# **B.E.** (Mechanical Engineering) 2018 Regulations, Curriculum & Syllabi



### **BANNARI AMMAN INSTITUTE OF TECHNOLOGY**

(An Autonomous Institution Affiliated to Anna University, Chennai Approved by AICTE - Accredited by NAAC with 'A' Grade) **SATHYAMANGALAM – 638 401 Erode District Tamil Nadu** Phone : 04295 226000 Fax : 04295 226666 Web:www.bitsathy.ac.in E-mail : stayahead@bitsathy.ac.in

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### B.E. / B.Tech. Rules and Regulations-2018 Approved in XVIII Academic Council Meeting held on 28.12.2018 BANNARI AMMAN INSTITUTE OF TECHNOLOGY, SATHYAMANGALAM REGULATIONS 2018

#### (CHOICE BASED CREDIT SYSTEM)

(Common to all B.E./B.Tech. Degree Programmes)

Regulation 2018 has been prepared in accordance with the guidelines given by the University Grants Commission, All India Council for Technical Education and affiliating University incorporating the features of the Choice Based Credit System (CBCS). The Regulation 2018 is applicable to the candidates admitted to the Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) Degree Programmes of the Institution in the academic year 2018-2019 for Regular admission (Academic year 2019-2020 for Lateral Entry) and subsequently.

The regulations hereunder are subjected to amendments as may be decided by the Academic Council of the Institution from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already in the middle of the programme) as may be decided by the Academic Council.

#### 1. ADMISSION

Candidate, seeking admission to the B.E./B.Tech. Programme, shall satisfy the conditions of admission prescribed by the Directorate of Technical Education and Anna University, Chennai as given below.

#### 1.1 Regular Admission

Candidates, for admission to the first semester of the eight semesters B.E./B.Tech. Degree Programmes, shall be required to have passed:

Higher Secondary Examination (10 +2) of curriculum (Regular Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics, and Chemistry as three of the four subjects of the study prescribed under Part-III or any other examinations of any Board or University or authority accepted by the Syndicate of the University / Directorate of Technical Education (DoTE), Chennai as equivalent thereto.

#### (or)

 Should have passed Higher Secondary Examination of Vocational Stream (Engineering/Technology), prescribed by the Government of Tamil Nadu.

#### 1.2 Lateral Entry Admission

1.2.1 The candidates who possess Diploma in Engineering / Technology awarded by the State Board of Technical Education and Training, Tamil Nadu or its equivalent are eligible to apply for Lateral Entry admission to the third semester of B.E. / B.Tech. Programmes in the branch of study as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time.

#### (or)

1.2.2 The candidates who possess the Bachelor Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject in B.Sc. is eligible to apply for Lateral Entry admission to the third semester of B.E./B.Tech. Programmes, as per the eligibility criteria prescribed by the Directorate of Technical Education from time to time. Such candidates shall undergo two additional Engineering subject(s) one each in third and fourth semesters, as bridge courses.

#### 2. PROGRAMMES OFFERED

A candidate may be offered admission to any one of the programmes offered by the Institution for the candidates specified in Clause 1.1 and as per the eligibility criteria of DoTE for the candidates under Clause 1.2 from the list given below:

#### **B. E. Programmes**

- i. Aeronautical Engineering
- ii. Agricultural Engineering
- iii. Automobile Engineering
- iv. Civil Engineering
- v. Computer Science and Engineering
- vi. Electronics and Communication Engineering
- vii. Electrical and Electronics Engineering
- viii. Electronics and Instrumentation Engineering
- ix. Mechanical Engineering
- x. Mechatronics

#### **B. Tech. Programmes**

- i. Biotechnology
- ii. Fashion Technology
- iii. Food Technology
- iv. Information Technology
- v. Textile Technology

#### 3. STRUCTURE OF THE PROGRAMME

- 3.1 Every programme shall have a distinct curriculum with syllabi consisting of theory, laboratory, project, soft-skills and personality development courses, as prescribed by the respective Boards of Studies, broadly categorized under:
  - (i) **Basic Science** courses including Mathematics, Physics, Chemistry and further specialization in these subjects
  - (ii) Basic Engineering courses including Engineering Graphics, Engineering Practices, Basics of Electrical, Electronics, Civil, Mechanical Engineering, Engineering Mechanics and Computer Programming.
  - (iii) Humanities and Social Science courses including Language Courses, Management Courses, Soft Skills and Professional Ethics.
  - (iv) **Professional Courses** include Discipline Core Courses, Professional Electives, and Open Electives.
  - (v) Employability Enhancement Courses (EEC) includes Project Work and /or Internship, Seminar, Industrial /Practical Training, Value Added and Certificate Courses.

