understand the functioning and characteristic curves of pumps

Course Outcomes:
  - Able to explain the effect of fluid properties on a flow system.
  - Able to identify type of fluid flow patterns and describe continuity equation.
  - To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.
  - To select and analyze an appropriate turbine with reference to given situation in power plants.
  - To estimate performance parameters of a given Centrifugal and Reciprocating pump.
  - Able to demonstrate boundary layer concepts.

UNIT - I
Fluid statics: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

UNIT - II
Fluid kinematics: Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.
Fluid dynamics: Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

UNIT - III
Boundary Layer Concepts: 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.
Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow: Pitot tube, venturi meter, and orifice meter, Flow nozzle

UNIT - IV
Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.
Hydraulic Turbines: Classification of turbines, Heads and efficiencies, impulse and reaction

turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT - V
Centrifugal pumps: Classification, working, work done – barometric head- losses and efficiencies specific speed- performance characteristic curves, NPSH.
Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

TEXT BOOKS:
1. Hydraulics, Fluid mechanics and Hydraulic Machinery - MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.

REFERENCES:
1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

19ME405PC: INSTRUMENTATION AND CONTROL SYSTEMS

	L	**T**	**P**	**C**
B.Tech. IV SEM	**3**	**0**	**0**	**3**

Prerequisite: Mathematics-I, Thermodynamics, Basic of Electrical and Electronics Engineering.

Course Objectives:
- Understanding the basic characteristic of a typical instrument.
- Identifying errors and their types that would occur in an instrument.
- Identifying properties used for evaluating the thermal systems.
- The concept of transducer and Various types and their characters.

Course Outcome:
- To identify various elements and their purpose in typical instruments, to identify various errors that would occur in instruments.
- Analysis of errors so as to determine correction factors for each instrument.
- To understand static and dynamic characteristics of instrument and should be able to determine loading response time.
- For given range of displacement should be able to specify transducer, it accurate and loading time of that transducer.

UNIT – I
Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics– sources of errors, Classification and elimination of errors. Measurement of Displacement: Theory and construction of various transducers to measure displacement – Using Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers; Calibration procedures.

UNIT – II
Measurement of Temperature: Various Principles of measurement-Classification: Expansion Type: Bimetallic Strip- Liquid in glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry: Optical Pyrometer; Changes in Chemical Phase: Fusible Indicators and Liquid crystals. Measurement of Pressure: Different principles used-Classification: Manometers, Dead weight pressure gauge Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges, Bellows, Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges, ionization pressure gauges, McLeod pressure gauge.

UNIT – III
Measurement of Level: Direct methods – Indirect methods – Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators –Bubbler level indicators.Flow measurement: Rotameter, magnetic, Ultrasonic, Turbine flowmeter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).
Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Non- contact type Stroboscope; Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle- Piezo

electric accelerometer.

UNIT – IV
Stress-Strain measurements: Various types of stress and strain measurements –Selection and installation of metallic strain gauges; electrical strain gauge – gauge factor – method of usage ofresistance strain gauge for bending, compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes.
Measurement of Humidity: Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew point meter. Measurement of Force, Torque and Power- Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT – V
Elements of Control Systems: Introduction, Importance – Classification – Open and closed systems- Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems- Transfer functions- First and Second order mechanical systems

TEXT BOOKS:
1. Principles of Industrial Instrumentation & Control Systems, - Alavala, - Cengage Learning
2. Basic Principles – Measurements (Instrumentation) & Control Systems – S. Bhaskar – Anuradha Publications.

REFERENCE BOOKS:
1. Measurement Systems: Applications & design, E. O. Doebelin, TMH
2. Instrumentation, Measurement & Analysis, B.C. Nakra & K.K. Choudhary, TMH
3. Experimental Methods for Engineers / Holman
4. Mechanical and Industrial Measurements / R. K. Jain/ Khanna Publishers.
5. Mechanical Measurements / Sirohi and Radhakrishna / New Age International.

19EE409ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

B.Tech. IV SEM

L	T	P	C
0	0	2	1

Pre-requisites: Basic Electrical and Electronics Engineering

Course Objectives:
➢ To introduce the concepts of electrical circuits and its components
➢ To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
➢ To study and understand the different types of DC/AC machines and Transformers.
➢ To import the knowledge of various electrical installations.
➢ To introduce the concept of power, power factor and its improvement.
➢ To introduce the concepts of diodes & transistors, and
➢ To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes:
➢ To analyze and solve electrical circuits using network laws and theorems.
➢ To understand and analyze basic Electric and Magnetic circuits
➢ To study the working principles of Electrical Machines
➢ To introduce components of Low Voltage Electrical Installations
➢ To identify and characterize diodes and various types of transistors.

List of experiments/demonstrations:

PART A: ELECTRICAL
1. Verification of KVL and KCL
2. (i) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer

   (ii) Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta- star, Star-Star) in a Three Phase Transformer
3. Measurement of Active and Reactive Power in a balanced Three-phase circuit
4. Performance Characteristics of a Separately Excited DC Shunt Motor
5. Performance Characteristics of a Three-phase Induction Motor
6. No-Load Characteristics of a Three-phase Alternator

PART B: ELECTRONICS
1. Study and operation of
   (i) Multi-meters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
2. PN Junction diode characteristics
3. Zener diode characteristics and Zener as voltage Regulator
4. Input & Output characteristics of Transistor in CB / CE configuration
5. Full Wave Rectifier with & without filters
6. Input and Output characteristics of FET in CS configuration

TEXT BOOKS:
1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education.

REFERENCES:

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.

2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.

3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.

4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.

5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.

6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.

7. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.

8. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

9. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

19ME407PC: FLUID MECHANICS AND HYDRAULIC MACHINES LAB

B.Tech. IV SEM	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives:
- To understand the basic principles of fluid mechanics.
- To identify various types of flows.
- To understand boundary layer concepts and flow through pipes.
- To evaluate the performance of hydraulic turbines.
- To understand the functioning and characteristic curves of pumps.

Course Outcomes:
- Able to explain the effect of fluid properties on a flow system.
- Able to identify type of fluid flow patterns and describe continuity equation.
- To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
- To select and analyze an appropriate turbine with reference to given situation in power plants.
- To estimate performance parameters of a given Centrifugal and Reciprocating pump.
- Able to demonstrate boundary layer concepts

List of Experiments:
1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Verification of Bernoulli's Theorems.

19ME408PC: INSTRUMENTATION AND CONTROL SYSTEMS LAB

	L	T	P	C
B.Tech. IV SEM	0	0	2	1

Pre-requisites: Basic principles of Instrumentation and control systems

Course Outcomes: At the end of the course, the student will be able to Characterize and calibrate measuring devices. Identify and analyze errors in measurement. Analyze measured data using regression analysis. Calibration of Pressure Gauges, temperature, LVDT, capacitive transducer, rotameter.

LIST OF EXPERIMENTS:
1. Calibration of Pressure Gauges.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotameter for flow measurement.
10. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of McLeod gauge for low pressure.
12. Measurement and control of Pressure of a process using SCADA system.
13. Measurement and control of level in a tank using capacitive transducer with SCADA.
14. Measurement and control of temperature of a process using resistance temperature detector with SCADA.

19MC409GS: GENDER SENSITIZATION LAB
(An Activity-based Course)

B.Tech. IV SEM

L	T	P	C
0	0	2	0

COURSE DESCRIPTION
This course offers an introduction to Gender Studies, an interdisciplinary field that asks critical questions about the meanings of sex and gender in society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary. It draws on multiple disciplines – such as literature, history, economics, psychology, sociology, philosophy, political science, anthropology and media studies – to examine cultural assumptions about sex, gender, and sexuality.

This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities. This course also seeks to build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination. The course also features several exercises and reflective activities designed to examine the concepts of gender, gender-based violence, sexuality, and rights. It will further explore the impact of gender-based violence on education, health and development.

Objectives of the Course:
➢ To develop students' sensibility with regard to issues of gender in contemporary India.
➢ To provide a critical perspective on the socialization of men and women.
➢ To introduce students to information about some key biological aspects of genders.
➢ To expose the students to debates on the politics and economics of work.
➢ To help students reflect critically on gender violence.
➢ To expose students to more egalitarian interactions between men and women.

Learning Outcomes:
➢ Students will have developed a better understanding of important issues related to gender in contemporary India.
➢ Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
➢ Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
➢ Students will acquire insight into the gendered division of labour and its relation to politics and economics.
➢ Men and women students and professionals will be better equipped to work and live together as equals.
➢ Students will develop a sense of appreciation of women in all walks of life.
➢ Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT - I: UNDERSTANDING GENDER
Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men-Preparing for Womanhood. Growing up   Male. First lessons in Caste.