The medium of instruction is English for all the Courses, Examinations, Seminar Presentation, Projects and any other courses that a student registers for.

3.2 Each course is normally assigned a certain number of credits based on the following

Contact period per week	Credits
1 Lecture / 1 Tutorial period	1
2 laboratory Periods (Laboratory /	1
Seminar / Project Work / etc.)	

3.3 All the B.E. / B.Tech. Students will study Communicative English I during the First Semester. In the Second Semester, they will be divided into two streams based on their English language proficiency assessed in the Continuous Assessment during semester I, in which the upper segment will be provided an option to enroll and study Communicative English II / German / Japanese / French / Chinese / Hindi while the lower segment will study Communicative English II.

- 3.4 Every student shall be required to opt for Nine electives from the list of electives. Students can opt for the electives (Core / Professional) from his / her own discipline courses, during V to VIII Semesters, if he/she satisfies the prerequisite for that particular course.
- 3.5 However, out of nine electives, every student shall be required to opt for, a minimum of one and subject to a maximum of three courses as open elective from the list of electives of the branch / branches other than his / her branch of specialisation, if he/she satisfies the prerequisite for that particular course.
- 3.6 Students can also opt for **one-credit courses** of 15 to 20 hour duration, which will be offered by the experts from the industry on specialised topics. Students can opt for such **one-credit courses** during the semesters I to VI as and when these courses are offered. A student will also be permitted to register the **one-credit courses** offered by other Departments, provided the student has fulfilled the necessary pre-requisites or the courses that may not require any pre-requisites. Under no circumstances, the same one credit course shall be repeated in subsequent semesters in any Department / Centre for the same batch of the students and a maximum batch size for a given course shall not exceed 40. In case of disciplines with multiple divisions (intake more than 60) different course(s) shall be offered to other batch(es) of students.

On successful completion of one credit courses, credits will be indicated in the grade sheet as "Additional credits earned", but will not be considered for computing the Semester Grade Point Average (SGPA)/ Cumulative Grade Point Average (CGPA).

3.7 A student can register for Self-Study Elective(s) over and above the electives from any branch of Engineering / Technology at the rate of one per semester starting from V semester onwards provided he/she maintains a Cumulative Grade Point Average (CGPA) of 8.50 or above till the previous semesters with no current arrears. Credits will be indicated for such courses in the grade sheets (additional credits) but will not be considered for computing the CGPA. 3.8 A Student may be permitted to credit only one online course with the approval of the Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of three credits. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by the CoE. A student can get exemption for a maximum of 3 credits during the entire programme (in lieu of Core elective or Open elective). The Head of the Department may identify a faculty member as coordinator for the course, who is responsible for the evaluation process. The course shall be evaluated through the End Semester Examination only. The evaluation methodology may be decided by the course faculty coordinator.

#### 3.9 Industrial Training / Internship

The students may undergo Industrial training / Internship optionally for a period as specified in the table during summer / winter vacation and the credits earned will be indicated in the Mark Sheet. If the student earns three credits in Industrial Training / Internship, the student may drop one Professional Elective. In such cases, Industrial Training / Internship need to be undergone continuously from one organization only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for classification of the degree. The students may also undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) during summer / winter vacation, in lieu of Industrial training.

Duration of Training / Internship	Credits
2 Weeks	1
1 Month	2
2 Months	3

#### 3.10 Socially Relevant Projects

A Student may be permitted to carry out a socially relevant project during semester II to semester VI in consultation with the Faculty Guide and submit the project report, in the prescribed format, at the end of the Semester for the valuation.

On successful completion of socially relevant project work, one credit will be indicated in the grade sheet (Additional credits), but these credits will not be considered for computing the CGPA.