UNIT – II: GENDER ROLES AND RELATIONS
Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences-Declining Sex Ratio. Demographic Consequences-Gender Spectrum: Beyond the Binary

UNIT – III: GENDER AND LABOUR
Division and Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. - Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

UNIT – IV: GENDER - BASED VIOLENCE
The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No! -Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu*".
Domestic Violence: Speaking OutIs Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for my Life…."

UNIT – V: GENDER AND CULTURE
Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks- The Brave Heart.

Note: **Since it is Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.**

> ➢ *Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments. Apart from the above prescribed book, Teachers can make use of any authentic materials related to the topics given in the syllabus on "Gender".*
> ▢ **ESSENTIAL READING**: The Textbook, "*Towards a World of Equals: A Bilingual Textbook on Gender" written* by A.Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu **published by Telugu Akademi, Telangana Government in 2015.**

 ASSESSMENT AND GRADING:
  ➢ Discussion & Classroom Participation: 20%
  ➢ Project/Assignment: 30%
  ➢ End Term Exam: 50%

19ME501PC: DYNAMICS OF MACHINERY

B. Tech. V Sem.   L   T   P   C
                                                                                 3   1   0   4

Pre-requisite: Kinematics of Machinery

Course Objectives: The objective is to introduce some of the components mainly used in IC Engines and make analysis of various forces involved. Subjects deals with topics like inertia forces in slider crank mechanism; IC Engine components & the analysis like governors is introduced. It also deals with balancing of rotating & reciprocating parts. Studies are made about balancing of multi cylinder engines, Radial engines etc. study of primary & secondary forces are considered while balancing. Finally they are introduced to the topic of vibrations. The study deals with linear, longitudinal, & torsional vibrations. The idea is to introduce the concept of natural frequency and the importance of resonance and critical speeds.

Course Outcome: the study of KOM & DOM are necessary to have an idea while designing the various machine members like shafts, bearings, gears, belts & chains and various I.C. Engine Components & Machine tool parts.

UNIT – I
Precession: Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.
Static and Dynamic Force Analysis: Static force analysis of planar mechanisms – Analytical Method – Dynamic Force Analysis – D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

UNIT – II
Turning Moment Diagram and Flywheels: Engine Force Analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine – Graphical Method - Turning moment diagram –fluctuation of energy – flywheels and their design - Inertia of connecting rod- inertia force in reciprocating engines – crank effort and torque diagrams.-.

UNIT – III
Friction: pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate and cone clutches. Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake- internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

UNIT – IV
Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting – stability – effort and power of the governors.
Balancing: Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of "V" and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

UNIT – V
Vibrations: Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

TEXT BOOKS:
1. Theory of Machines /S.S.Rattan / Mc Graw Hill.
2. Theory of Machines /Sadhu Singh/ Pearson

REFERENCE BOOKS:
1. Theory of Machines and Mechanisms/Joseph E. Shigley / Oxford
2. Theory of Machines / Rao,J.S & R.V. Duggipati/ New Age

19ME502PC: DESIGN OF MACHINE MEMBERS - I

B. Tech. V Sem.   L T P C
                                                                                                             3 0 0 3

Note: Design Data books are not permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.

Pre-requisites: Engineering mechanics, mechanics of solids, manufacturing processes, metallurgy and material science.

Course Objectives:
*   To understand the general design procedures and principles in the design of machine elements.
*   To study different materials of construction and their properties and factors determining the selection of material for various applications.
*   To determine stresses under different loading conditions.
*   To learn the design procedure of different fasteners, joints, shafts and couplings.

Course Outcomes:
*   The student acquires the knowledge about the principles of design, material selection, component behavior subjected to loads, and criteria of failure.
*   Understands the concepts of principal stresses, stress concentration in machine members and fatigue loading.
*   Design on the basis of strength and rigidity and analyze the stresses and strains induced in a machine element.

UNIT – I
Introduction: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design. Tolerances and fits –BIS codes of steels.
Design for Static Strength: Simple stresses – Combined stresses – Torsional and Bending stresses – Impact stresses – Stress strain relation – Various theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations.

UNIT – II
Design for Fatigue Strength: Stress concentration–Theoretical stress Concentration factor– Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber's curve– Goodman's line– Soderberg's line.

UNIT – III
Riveted, Welded and Bolted Joints: Riveted joints- methods of failure of riveted joints- strength equations-efficiency of riveted joints-eccentrically loaded riveted joints.
Welded joints-Design of fillet welds-axial loads-circular fillet welds under bending, torsion. Welded joints under eccentric loading.
Bolted joints – Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices – bolts of uniform strength.

UNIT – IV
Keys, Cotters and Knuckle Joints: Design of keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, Gib and cotter joints-Knuckle joints.

UNIT – V
Shafts: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code. - Gaskets and seals (stationary & rotary)
Shaft Couplings: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

TEXT BOOKS:
1. Design of Machine Elements / V. Bhandari / Mc Graw Hill
2. Machine Design / Jindal / Pearson

REFERENCE BOOKS:
1. Design of Machine Elements / V. M. Faires / Macmillan
2. Design of Machine Elements-I / Kannaiah, M.H / New Age

19ME503PC: METROLOGY AND MACHINE TOOLS

B. Tech. V Sem.   **L T P C**
                                                                        3 0 0 3
Pre-requisites: None

Course Objectives: The course content enables students to:
- Acquire the knowledge of Engineering metrology and its practice which is having increasing importance in industry.
- Specifically make the student to improve applications aspect in the measurements and control of process of manufacture
- Impart the fundamental aspects of the metal cutting principles and their application in studying the behavior of various machining processes.
- Train in knowing the fundamental parts of various machine tools and their kinematic schemes.
- Discuss various principles of jigs and fixtures which will be used to hold and guide the work pieces and cutting tools in various machine tools

Course Outcome: At the end of the course, the student would be able to
- Identify techniques to minimize the errors in measurement.
- Identify methods and devices for measurement of length, angle, gear & thread parameters, surface roughness and geometric features of parts.
- Understand working of lathe, shaper, planer, drilling, milling and grinding machines.
- Comprehend speed and feed mechanisms of machine tools.
- Estimate machining times for machining operations on machine tools

UNIT – I
Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Chip formation and types of chips. Engine lathe – Principle of working, types of lathe, specifications. Taper turning,– Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

UNIT – II
Drilling and Boring Machines – Principles of working, specifications, types, operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planing machines –Principles of working – machining time calculations.

UNIT – III
Milling machines – Principles of working – Types of milling machines – Geometry of milling cutters methods of indexing. Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, machining time calculations

UNIT – IV
Limits, fits and tolerances- Types of Fits - Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly.
Limit Gauges: Taylor's principle, Design of GO and NO-GO gauges, Measurement of angles using Bevel protractor and Sine bar. Measurement of flatness using straight edges, surface plates, optical flat and auto collimator.

UNIT – V
Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf. Screw thread measurement, Gear measurement; Machine.

Tool Alignment Tests on lathe, milling and drilling machines. Coordinate Measuring Machines: Types and Applications of CMM.

TEXT BOOKS:
1. Machine Tool Practices/ Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson
2. Engineering Metrology/ R.K. Jain/ Khanna Publishers.

REFERENCE BOOKS:
1. Principles of Machine Tools, Bhattacharyya A and Sen.G.C / New Central Book Agency.
2. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson
3. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill
4. Principles of Engineering Metrology/ Rega Rajendra/ Jaico Publishers.
5. Metrology and Measurement/ Bewoor & Kulkarni/ Tata Mc Graw Hill

19SM504MS: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

B. Tech. V Sem.   L T P C
                                                                             3 0 0 3

Course Objective: To learn the basic Business types, impact of the Economy on Business and Firms specifically. To analyze the Business from the Financial Perspective.

Course Outcome: The students will understand the various Forms of Business and the impact of economic variables on the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm's financial position by analysing the Financial Statements of a Company.

UNIT – I: Introduction to Business and Economics
Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance.
Economics: Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply in Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT – II: Demand and Supply Analysis
Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.
Supply Analysis: Determinants of Supply, Supply Function & Law of Supply.

UNIT – III: Production, Cost, Market Structures & Pricing
Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.
Cost analysis: Types of Costs, Short run and Long run Cost Functions.
Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition.
Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

UNIT – IV: Financial Accounting: **Accounting concepts and Conventions, Accounting** Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts.

UNIT – V: Financial Analysis through Ratios: Concept of Ratio Analysis, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios (simple problems).
Introduction to Fund Flow and Cash Flow Analysis (simple problems).

TEXT BOOKS:

1. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata McGraw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

REFERENCES:

1. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.

19ME505PC C: THERMAL ENGINEERING - II

B. Tech. V Sem.   L   T   P   C
                                                                                             3   0   0   3

Note: **Steam Table Book Permitted.**
Pre-requisite: Thermodynamics

Course Objective**: To apply the laws of Thermodynamics to analyze steam and gas turbine cycles and to perform analysis of the major components of steam and gas turbine plants and their applications.**

Course Outcomes: At the end of the course, the student should be able to
  • Develop state – space diagrams based on the schematic diagrams of process flow of steam and gas turbine plants
  • Apply the laws of Thermodynamics to analyze thermodynamic cycles
  • Differentiate between vapour power cycles and gas power cycles
  • Infer from property charts and tables and to apply the data for the evaluation of performance parameters of the steam and gas turbine plants
  • Understand the functionality of major components of steam and gas turbine plants and to do the analysis of these components

UNIT – I
Steam Power Plant: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.
Boilers – Classification – Working principles with sketches including H.P.Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

UNIT – II
Steam Nozzles: Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.

UNIT – III
Steam Turbines: Classification – Impulse turbine; Mechanical details – Velocity diagram – Effect of friction – Power developed, Axial thrust, Blade or diagram efficiency – Condition for maximum efficiency. De-Laval Turbine - its features- Methods to reduce rotor speed-Velocity compounding and Pressure compounding- Velocity and Pressure variation along the flow – Combined velocity diagram for a velocity compounded impulse turbine.
Reaction Turbine: Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction –Velocity diagram – Parson's reaction turbine – Condition for maximum efficiency.

UNIT - IV

Steam Condensers**:** Requirements of steam condensing plant – Classification of condensers – Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources and its affects, Air pump- Cooling water requirement.

Gas Turbines: Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Actual cycle – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles – Merits and Demerits- Combustion chambers and turbines of Gas Turbine Plant- Brief Concepts.

UNIT – V

Jet Propulsion: Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods.

Rockets: Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant Rocket Engines.

TEXT BOOKS:
1. Thermal Engineering / Mahesh M Rathore/ Mc Graw Hill
2. Gas Turbines – V. Ganesan /Mc Graw Hill

REFERENCE BOOKS:
1. Gas Turbine Theory/ Saravanamuttoo, Cohen, Rogers/ Pearson
2. Fundamentals of Engineering Thermodynamics / Rathakrishnan/ PHI
3. Thermal Engineering/ Rajput/ Lakshmi Publications

19ME506PC C: OPERATIONS RESEARCH

B. Tech. V Sem.   **L T P C**
                                                              3 0 0 3

Prerequisites: None

Course Objectives: Understanding the mathematical importance of development of model in a particular optimization model for the issue and solving it.
Course Outcome: Understanding the problem, identifying variables & constants, Formulation of optimization model and applying appropriate optimization technique

UNIT - I
Development-definition-characteristics and phases-Types of models-Operations Research models- applications.
Allocation: Linear Programming Problem Formulation-Graphical solution- Simplex method-Artificial variable techniques: Two-phase method, Big-M method.

UNIT - II
Transportation problem - Formulation-Optimal solution, unbalanced transportation problem- Degeneracy.
Assignment problem- Formulation-Optimal solution,- Variants of Assignment problem-Travelling salesman problem.

UNIT - III
Sequencing- Introduction-Flow-Shop sequencing- n jobs through two machines – n jobs through three machines- Job shop sequencing-two jobs through 'm' machines
Replacement: Introduction- Replacement of items that deteriorate with time- when money value is not counted and counted- Replacement of items that fail completely- Group Replacement.

UNIT - IV
Theory of Games**: Introduction- Terminology- Solution of games with saddle points and without saddle points. 2 x 2 games- dominance principle- m x 2 & 2 x n games-Graphical method.**
Inventory**: Introduction- Single item, Deterministic models- purchase inventory models with one price break and multiple price breaks- Stochastic models _ Demand may be discrete variable or continuous variable- single period model and no setup cost.**

UNIT - V
Waiting lines**: Introduction- Terminology- Single channel- Poisson arrivals and Exponential service times with infinite population.**
Dynamic Programming: **Introduction- Terminology, Bellman's principle of optimality-Applications of Dynamic programming- shortest path problem- linear programming problem.**

TEXT BOOK:
1. Operations Research/ J. K. Sharma4e./ MacMilan
2. Introduction to OR/ Hillier & Libemann/TMH

REFERENCE BOOKS:

1. Introduction to OR/Taha/PHI
2. Operations Research/NVS Raju/SMS Education/3rd Revised Edition
3. Operations Research /A. M. Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
4. Operations Research/ Wagner/ PHI Publications.
5. Operations Research/M.V. Durga Prasad, K.Vijaya Kumar Reddy, J. Suresh Kumar/Cengage Learning.

19ME507PC: THERMAL ENGINEERING LAB

B. Tech. V Sem.   **L T P C**
                                                                                        0 0 2 1

Pre-Requisite: Thermodynamics & Thermal Engineering - I

Objective: **To understand the working principles of IC Engines, Compressors.**

List of Experiments
1. I.C. Engines Valve / Port Timing Diagrams
2. I.C. Engines Performance Test for 4 Stroke SI engines
3. I.C. Engines Performance Test for 2 Stroke SI engines
4. I.C. Engines Morse, Retardation, Motoring Tests
5. I.C. Engine Heat Balance – CI/SI Engines
6. I.C. Engines Economical speed Test on a SI engine
7. I.C. Engines effect of A/F Ratio in a SI engine
8. Performance Test on Variable Compression Ratio Engine
9. IC engine Performance Test on a 4S CI Engine at constant speed
10. Volumetric efficiency of Air – Compressor Unit
11. Dis-assembly / Assembly of Engines
12. Study of Boilers

Note: **Perform any 10 out of the 12 Exercises.**

19ME508PC: METROLOGY AND MACHINE TOOLS LAB

B. Tech. V Sem. **L T P C**
0 0 2 1

Course Objectives:
1. To import practical exposure to the metrology equipment & Machine Tools
2. To conduct experiments and understand the working of the same.

Prerequisites: Theoretical exposure to Metrology and machine tools.

List of Experiments:
1. Step turning on lathe machine
2. Taper turning on lathe machine
3. Thread cutting and knurling on lathe machine (2 exercises)
4. Measurement of cutting forces on lathe
5. Machining of holes using Drilling machines.
6. Gear cutting on the Milling machine
7. Grinding of Tool angles using Cylindrical / Surface Grinding
8. Measurement of lengths, heights, diameters by vernier calipers, micrometers.
9. Measurement of Diameter of bores by internal micrometers and dial bore indicators.
10. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
11. Angle and taper measurements by bevel protractor and sine bars.
12. Thread measurement by 2-wire and 3-wire methods.
13. Surface roughness measurement by Tally Surf.
14. Use of mechanical comparator

19ME509PC: KINEMATICS AND DYNAMICS LAB

B. Tech. V Sem.   **L T P C**
                                                               0 0 2 1

Pre-requisites:
 Prerequisites for the graduate-level course are Kinematics, Dynamics, differential equations, motion simulation, displacement, velocity, acceleration, force, torque, power, Newton's motion laws, vibration, Gyroscopic Effect, Cams, Bearings.

Course Objectives: **The objective of the lab is to understand the kinematics and dynamics of mechanical elements such as linkages, gears, cams and learn to design such elements to accomplish desired motions or tasks.**

Course Outcomes: Upon successful completion of this lab, students should be able to:
- Understand types of motion
- Analyze forces and torques of components in linkages
- Understand static and dynamic balance
- Understand forward and inverse kinematics of open-loop mechanisms

Experiments: (A Minimum of 10 experiments are to be conducted)
1. To determine the state of balance of machines for primary and secondary forces
2. To determine the frequency of torsional vibration of a given rod
3. Determine the effect of varying mass on the centre of sleeve in porter and proell governor
4. Find the motion of the follower if the given profile of the cam
5. The balance masses statically and dynamically for single rotating mass systems
6. Determine the critical speed of a given shaft for different n-conditions
7. For a simple pendulum determine time period and its natural frequency
8. For a compound pendulum determine time period and its natural frequency
9. Determine the effect of gyroscope for different motions
10. Determine time period, amplitude and frequency of undamped free longitudinal vibration of single degree spring mass systems.
11. Determine the pressure distribution of lubricating oil at various load and speed of a Journal bearing.
12. Determine time period, amplitude and frequency of damped free longitudinal vibration of single degree spring mass systems

*19MC510IPR: INTELLECTUAL PROPERTY RIGHTS

B. Tech. V Sem.   **L   T   P   C**
                                                                 3   0   0   0

UNIT – I
Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II
Trade Marks: 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 copy rights: 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
Trade Secrets: 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: 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, and international development in trade secrets law.

TEXT BOOKS & REFERENCES:
1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

19ME601PC: DESIGN OF MACHINE MEMBERS - II

B. Tech. VI Sem.   **L T P C**
                                                                                                           3 0 0 3

Note: **Design Data Book is permitted. Design of all components should include design for strength and rigidity apart from engineering performance requirements.**

Pre-requisites**: Study of engineering mechanics, design of machine members-I and theory of machines.**

Course objectives:
- To gain knowledge about designing the commonly used important machine members such as bearings, engine parts, springs, belts, gears etc.
- To design the components using the data available in design data books.