#### 4. VALUE ADDED COURSES

A Student can opt for the Value Added Courses offered by the various Department / Centres from Semester II to VII. Head of the Department / Centre shall submit the list of such courses, duly approved / ratified by the Academic Council, to the Controller of Examinations to administer the examination process. A separate Certificate will be issued on successful completion of the course by the Office of the Controller of Examinations.

#### 5. DURATION OF THE PROGRAMME

- 5.1 A regular student (admitted after 10+2) or equivalent is normally expected to satisfactorily fulfil the requirements for award of the degree B.E. / B.Tech. within four academic years (8 semesters) from the date of admission but in any case not more than 7 years (14 Semesters); lateral entry students shall fulfil such requirements within three academic years (6 semesters) from the date of admission but in any case not more than six years (12 Semesters) leading to the award of Degree of Bachelor of Engineering (B.E.) / Bachelor of Technology (B.Tech.) of Anna University, Chennai.
- 5.2 The total period for completion of the programme from the commencement of the semester, to which the student was admitted, shall not exceed the maximum period (Clause 5.1), regardless to the break-of-study (vide Clause 15) or period of prevention in order.
- 5.3 Each semester shall consist of minimum 90 working days. Head of the Department shall ensure that every faculty member teaches the subject / course as prescribed in the approved curriculum and syllabi.

5.4 Special Theory / Practical Sessions may be conducted for students who require additional inputs over and above the number of periods normally specified (Remedial Classes), as decided by the Head of the Department, within the specified duration of the Semester / Programme.

#### 6. COURSE ENROLLMENT AND REGISTRATION

- 6.1 Each student, on admission shall be assigned to a Faculty Advisor (vide Clause 8) who shall advise / counsel the student about the details of the academic programme and the choice of course(s) considering the student's academic background and career objectives.
- 6.2 Every student shall enroll for the courses of the succeeding semester, in the current semester. However, the student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the semester concerned.
- 6.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.
  - 6.3.1 Each student, on admission to the programme, shall register for all the courses prescribed in the curriculum in the first Semester of study (III Semester for students admitted under lateral entry stream).
  - 6.3.2 The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II. In case, if a student fails to register in course(s), he/ she may be permitted to register the same, as specified in the Clause 6.5, in the subsequent semesters or when it is offered.
  - 6.3.3 The enrollment for the courses of the Semesters III to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If a student wishes, the student may drop or add courses (vide Clause 6.4) within **five** working days after the commencement of the

semester concerned and complete the registration process duly authorized by the Faculty Advisor.

#### 6.4 Flexibility to Add or Drop courses

- 6.4.1 A student has to earn the total number of credits specified in the Curriculum of the respective Programme of study in order to be eligible to obtain the degree. However, if a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum by opting for one- credit courses, self study electives or additional courses.
- 6.4.2 From the III to VIII semesters (from IV to VIII Semesters in case of lateral entry students), the student has the option of registering for additional courses or dropping existing courses. The total number of credits that a student can add or drop is limited to 8, subject to a maximum of 2 courses in a given Semester. In such cases, the attendance requirement as stated in Clause 7 is mandatory.
- 6.4.3 The student shall register Project work I in semester VII and Project work II in semester VIII only.

#### 6.5 Reappearance Registration

- 6.5.1 If a student fails in a theory course, the student shall do reappearance registration (Examination) for that course in the subsequent semesters or when it is offered next.
- 6.5.2 On registration, a student may attend the classes for the reappearance registration courses, if the student wishes, and the attendance requirement (vide Clause 7) is not compulsory for such courses.
- 6.5.3 However, if a student wishes to improve his/ her continuous assessment, in the second attempt during reappearance, he/she shall satisfy the Clause 6.5.5 and appear for continuous assessment as given for that particular course.
- 6.5.4 If the theory course, in which the student has failed, is either a professional elective or an open elective, the student may register for the same or any other professional elective or open elective course, respectively in the subsequent semesters. However, the change of elective courses is permitted only once.