Course Outcomes:
- Knowledge about journal bearing design using different empirical relations.
- Estimation of life of rolling element bearings and their selection for given service conditions.
- Acquaintance with design of the components as per the standard, recommended procedures which is essential in design and development of machinery in industry.

UNIT – I
Sliding contact bearings: **Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.**

UNIT – II
Rolling contact bearings: Ball and roller bearings – Static load – dynamic load – equivalent radial load
– design and selection of ball & roller bearings.

UNIT – III
Engine Parts: **Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends –Pistons, Forces acting on piston – Construction, Design and proportions of piston.**

UNIT – IV
Mechanical Springs: Stresses and deflections of helical springs – Extension and compression springs
– Design of springs for fatigue loading – natural frequency of helical springs – Energy storage capacity
– helical torsion springs – Design of co-axial springs, Design of leaf springs.
Belts & Pulleys**: Transmission of power by Belt and Rope Drives, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives.**

UNIT – V
Gears: **Spur gears& Helical gears- Brief introduction involving important concepts – Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.**

TEXT BOOKS:
1. Design of Machine Elements / Spotts/ Pearson
2. Machine Design / Pandya & Shah / Charothar

REFERENCE BOOKS:
1. Design of Machine Elements-II / Kannaiah / New Age.
2. Design of Machine Elements / Sharma and Purohit/PHI
3. Design Data Book/ P.V. Ramana Murti & M. Vidyasagar/ B.S. Publications
4. Design Data Handbook/ S. Md. Jalaludeen/ Anuradha Publishers

19ME602PC: HEAT TRANSFER

B. Tech. VI Sem.   L T P C
                                                                                         3 1 0 4

Note: **Heat Transfer Data Book is permitted.**

Pre-requisite: Thermodynamics

Course Objectives**: To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications**

Course Outcome: At the end of this course, student will be able to
- Understand the basic modes of heat transfer
- Compute one dimensional steady state heat transfer with and without heat generation
- Understand and analyze heat transfer through extended surfaces
- Understand one dimensional transient conduction heat transfer
- Understand concepts of continuity, momentum and energy equations
- Interpret and analyze forced and free convective heat transfer
- Understand the principles of boiling, condensation and radiation heat transfer
- Design of heat exchangers using LMTD and NTU methods

UNIT – I
Introduction: **Modes and mechanisms of heat transfer – Basic laws of heat transfer – General discussion about applications of heat transfer.**
Conduction Heat Transfer: **Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady, and periodic heat transfer – Initial and boundary conditions**
One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders, and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

UNIT – II
One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat Generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature
One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance
– Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.

UNIT – III
Convective Heat Transfer: **Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation**
– Buckingham □ Theorem and method, application for developing semi – empirical non-dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

Forced convection: External Flows: **Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.**

UNIT – IV
Internal Flows: **Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.**

Free Convection: **Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.**
Heat Exchangers: **Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.**

UNIT - V
Heat Transfer with Phase Change:
Boiling**: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling.** Condensation: **Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.**
Radiation Heat Transfer: **Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.**

TEXT BOOKS:
1. Heat and Mass Transfer – Dixit /Mc Graw Hill
2. Heat and Mass Transfer / Altamush Siddiqui/ Cengage

REFERENCE BOOKS:
1. Essential Heat Transfer - Christopher A Long / Pearson
2. Heat Transfer –Ghoshdastidar / Oxford

19ME603PC : CAD & CAM

B. Tech. VI Sem   L   T   P   C
                                                                       3   0   0   3

Pre-requisites: **To learn the importance and use of computer in design and manufacture**

Course objectives: **To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. To understand the need for integration of CAD and CAM**

Course Outcomes: **Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces. Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components. To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.**

UNIT – I
Fundamentals of CAD/ CAM, Application of computers for Design and Manufacturing, Benefits of CAD/ CAM - Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAM software- definition of system software and application software, CAD/ CAM database and structure. Geometric Modeling: **Wire frame modeling, wire frame entities, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.**

UNIT - II
Surface modeling: **Algebraic and geometric form, Parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.**
Solid Modelling: **Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.**

UNIT – III
NC Control Production Systems: **Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.**

UNIT – IV
Group Technology: **Part families, Parts classification and coding. Production flow analysis, Machine cell design.**
Computer aided process planning: **Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.**
Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements

planning

UNIT – V

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM

TEXT BOOKS:
1. CAD/CAM Concepts and Applications / Alavala / PHI
2. CAD/CAM Principles and Applications / P. N. Rao / Mc Graw Hill

REFERENCE BOOKS:
1. CAD/CAM/ Groover M.P/ Pearson
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian / New Age

19ME609PE: UNCONVENTIONAL MACHINING PROCESSES (PE - I)

B. Tech. VI Sem   L T P C
                                                                             3 0 0 3

Course Overview: **The objective of this course is to introduce the student to more advanced topics in the machining processes. To bring out the need for Unconventional Machining Processes which will overcome the difficulties associated with Traditional Machining.**

Course Objectives:
- To teach the modeling technique for machining processes
- To teach interpretation of data for process selection
- To teach the mechanics and thermal issues associated with chip formation
- To teach the effects of tool geometry on machining force components and surface finish
- To teach the machining surface finish and material removal rate

Course Outcomes:
- Understand the basic techniques of Unconventional Machining processes modeling
- Estimate the material removal rate and cutting force, in an industrially useful manner, for Unconventional Machining processes.

UNIT – I
Introduction **– Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications.**
Ultrasonic machining – Elements of the process, mechanics of metal removal process, parameters, economic considerations, applications and limitations, recent development.

UNIT - II
Abrasive Jet Machining, Water Jet Machining And Abrasive Water Jet Machining: Basic principles, equipment, process variable, and mechanics of metal removal, MRR, application and limitations.
Electro – Chemical Processes**: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring processes, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate.**

UNIT – III
Thermal Metal Removal Processes**: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.**

UNIT – IV
Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of

cut.

UNIT - V

Application of plasma for machining, metal removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining – principle - maskants - applications.

Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

TEXT BOOKS:
1. Advanced Machining Processes / VK Jain / Allied publishers
2. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill

REFERENCE BOOKS:
1. Unconventional Manufacturing Processes/ Singh M.K/ New Age Publishers
2. Advanced Methods of Machining/ J.A. McGeough/ Springer International
3. Non-Traditional Manufacturing Processes/ Benedict G.F./ CRC Press

19ME610PE: MACHINE TOOL DESIGN (Professional Elective – I)

B. Tech. VI Sem.   L T P C
                                                                        3 0 0 3

Pre-requisites: Machine Design, Machine Tools and Metrology, Machining Science

Course Objectives: This course is designed to:
- Implement the tool design process when designing tooling for the manufacturing of a product.
- Apply Geometric Tolerancing principles in the designs of tooling.
- Evaluate and select appropriate materials for tooling applications.
- Design, develop and evaluate cutting tools and work holders for a manufactured product.
- Design, develop and evaluate appropriate Gauging systems to define limits and specifications of a work piece during the manufacturing process.
- Design, develop, and evaluate tooling for various joining processes.
- Apply ANSI standards to tool design drawings and layouts.
- Use CAD and conventional techniques in creating tooling drawings.

Course Outcomes: **At the end of the course, the student will be able to, understand basic motions involved in a machine tool, design machine tool structures, design and analyze systems for specified speeds and feeds, select subsystems for achieving high accuracy in machining, understand control strategies for machine tool operations and apply appropriate quality tests for quality assurance.**

UNIT - I
Introduction to Machine Tool Drives and Mechanisms: Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission.

UNIT - II
Regulation of Speeds and Feeds: Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

UNIT - III
Design of Machine Tool Structures: Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages.

UNIT - IV
Design of Guideways, Power Screws and Spindles: Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slideways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.
Design of Spindles and Spindle Supports: Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings.

UNIT - V

Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness Acceptance Tests

TEXT BOOKS:
1. Tool Design/ Donaldson/ Fifth Edition, McGraw Hill
2. Principles of Machine Tools/ G.C. Sen and A. Bhattacharyya /New Central Book Agency.

REFERENCE BOOKS:
1. Design of Machine Tools / D. K Pal, S. K. Basu / Oxford
2. Machine Tool Design and Numerical Control/ N.K. Mehta / Mc Graw Hill
3. Metal Cutting and Tool Design/ Ranganath B.J./ Vikas Publishers
4. Fundamentals of Tool Design/ ASTME, PHI
5. Tooling Data/ Joshi P.H./ Wheeler Publishing

19ME611PE: PRODUCTION PLANNING AND CONTROL (Professional Elective – I)

B. Tech. VI Sem.   **L   T   P   C**
                                                                              3   0   0   3

Pre-requisites: Management Science & Productivity.

Course Objectives**: Understand the importance of Production planning & control. Learning way of carrying out various functions so as to produce right product, right quantity at right time with minimum cost.**

Course Outcomes: **At the end of the course, the student will be able to understand production systems and their characteristics. Evaluate MRP and JIT systems against traditional inventory control systems. Understand basics of variability and its role in the performance of a production system. Analyze aggregate planning strategies. Apply forecasting and scheduling techniques to production systems. Understand theory of constraints for effective management of production systems.**

UNIT – I
Introduction**: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.**
Forecasting – **Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques-quantitative and qualitative techniques. Measures of forecasting errors.**

UNIT – II
Inventory management – **Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only.** Aggregate planning – **Definition – aggregate-planning strategies – aggregate planning methods – transportation model.**

UNIT – III
Line Balancing**: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.**
Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

UNIT – IV
Scheduling –**Definition – Scheduling Policies – types of scheduling methods – differences with loading**
– flow shop scheduling – job shop scheduling, line of balance (LOB) – objectives - steps involved.

UNIT – V
Dispatching**: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.**
Follow up**: definition – types of follow up – expediting – definition – expediting procedures-Applications of computers in planning and control.**

TEXT BOOKS:
1. Operations management – Heizer- Pearson.
2. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

REFERENCE BOOKS:
1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications

19ME604PC: FINITE ELEMENT METHODS

B. Tech. VI Sem   **L T P C**
                                                                         3 0 0 3

Pre-requisites: Mechanics of Solids

Course Objective**: The aim of the course is to provide the participants an overview on Finite Element Method, Material models, and Applications in Civil Engineering. At the end of the course, the participants are expected to have fair understanding of:**
- Basics of Finite Element Analysis.
- Available material models for structural materials, soils and interfaces/joints.
- Modeling of engineering systems and Soil–Structure Interaction (SSI).
- Importance of interfaces and joints on the behavior of engineering systems.
- Implementation of material model in finite element method and applications

Course Outcomes**: At the end of the course, the student will be able to, Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer. Formulate and solve problems in one dimensional structures including trusses, beams and frames. Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi- symmetric and plate bending problems. ANSYS, ABAQUS, NASTRAN, etc.**

UNIT – I
Introduction to Finite Element Methods: General Procedure – Engineering Applications – Stress and Equilibrium, Strain – Displacement relations. Stress – strain relations: Finite Elements: 1- Dimensional, 2 – Dimensional, 3-Dimensional & Interpolation Elements
One Dimensional Problems: **1-D Linear and 1-D Quadratic Elements - Finite element modeling, Coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.**

UNIT – II
Analysis of Trusses: **Derivation of Stiffness Matrix for Plane Truss, Displacement of Stress Calculations.**
Analysis of Beams: **Element stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector, Deflection.**

UNIT – III
Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, Estimation of Load Vector, Stresses
Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four noded Isoparametric elements and numerical integration.

UNIT – IV
Steady State Heat Transfer Analysis: one dimensional analysis of Slab, fin and two-dimensional analysis of thin plate.

UNIT – V

Dynamic Analysis: **Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, truss and beam.**

Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation. techniques such as semi-automatic and fully Automatic use of softwares such as ANSYS, ABAQUS, NASTRAN using Hexahedral and Tetrahedral Elements.

TEXT BOOKS:
1. Finite Element Methods: Basic Concepts and applications/Alavala/PHI
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu /Pearson

REFERENCE BOOKS:
1. An Introduction to the Finite Element Method / J. N. Reddy/ Mc Graw Hill
2. Finite Element Analysis / SS Bhavikatti / New Age
3. Finite Element Method/ Dixit/Cengage

19ME605PC : HEAT TRANSFER LAB

B. Tech. VI Sem.   **L T P C**
                                                                     3 0 0 3

Pre-requisite: Thermodynamics

Course Objectives**: To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications**

Course Outcome**: At the end of the lab sessions, the student will be able to**
- Perform steady state conduction experiments to estimate thermal conductivity of different materials
- Perform transient heat conduction experiment
- Estimate heat transfer coefficients in forced convection, free convection, condensation and correlate with theoretical values
- Obtain variation of temperature along the length of the pin fin under forced and free convection
- Perform radiation experiments: Determine surface emissivity of a test plate and Stefan- Boltzmann's constant and compare with theoretical value

Minimum twelve experiments from the following:
1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus

19ME606PC: CAD & CAM LAB

B. Tech. VI Sem.   **L T P C**
                                                                        0 0 2 1

Pre-requisites: **To give the exposure to usage of software tools for design and manufacturing. To acquire the skills needed to analyze and simulate engineering systems.**

Course Objectives: **To be able to understand and handle design problems in a systematic manner. To be able to apply CAD in real life applications. To be understand the basic principles of different types of analysis.**

Course Outcomes: **To understand the analysis of various aspects in of manufacturing design**

Note: conduct any TEN excercises from the list gien below:
1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling: Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
5. Determination of stresses in 3D and shell structures (at least one example in each case)
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
7. Study state heat transfer analysis of plane and axi-symmetric components.
8. Development of process sheets for various components based on Tooling and Machines.
9. Development of manufacturing defects and tool management systems.
10. Study of various post processors used in NC Machines.
11. Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAM software.

19EN607HS: ADVANCED COMMUNICATIONS SKILLS LAB

B. Tech. VI Sem.   L T P C
                                                                                 0 0 2 1

1. INTRODUCTION:

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organize ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

2. OBJECTIVES:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

3. SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language
   – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effective googling.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/Technical report writing/* – planning for writing – improving one's writing.

4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/ e-mails/assignments etc.

5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

4. MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics.
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
- T. V, a digital stereo & Camcorder
- Headphones of High quality

5. SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and used.

- Oxford Advanced Learner's Compass, 7th Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dream tech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)

TEXT BOOKS:

1. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition

2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

REFERENCES:

1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar and Hemalatha Nagarajan. Pearson 2007
2. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
3. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
5. English Vocabulary in Use series, Cambridge University Press 2008.
6. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley. 2012. Cengage Learning.
7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. English for Technical Communication for Engineering Students, Aysha Vishwamohan,

Tata Mc Graw-Hill 2009.

*19MC608ES: ENVIRONMENTAL SCIENCE

B. Tech. VI Sem   **L   T   P   C**
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Course Objectives:
- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures
- Understanding the environmental policies and regulations

Course Outcomes:
Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

UNIT - I
Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II
Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT - III
Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT - IV
Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.
Overview of air pollution control technologies, Concepts of bioremediation. Global Environmental Problems and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.**

UNIT - V
Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules,

biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). Towards Sustainable Future: Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:
1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:
1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

19ME701PC: REFRIGERATION AND AIR CONDITIONING

B. Tech. VII Sem.   L T P C
                                                                                         3 0 0 3

Pre-requisite: Thermodynamics

Course Objective: To apply the principles of Thermodynamics to analyze different types of refrigeration and air conditioning systems and to understand the functionality of the major components.

Course Outcomes: At the end of the course, the student should be able to Differentiate between different types of refrigeration systems with respect to application as well as conventional and unconventional refrigeration systems. Thermodynamically analyse refrigeration and air conditioning systems and evaluate performance parameters. Apply the principles of Psychometrics to design the airconditioning loads for the industrial applications.

UNIT – I
Introduction to Refrigeration: - Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycle of refrigeration.
Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air crafts- Air systems – Application of Air Refrigeration, Justification – Types of systems – Problems.

UNIT – II
Vapour compression refrigeration – working principle and essential components of the plant – Simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effectof sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – Problems.

UNIT - III
System Components: Compressors – General classification – comparison – Advantages and Disadvantages. Condensers – classification – Working Principles. Evaporators – classification – Working Principles. Expansion devices – Types – Working Principles. Refrigerants – Desirable properties – common refrigerants used – Nomenclature – Ozone Depletion – Global Warming – Azeotropes and Zeotropes.

UNIT - IV
Vapor Absorption System – Calculation of max COP – description and working of NH3 – water system
– Li – Br system. Principle of operation Three Fluid absorption system, salient
features.Steam Jet Refrigeration System – Working Principle and Basic Components
Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

UNIT – V

Introduction to Air Conditioning: Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF,ASHF, ESHF and ADP.

Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial airconditioning and Requirements – Air conditioning Load Calculations.

Air Conditioning systems - Classification of equipment, cooling, heating humidification anddehumidification, filters, grills and registers, deodorants, fans and blowers.

Heat Pump – Heat sources – different heat pump circuits – Applications.