- 6.5.5 In this case (Clause 6.5.4), the student shall attend the classes, satisfy the attendance requirements (vide Clause 7), earn Continuous Assessment marks and appear for the End Semester Examination.
- 6.5.6 The student who fails in any continuous assessment courses (Laboratory/ Project work / Seminar or any other HSS/EEC courses) shall register for the same in the subsequent semesters or when offered next, and **repeat** the course as per Clause 6.5.5.
- 6.5.7 If a student is prevented from writing the end semester examination of a course or several courses due to lack of attendance, the student has to register for that / those course(s) again, when offered next, attend the classes and fulfill the requirements as per Clause 6.5.5 & 6.5.6. If the course, in which the student has 'lack of attendance', is a Core Elective or an Open Elective, the student may register for the same or any other Core Elective or Open Elective course(s) respectively in the subsequent semesters and appear in the examination as per Clause 6.5.5.
- 6.5.8 If a student fails to secure a pass in any theory courses (including elective) he/she is given a maximum of three arrear attempts to complete the courses. If the student still fails to secure a pass, he/she shall register for the same when offered next and repeat the course.

### 7. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide Clause 7.1 and 7.2) shall be deemed to have satisfied the attendance requirements for appearing for End Semester Examination of a particular course.

- 7.1 Every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.
- 7.2 If a student, secures attendance between 70% and 79% in any course(s) in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) or participation in Institution/ University/ State/ National/

International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate / participation certificate attested by the Head of the Department (along with Condonation form). Such certificates along with the condonation forms shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations. However during the entire programme of study, a student can avail such Condonation in any two semesters only (regardless the number of courses).

- 7.3 A student shall normally be permitted to appear for End Semester Examination of the course(s) if the student has satisfied the attendance requirements (vide Clause 7.1 7.2) and has registered for examination in those courses of that semester by paying the prescribed fee.
- 7.4 Students who do not satisfy Clause 7.1 and 7.2 and who secure less than 70% attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in the subsequent semesters or when it is offered next (vide Clause 6.5).
- 7.5 If a student has shortage of attendance in all the registered courses, he/she would not be permitted to move to the higher semester and has to repeat the current semester in the subsequent year.
- 7.6 In the case of reappearance (Arrear) registration for a course, the attendance requirement as mentioned in Clauses 7.1 7.3 is not applicable. However, the student has to register for examination in that course by paying the prescribed fee.
- 7.7 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of grades.

#### 8. FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a Faculty member of the Department who shall function as Faculty Advisor

for those students. The Faculty Advisor shall advise and guide the students in registering of courses, reappearance of courses, monitor their attendance and progress and counsel them periodically. The Faculty Advisor also discusses with or informs the parents about the progress / performance of the students concerned.

The responsibilities of the faculty advisor shall be:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- To guide student enrolment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

#### 9. COMMITTEES

#### 9.1 Common Course Committee

9.1.1 A theory course handled by more than one faculty including the discipline with multiple divisions (greater than or equal to 2) shall have a "Common Course Committee" comprising of all members of faculty teaching that course with one of the members as the Course Coordinator, nominated by the Head of the Institution (Head of the Department in the case of multiple divisions of a discipline) and student representatives (one per specialization or division) registered for that course in the current semester.

First meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

9.1.2 In addition, Common Course Committee (without the student representatives) shall meet to ensure uniform evaluation through the common question papers during Continuous Assessment and End Semester Examinations.

#### 9.2 Class Committee Meeting

For all the courses taught, prescribed in the curriculum, Class Committee meeting shall be convened thrice in a semester (first meeting within 15 days from the commencement of the semester and other two meetings at equal interval after the first meeting) comprising members of the faculty handling all the courses and two student representatives from the class.

One of the members of the faculty (preferably not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of the Committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

#### **10. SYSTEM OF EXAMINATION**

- 10.1 Performance in each course of study shall be evaluated based on (i) Continuous Assessment throughout the semester and (ii) End Semester examination at the end of the semester for the regular courses or as given in the Clause 16. However, the final examination in the case of certificate / value added courses may be conducted, as and when the course is completed, through the office of the Controller of Examinations.
- 10.2 Each course, both theory and laboratory including project work, shall be evaluated as per the Scheme of Assessment given in Clause 16.
- 10.3 The End Semester Examinations shall normally be conducted after satisfying the Clause 5.2.
- 10.4 For the End Semester examinations, both theory and project work, the internal and external examiners (from Academia or Industry) shall be appointed by the Controller of Examinations as per the guidelines given by the Examination cum Evaluation committee of the Institute.