TEXT BOOKS:

1. Refrigeration and Air conditioning / CP Arora / Mc Graw Hill
2. Refrigeration and Air-Conditioning / RC Aora / PHI

REFERENCE BOOKS:

1. Principles of Refrigeration - Dossat / Pearson
2. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / Mc Graw Hill

19ME721PC: ADDITIVE MANUFACTURING (PE - II)

B. Tech. VII Sem.   L T P C
                                                                                             3 0 0 3

Pre-requisites: Manufacturing Processes, Engineering Materials

Course Objectives:
- To understand the fundamental concepts of Additive Manufacturing (i.e. Rapid Prototyping) and3-D printing, its advantages and limitations.
- To classify various types of Additive Manufacturing Processes and know their working principle,advantages, limitations etc.
- To have a holistic view of various applications of these technologies in relevant fields such asmechanical, Bio-medical, Aerospace, electronics etc.

Course Outcomes:
- Describe various CAD issues for 3D printing and rapid prototyping and related operations forSTL model manipulation.
- Formulate and solve typical problems on reverse engineering for surface reconstruction fromphysical prototype models through digitizing and spline-based surface fitting.
- Formulate and solve typical problems on reverse engineering for surface reconstruction fromdigitized mesh models through topological modelling and subdivision surface fitting.
- Explain and summarize the principles and key characteristics of additive manufacturingtechnologies and commonly used 3D printing and additive manufacturing systems.
- Explain and summarize typical rapid tooling processes for quick batch production of plastic andmetal parts.

UNIT - I
Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes.

UNIT - II
Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT - III

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications,Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; Indirect Rapid Tooling Methods:Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling : Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT - IV

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid andInvalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT - V

RP Applications: Application - Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

TEXT BOOKS:
1. Rapid prototyping; Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/WorldScientific Publications
2. Rapid Manufacturing /D.T. Pham and S.S. Dimov/Springer

REFERENCE BOOKS:
1. Terry Wohlers, Wholers Report 2000, Wohlers Associates
2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME

19ME722PC: AUTOMATION IN MANUFACTURING (PE – II)

B.Tech. VII Sem.   L T P C
                                                                        3 0 0 3

UNIT - I
Introduction: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and too changing and machine tool control transfer the automaton.

UNIT - II
Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.
Analysis of Automated flow lines: General terminology and analysis of transfer lines without and withbuffer storage, partial automation, implementation of automated flow lines.

UNIT - III
Assembly system and line balancing: Assembly process and systems assembly line, line balancingmethods, ways of improving line balance, flexible assembly lines.

UNIT - IV
Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.
Automated storage systems, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT -V
Fundamentals of Industrial controls: Review of control theory, logic controls, sensors and actuators,Data communication and LAN in Manufacturing.
Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.

TEXT BOOK:
1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover3e./PE/PHI, 2009.

REFERENCE BOOKS:
2. Computer Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang,Pearson, 2009.
3. Automation by W. Buekinsham.

19ME723PC: MEMS (PE – II)

B.Tech. VII Sem.   **L T P C**
                                                                          3 0 0 3

Pre-requisites: Fluid Mechanics

Course Objectives: At the end of this course the student will be able to
- Integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- Understand the rudiments of Micro fabrication techniques.
- identify and understand the various sensors and actuators'
- different materials used for MEMS
- applications of MEMS to disciplines beyond Electrical and Mechanical engineering

Course Outcomes:
- Students will be able to understand working principles of currently available micro sensors, actuators, and motors, valves, pumps, and fluidics used in Microsystems.
- Students will be able to apply scaling laws that are used extensively in the conceptual design of micro devices and systems. Students will be able to differentiate between the positive and negative consequences of scaling down certain physical quantities that are pertinent to Microsystems.
- Students will be able to use materials for common micro components and devices.
- Students will be able to choose a micromachining technique, such as bulk micromachining andsurface micromachining for a specific MEMS fabrication process.
- Students will be able to understand the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching.
- Students will be able to consider recent advancements in the field of MEMS and devices.
- Students will be able communicate their results and findings orally via formal presentations andin writing through reports.

UNIT – I
Introduction to MEMS and Micro fabrication: MEMS Roadmap MEMS markets-MEMS foundries-Benefits of Miniaturization -Benefits of Scaling. Micro fabrication: Basic Fabrication Processes– oxidation -film deposition lithography–etching-ion implantation–diffusion.

UNIT - II
Surface Micromachining and Bulk Micromachining: Surface Micromachining: Basic process flow– release–stiction-material choices-residual stress-Electroplating. Bulk Micromachining: LIGA-Wet Etch- based-dissolved wafer process- SOI MEMS–Scream–MEMS–RIE–DRIE

UNIT - III
Mechanics of MEMS Materials: Stress–strain-material properties-measurement & characterization ofmechanical parameters. Microstructural Elements: bending moment and strain-flexural rigidity- residual stress boundary conditions-spring combinations.

UNIT - IV
MEMS Devices: Pressure sensors-Accelerometers-Gyroscopes-RF MEMS Switch-Temperaturesensors Humidity sensors. Microactuators: Electrostatic–piezoelectric–SMA–Thermoelectric- electromagnetic.

UNIT - V
Fluid Dynamics and Micro pumps: Viscosity–density-surface tension-continuity equation-Newton'ssecond law-Navier-Stokes equation and its interpretation-flow types.
Micro fluidics: Electro kinetics electro osmosis–electrophoresis-fabrication methods-Lab ona Chip–micropumps-microvalves.

TEXT BOOKS:
1. MEMS & Microsystems Design and Manufacture/ Tai-Ran Hsu/ Tata Mc Graw Hill
2. Microelectromechanical Systems / Bhattacharyya / Cengage

REFERENCES BOOKS:
1. Foundations of MEMS /Chang Liu / Pearson
2. MEMS/ Mahalik/ Mc Graw Hill
3. MEMS and MOEMS Technology and Applications/ PHI
4. Microsystems Design/ Stephen D. Senturia /Springer
5. Introductory MEMS – Fabrication and Applications/ Thomas M. Adams and Richard A Layton/Springer
6. Microelectronic Devices/ Dipankar Nagchaudhuri/ Pearson Education Asia

19ME731PC: POWER PLANT ENGINEERING (PE – III)

B.Tech. VII Sem.   L T P C
                                                                             3 0 0 3

Pre-Requisites: None

Course Objective: The goal of this course is to become prepared for professional engineering designof conventional and alternative power-generation plants. The learning objectives include

- Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cyclepower plants.
- A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle,hydro, wind, geothermal, solar, and alternate power plants.
- Awareness of the economic, environmental, and regulatory issues related to power generation.

Course Outcomes: At the end of the course students are able to:

- Understand the concept of Rankine cycle.
- Understand working of boilers including water tube, fire tube and high pressure boilers anddetermine efficiencies.
- Analyze the flow of steam through nozzles
- Evaluate the performance of condensers and steam turbines
- Evaluate the performance of gas turbines

UNIT – I

Introduction to the Sources of Energy – Resources and Development of Power in India.

Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipments, typesof coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

Combustion Process: Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers,spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needsand draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heatrejection. Corrosion and feed water treatment.

UNIT – II

Internal Combustion Engine Plant: Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.

Gas Turbine Plant: Introduction – classification - construction – Layout with auxiliaries – Principles ofworking of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

UNIT – III

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.**Hydro Projects and Plant:** Classification – Typical layouts – plant auxiliaries – plant operation pumpedstorage plants.

UNIT – IV

Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. **Types of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT – V

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve.

Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

TEXT BOOKS:
1. Power Plant Engineering/ P. K. Nag / Mc Graw Hill
2. Power Plant Engineering / Hegde / Pearson.

REFERENCES BOOKS:
1. Power Plant Engineering / Gupta / PHI
2. Power Plant Engineering / A K Raja / New age

19ME732PC: AUTOMOBILE ENGINEERING (PE – III)

B.Tech. VII Sem.   **L T P C**

         3 0 0 3

UNIT - I

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobileengines. – Power unit – Introduction to engine lubrication – engine servicing

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction to CRDI and TDI Systems.

UNIT - II

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling

– pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser, and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, enginetemperature indicator etc.

UNIT - III

Transmission System: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

UNIT - IV

Braking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

Steering System: Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT - V

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection

Energy alternatives

– Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels, and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits. Standard Vehicle maintenance practice.

TEXT BOOKS:

1. Automobile Engineering / William H Crouse
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, FrontlinePublications.

REFERENCE BOOKS:

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan
5. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International

19ME733PC: RENEWABLE ENERGY SOURCES (PE – III)

B. Tech. VII Sem.   **L T P C**

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Course Objectives:
- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparisonwith fossil fuels.

Course Outcomes:
- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

UNIT-I

Global and National Energy Scenario: Over view of conventional & renewable energy sources, need& development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO2 reduction potential of renewable energy- concept of Hybrid systems.

UNIT-II

Solar Energy: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, SolarThermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

UNIT-III

Wind Energy: Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection,Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

UNIT-IV

Biogas: Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomassconversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysisand liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

UNIT-V

Ocean Energy: Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, typesof turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy**: Geothermal power plants, various types, hot springs and steam ejection.

TEXT BOOKS:

1. Renewable Energy Sources / Twidell, J.W. and Weir, A./ EFN Spon Ltd., 1986.
2. Non-Conventional Energy Sources / G.D Rai/ Khanna Publishers

REFERENCE BOOKS:

1. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press,U.K, 1996.

19ME741PC: COMPUTATIONAL FLUID DYNAMICS (PE – IV)

B. Tech. VII Sem.   **L T P C**
                                                                             3 0 0 3

Pre-requisite: Heat Transfer and Fluid Mechanics

Course Objective: To apply the principles of Heat Transfer and Fluid Mechanics to formulate governing equations for physical problems and to solve those using different numerical techniques

Course Outcomes: At the end of the course, the student should be able to:
- Differentiate between different types of Partial Differential Equations and to know andunderstand appropriate numerical techniques.
- Solve the simple heat transfer and fluid flow problems using different numerical techniques,viz., FDM.
- Understand and to appreciate the need for validation of numerical solution.

UNIT - I:
Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool – Applications in various branches of Engineering
Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding the physical and numerical aspects of the PDE – One way and Two Way variables – Well posed problems – Initial and Boundary Conditions
Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition
– Pivoting – Treatment of Banded Matrices – Thomas Algorithm
Iterative Method: Gauss Seidel and Jordan Methods - Stability
Criterion

UNIT - II:
Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order andsecond order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beamsetc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization
– Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates

UNIT - III:
FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition – Explicit, implicit and semi implicit methods – Types of errors – Stability and Consistency – Von NeumannStability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE -

First order and Second order wave equations –Discretization using Explicit method - Stability criterion – Courant Number – CFL Condition - Its significance - Treatment of simple problems

UNIT - IV:
Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack's Technique
Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid Driven Cavity Problem -Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere – Obtaining Elliptic Equations

UNIT - V:
Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation – Discretization using FTCS method with respect to Upwind Scheme and TransportProperty – Upwind Scheme and Artificial Viscosity
Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell (MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm

TEXT BOOKS:
1. Computational Fluid Dynamics: The basics with applications/ John D Anderson/McGraw HillPublications
2. Numerical Heat Transfer and Fluid Flow/ S.V. Patankar/ Mc Graw Hill

REFERENCE BOOKS:
1. Computational Fluid Flow and Heat Transfer / K Muralidharan and T Sudarajan/ NarosaPublishers.
2. Computational Methods for Fluid Dynamics / Firziger & Peric/ Springer

19ME742PC: TURBO MACHINERY (PE – IV)

B. Tech. IV Year I Sem.   L T P C
                                                                    3 0 0 3

Pre-requisites: Thermal Engineering, Heat Transfer

Course Objectives:
- Provide students with opportunities to apply basic flow equations
- Train the students to acquire the knowledge and skill of analyzing different turbo machines.
- How to compare and chose machines for various operations

Course Outcomes:
- Ability to design and calculate different parameters for turbo machines
- Prerequisite to CFD and Industrial fluid power courses
- Ability to formulate design criteria
- Ability to understand thermodynamics and kinematics behind turbo machines

UNIT - I
Introduction to Turbomachinery: Classification of turbo-machines, second law of thermodynamics applied to turbine and compressors work, nozzle, diffuser work, fluid equation, continuity, Euler's, Bernoulli's, equation and its applications, expansion and compression process, reheat factor, preheat factor

UNIT - II
Fundamental Concepts of Axial and Radial Machines: Euler's equation of energy transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje's slip factor, suction pressure and net positive suction head, phenomena of cavitation in pumps, concept of specific speed, shape number, axial, radial and mixed flow machines, similarity laws.

UNIT - III
Gas Dynamics: Fundamental thermodynamic concepts, isentropic conditions, mach numbers, and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory.
Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach numbers, Pre whirl, Performance

UNIT - IV
Axial Flow Compressors: Flow Analysis, Work, and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance
Cascade Analysis: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT - V

Axial Flow Gas Turbines: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

TEXT BOOKS:
1. Principles of Turbo Machines/DG Shepherd / Macmillan
2. Turbines, Pumps, Compressors/Yahya/ Mc Graw Hill

REFERENCE BOOKS:
1. A Treatise on Turbo machines / G. Gopal Krishnan *and* D. Prithviraj/ SciTech
2. Gas Turbine Theory/ Saravanamuttoo/ Pearson
3. Turbo Machines/ A Valan Arasu/ Vikas Publishing House Pvt. Ltd.

19ME743PC: FLUID POWER SYSTEMS (PE – IV)

B.Tech. IV Year I Sem.   **L T P C**
                                                                                 3 0 0 3

Pre-requisites: Fluid Mechanics and Hydraulics Machinery

Course outcomes: After doing this, student should be able to
- Understand the Properties of fluids, Fluids for hydraulic systems,
- governing laws. distribution of fluid power, Design and analysis of typical hydraulic circuits.
- Know accessories used in fluid power system, Filtration systems and
- maintenance of system.

UNIT- I
Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. ISO symbols,energy losses in hydraulic systems. Applications, Basic types and constructions of Hydraulic pumps and motors. Pump and motor analysis. Performan curves and parameters.

UNIT- II
Hydraulic actuators, types and constructional details, lever systems, control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and Design.

UNIT- III
Proportional control valves and servo valves. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Design and analysis of typical hydraulic circuits. Regenerative circuits, high low circuits, Synchronization circuits, and accumulator sizing.

UNIT- IV
Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system. Components ofpneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development ofsingle and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling;

UNIT- V
Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel-dependent control and Time dependent control, combined control, Program Control, Electropneumatic control and air-hydraulic control, Ladder diagrams. Applications in Assembly, Feeding, Metal working, materials handling and plastics working.

TEXT BOOKS:
1. Fluid Power Control systems/ Pippenger, J.J., and R. M. Koff/ New York: McGraw Hill.
2. "Fluid Power Systems: modeling, simulation and microcomputer control"/ John Watton/Prentice Hall International.

REFERENCE BOOKS:
1. Fundamentals of Fluid Power Control. / John Watton/ 1 st Ed. Cambridge University Press,2009
2. "Fluid Power with applications"/ Anthony Esposito / Pearson Education.

19ME851PC: INDUSTRIAL ROBOTICS (PE – V)

B. Tech. VIII Sem.   L T P C
                                                                                     3 0 0 3

Pre-requisites: Basic principles of Kinematics and mechanics

Course Objectives: The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, andincorporate robotic technology in engineering systems.
- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through designprojects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

Course Outcomes: At the end of the course, the student will be able to understand the basic components of robots. Differentiate types of robots and robot grippers. Model forward and inverse kinematics of robot manipulators. Analyze forces in links and joints of a robot. Programme a robot toperform tasks in industrial applications. Design intelligent robots using sensors.

UNIT – I
Introduction: Automation and Robotics – An over view of Robotics – present and future applications. **Components of the Industrial Robotics:** common types of arms. Components, Architecture, numberof degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT – II
Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems. **Manipulator Kinematics**-H notation-H method of Assignment of frames-H Transformation Matrix, jointcoordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulators.

UNIT – III
Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler andNewton – Euler formations – Problems.
Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion
– straight line motion.

UNIT - IV
Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – End Effectors and Tools

UNIT V

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection. Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

REFERENCE BOOKS:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada, Slotine / Wiley Inter-Science
3. Robotics – Fu et al / TMH Publications.

19ME852PC: MECHANICAL VIBRATIONS (PE – V)

B. Tech. VIII Sem.   **L T P C**
                                                                            3 0 0 3

Pre-requisites: Engineering Mechanics

Course objectives: Understand various levels of vibrations and remedies for each of them.
Course Outcomes: At the end of the course, the student will be able to, Understand the causes and effects of vibration in mechanical systems. Develop schematic models for physical systems and formulate governing equations of motion. Understand the role of damping, stiffness and inertia in mechanical systems Analyze rotating and reciprocating systems and compute critical speeds. Analyzeand design machine supporting structures, vibration isolators and absorbers.

UNIT - I
Single degree of Freedom systems - I: Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolationand transmissibility.

UNIT - II
Single degree of Freedom systems - II: Response to Non-Periodic Excitations: unit impulse, unit stepand unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT - III
Two-degree freedom systems: Principal modes- undamped and damped free and forced vibrations;undamped vibration absorbers;
Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigenvalue problem; normal modes and their properties; Free and forced vibration by Modal analysis; Methodof matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete- Time systems.

UNIT - IV
Continuous system: Free vibration of strings – longitudinal oscillations of bars- traverse vibrations ofbeams- Torsional vibrations of shafts.
Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed. **Numerical Methods:** Rayleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer'smethods.
Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

UNIT - V
Sound level and subjective response to sound: Subjective response to sound, frequency dependenthuman response to sound, sound-pressure dependent human response, the decibel scale, relationshipamong sound power, sound intensity and sound pressure level, relationship between sound power leveland sound intensity, relationship between sound intensity level and sound pressure level, sound measuring instruments.