#### **11. PASSING REQUIREMENTS AND PROVISIONS**

- 11.1 The Passing requirement for a student in a course is determined based on the marks obtained both in Continuous Assessment and End Semester Examinations. If the student gets <50% of marks in End Semester Examination, then the student will be awarded only RA (Reappearance) grade.
  - 11.1.1 If a student fails to secure a pass in a particular course, i.e., failing to obtain minimum marks, as stated above, it is mandatory that he/she shall reappear for the examination in that course in the subsequent semester(s) whenever the examinations are conducted for that course, till he / she secures a 'Pass'.

Continuous Assessment (CA) marks obtained by the student in the first appearance shall be retained and considered valid for one subsequent attempt, except Clause 6.5.4, 6.5.5, 6.5.6 and 6.5.7. However, from the third attempt onwards, the student shall be declared to have passed the course if he/she secures a minimum of 6 Grade Points (B Grade) in the course prescribed during the End Semester Examinations.

- 11.2 If a candidate fails in the seventh semester examinations of Project work I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the End semester examination of Project work II, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva-voce examination will be considered as reappearance with payment of exam fee. In case a student fails in the resubmission of a project report and subsequent viva-voce examination, the student shall register for the course again, when offered next.
- 11.3 The passing requirement for the courses which are assessed only through continuous assessment (Laboratory and EEC courses except project work), shall be fixed as minimum 50% and the remaining grades are decided as per clause 12.4. If a candidate fails in EEC courses (Except Project work), he/she has to register and repeat the course within 30 days from the date of declaration of the

results. In case a student fails to register within 30 days, he/she shall register for the course again, when offered next.

11.4 The minimum number of total credits to be earned by a student to qualify for the award of Degree in the various branches of study as prescribed by the respective Boards of Studies is given below:

	Minimum	Credits
Branch of Study	Regular	Lateral
	Admission	Entry
B.E. Programmes		
Aeronautical Engineering	172	135
Agricultural Engineering	172	134
Automobile Engineering	170	133
Civil Engineering	171	133
Computer Science and Engineering	171	133
Electronics and Communication Engineering	172	131
Electrical and Electronics Engineering	170	131
Electronics and Instrumentation Engineering	170	131
Mechanical Engineering	170	131
Mechatronics	170	132
B.Tech. Programmes		
Biotechnology	172	134
Fashion Technology	172	134
Food Technology	170	132
Information Technology	170	132
Textile Technology	171	133

- 11.5 Student Migration and Credit Transfer: Normalization of the Credits will be carried out in consultation with the Board of Studies of the programme concerned and approved by the Head of Institution, if a student migrates from other Autonomous institutions to Bannari Amman Institution of Technology or rejoins from previous regulation to this regulation.
- 11.6 A student shall be declared to have qualified for award of B.E/B.Tech. Degree if he/she successfully completes the course requirements (vide Clause 7, 10 and 11) and passed all the prescribed courses of study of the respective programme (listed in Clause 2), within the duration specified in Clause 5.1.

#### 12. ASSESSMENT AND AWARD OF LETTER GRADES

- 12.1 The assessment shall be based on the performance in the End Semester Examinations and / or Continuous Assessment, carrying marks as specified in Clause 16. Letter Grades (based on Credit Point and Grade Point) are awarded to the students based on the performance in the evaluation process.
- 12.2 Credit Point is the product of Grade Point and number of credits for a course and Grade Point is a numerical weight allotted to each letter grade on a 10-point scale (as specified in the Clause 12.4), while the Letter Grade is an index of the performance of a student in a said course.
- 12.3 Condition for Relative Grading

The minimum number of students for applying relative grading system is 30. If the students' strength is less than 30 then absolute grading system will be applied. The relative grading system shall not be applied for laboratory and EEC courses.

12.4 The performance of a student will be reported using Letter Grades in absolute grading, each carrying certain points as detailed below: In relative grading, grades will be decided by the faculty concerned. A student who earns a minimum of 6 grade points in a course is declared to have successfully passed the course.