TEXT BOOKS:

1. Elements of Vibration Analysis / Meirovitch/ Mc Graw Hill
2. Principles of Vibration / Benson H. Tongue/Oxford

REFERENCE BOOKS:

1. Mechanical Vibrations / SS Rao / Pearson
2. Mechanical Vibration /Rao V. Dukkipati, J Srinivas/ PHI
3. Mechanical Vibrations/ G.K. Grover/ Nemchand & Brothers

19ME853PC: COMPOSITE MATERIALS (PE – V)

B. Tech. VIII Sem.   **L T P C**
                                                                                3 0 0 3

Course objectives:
- Develop understanding of the structure of ceramic materials on multiple length scales.
- Develop knowledge of point defect generation in ceramic materials, and their impact ontransport properties.
- To describe key processing techniques for producing metal, ceramic-, and polymer-matrixcomposites.
- To demonstrate the relationship among synthesis, processing, and properties in compositematerials.

Course Outcomes:
- Knowledge of the crystal structures of a wide range of ceramic materials and glasses.
- Able to explain how common fibers are produced and how the properties of the fibers arerelated to the internal structure.
- Able to select matrices for composite materials in different applications.
- Able to describe key processing methods for fabricating composites.

UNIT - I
Introduction: Definition, Classification of Composite materials based on structure, based on matrix, Advantages of composites, Applications of composites, Functional requirements of reinforcement and matrix.

UNIT - II
Types of reinforcements and their properties: Fibers: Carbon, Boron, Glass, Aramid, Al2O3, SiC, Natureand manufacture of glass, carbon and aramid fibres, Comparison of fibres. Role of interfaces: Wettability and Bonding, The interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial strength.

UNIT - III
Fabrication of Polymeric Matrix Composites, Structure and properties of Polymeric Matrix Composites,Interface in Polymeric Matrix Composites, Applications; Fabrication of Ceramic Matrix Composites, Properties of Ceramic Matrix Composites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites Applications of Ceramic Matrix Composites.

UNIT - IV
Fabrication of Metal Matrix Composites: Solid state fabrication, Liquid state fabrication and In-situ fabrication techniques; Interface in Metal Matrix Composites: Mechanical bonding, Chemical bonding and Interfaces in In-situ Composites; Discontinuously reinforced Metal Matrix Composites, Properties and Applications. Fabrication of Carbon fiber composites, properties, interface and applications.

UNIT - V

Micromechanics of Composites: Density, Mechanical Properties: Prediction of Elastic constants, Micromechanical approach, Halpin-Tsai equations, Transverse stresses; Thermal properties: Hydrothermal stresses and Mechanics of Load transfer from matrix to fiber.

TEXTS BOOKS:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.
2. An Introduction to Composite Materials, Hull, Cambridge, 2nd Edt. 1997.

REFERENCE BOOKS:

1. Composites, Engineered Materials Handbook, Vol. 1, ASM International, Ohio, 1988.
2. Structure and Properties of Composites, Materials Science and Technology, Vol. 13, VCH,Weinheim, Germany, 1993
3. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman& Hall, London, 1994

19ME861PC: INDUSTRIAL MANAGEMENT (PE – VI)

B. Tech. VIII Sem.   **L T P C**

                                                                   3 0 0 3

Prerequisites: None

Course objectives:
- Understand the philosophies of management gurus
- Understand the various types of organization structures and their features, and Theiradvantages and disadvantages.
- Learning various Industrial Engineering Practices like Operations Management techniques,work study, statistical quality control techniques, Job evaluation techniques and network analysis techniques.

Course outcomes:
- Able to apply principles of management
- Able to design the organization structure
- Able to apply techniques for plant location, design plant layout and value analysis
- Able to carry out work study to find the best method for doing the work and establish standardtime for a given method
- Able to apply various quality control techniques and sampling plans
- Able to do job evaluation and network analysis.

UNIT - I
Introduction to Management: Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

UNIT - II
Designing Organizational Structures: Departmentalization and Decentralization, Types of Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structureand their merits, demerits and suitability.

UNIT - III
Operations Management: Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Valueanalysis-Definition-types of values- Objectives- Phases of value analysis-Fast diagram

UNIT - IV:

Work Study: Introduction — definition — objectives — steps in work study — Method study — definition, objectives — steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations — work sampling.

Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart,

– Attributes- Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

UNIT - V

Job Evaluation: Methods of job evaluation — simple routing objective systems — classification method factor comparison method, point method, benefits of job evaluation and limitations. **Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

TEXT BOOKS
1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/KhannaPublishers.

REFERENCE BOOKS
1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.
2. Human factors in Engineering & Design/Ernest J McCormick /TMH.
3. Production & Operation Management /Paneer Selvam/PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book/Maynard.
6. Industrial Engineering Management I Ravi Shankar/Galgotia.

19ME862PC: PRODUCTION AND OPERATIONS MANAGEMENT (PE – VI)

B. Tech. VIII Sem.   **L   T   P   C**
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Prerequisites: None
Course objectives:
- Learn the importance of studying the subject: Production and Operations Management.
- Learn the characteristics of various types of production systems and understand the currentissues of operations Management.
- Understand the procedure for product design & approaches for product development.
- Learn the procedure to carry out value analysis by different methods
- Learn the methods for location of plant and plant layouts
- Understand the procedures for aggregate planning, MRP and JIT
- Learn the procedures for scheduling
- Learning the techniques for network analysis.

Course Outcomes:
- Able to execute operations management functions
- Able to carry out value analysis
- Able to carry out aggregate planning and implement MRP Or JIT
- Able to schedule the jobs so as to complete them in minimum makespan time
- Able to carry out network analysis.

UNIT - I
Operation Management – Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management.
Product design – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction toconcurrent engineering.

UNIT - II
Value engineering – objective – types of values – function & cost – product life cycle- steps in value engineering – methodology in value engineering – FAST Diagram – Matrix Method.
Location – Facility location and layout – Factors considerations in Plant location- Comparative Study ofrural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Typesof layout – line balancing.

UNIT - III
Aggregate Planning – definition – Different Strategies – Various models of Aggregate Planning – Transportation and graphical models.
Advance inventory control systems push systems – Material Requirement – Terminology – types of demands – inputs to MRP- MRP logic – Lot sizing methods – benefits and drawbacks of MRP – Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT
– JIT Production process – benefits of JIT.

UNIT - IV
Scheduling – Policies – Types of scheduling – Forward and Backward Scheduling – Grant Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobsand n machines – Line of Balance.

UNIT - V
Project Management – Programming Evaluation Review Techniques (PERT) – three times estimation
– critical path – probability of completion of project – critical path method – crashing of simple nature. –Total Quality Management – ISO 9000 Series Standards – Six Sigma

TEXT BOOKS:
1. Operations Management/ Chase/ TMH
2. Production and Operations Management/ S.N. Chary/ TMH

REFERENCE BOOKS:
1. "Operations Management / E.S. Buffs/ Wiley
2. "Operations Management "Theory and Problems/Joseph G. Monks.
3. "Production Systems Management /James I. Riggs.
4. "Production and Operations Management /Panner Selvam/ PHI
5. "Production and Operations Analysis/ Nahima/
6. Operations Management/ William J. Stevenson/ Mc Graw Hill

19ME863PC: TRIBOLOGY (PE – VI)

B. Tech. VIII Sem.
L T P C
3 0 0 3

Pre-requisites: Fluid mechanics, Design of machine members-II

Course Objectives:
- To expose the student to different types of bearings, bearing materials,
- To understand friction characteristics and power losses in journal bearings.
- To learn theory and concepts about different types of lubrication.

Course Outcomes:
- Understanding friction characteristics in journal bearings.
- Knowledge about different theories of lubrication to reduce friction and wear.

UNIT – I

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature dependent variation, viscosity index, determination of viscosity, different viscometers used.

Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

UNIT – II

Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro-dynamic theory applied to journal bearing, minimum oil film thickness, oil whipand whirl anti -friction bearing.

UNIT – III

Friction and power losses in journal bearings: Calibration of friction loss, friction in concentric bearings, bearing moduIus, Sommer-field number, heat balance, practical considerations of journal bearing design

UNIT – IV

Air lubricated bearing: Advantages and disadvantages, application to Hydrodynamic journal bearings,hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect. Study of current concepts of boundary friction and dry friction.

UNIT- V

Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. Bearing materials: General requirements of bearing materials, types of bearing materials.

TEXT BOOK:
1. Engineering Tribology/ Gwidon W. Stachowiak & Andrew W. Batchelor/ Elesevier
2. Engineering Tribology/ Prasanta Sahoo / PHI

REFERENCE BOOKS:

1. Tribology – B.C. Majumdar
2. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja/PHI
3. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co.