Range of Total Marks (as specified in Clause 16) / Specific Reason	Grade Points	Letter Grade
91 to 100	10	O (Outstanding)
81 to 90	9	A + (Excellent)
71 to 80	8	A (Very Good)
61 to 70	7	B + (Good)
50 to 60	6	B (Above average)
0 to 49	0	RA (Reappearance Registration)
Incomplete	0	Ι
Withdrawal	0	W
Absent	0	AB
Shortage of Attendance	0	SA

- 'RA' ---Reappearance registration is required for that particular course
- 'I' --- Continuous evaluation is required for that particular course in the subsequent examinations.
- 'SA' --- shortage of attendance (Clause 7) and hence prevented from writing end semester examination.
- 12.5 After completion of the evaluation process, Semester Grade Point Average (SGPA), and the Cumulative Grade Point Average (CGPA) is calculated using the formula:

$$SGPA/CGPA = \frac{\sum_{i=1}^{n} C_{i} * g_{i}}{\sum_{i=1}^{n} C_{i}}$$

Where,

- $C_i$  : Credit allotted to the course.
- $g_i$  : Grade Point secured corresponding to the course.
- n : number of courses successfully cleared during the particular semester in the case of SGPA and all the semesters, under consideration, in the case CGPA.
- 12.6 A student who does not appear for the End Semester Examinations in a course, after registering for the same, shall be deemed to have appeared for that examination for the purpose of classification (Subject to Clause 14 and 15).
- 12.7 For the non credit courses grades shall be indicated as given in the Clause 16 and shall not be counted for the computation of SGPA/CGPA.
  For the Co-curricular activities such as NCC / NSS / NSO / YRC, a satisfactory / not satisfactory grading will appear in the mark sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement in the second year. A satisfactory grade in the above co-curricular activities is compulsory for the award of degree.

- 12.8 **Revaluation:** A student, who seeks the re-valuation of the answer script, is directed to apply through proper application to the Controller of Examinations in the prescribed format through the Head of the Department. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses. In the case of theory courses with laboratory component, a student can seek revaluation for the theory component only, following the procedure stated above.
- 12.9 **Supplementary Examinations**: If a student fails to secure a pass in theory course(s) of VIII semester examination, he/she is eligible to appear for a one time Supplementary Examination which shall be conducted at the end of VIII semester, for the subjects of VIII semester alone within 30 days from the date of declaration of the results.

#### 12.10 Eligibility for the Award of Degree

A student shall be declared to be eligible for the award of the B.E. / B.Tech. Degree provided the student has

- i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.
- ii. Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the courses prescribed in all the 8 semesters within a maximum period of 7 years reckoned from the commencement of the first semester to which the candidate was admitted.
- iii. Successfully completed the NCC / NSS / NSO / YRC / Extra-curricular/ Co-curricular requirements.
- iv. No disciplinary action is pending against the student.
- v. The award of Degree must have been approved by the Syndicate of the University.

#### **13. CLASSIFICATION OF THE DEGREE AWARDED**

For the purpose of the 'Award of Degree', the duration of completion of the programme shall be the total duration taken by a student for completing first time registration of all the required courses and satisfying Clause 11, regardless to the period of Break-of-study as per Clause 15 and satisfy any one of the conditions required as given below.

- 13.1 **First Class with Distinction**: A student who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction**:
  - Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry students) in the student's First Appearance within five years, which includes authorized break of study of one year. Withdrawal from examination (vide Clause 15) will not be considered as an appearance.
  - Should have secured a CGPA of not less than 8.50
  - Should **NOT** have been prevented from writing end semester examination due to lack of attendance in any of the courses.
- 13.2 **First Class**: A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:
  - Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry students) within five years, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
  - Should have secured a CGPA of not less than 7.00
- 13.3 **Second Class**: All other students (not covered in clauses 13.1 and 13.2) who qualify for the award of the degree shall be declared to have passed the examination in **Second Class**.

#### **14. WITHDRAWAL FROM THE EXAMINATION**

- 14.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme.
- 14.2 Withdrawal application shall be valid only, if the student is eligible to write the examination as per Clause 7 and, if it is made within TEN working days before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.
- 14.3 Notwithstanding the requirement of mandatory TEN working days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.
- 14.4 If a student withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examination(s).
- 14.5 Withdrawal shall not be considered as an appearance in the examination for the eligibility of a student for First Class with Distinction or First Class.
- 14.6 Withdrawal is permitted for the end semester examinations in the final semester, only if the period of study of the student concerned does not exceed 5 years as per clause 13.1 & 13.2.

#### **15. AUTHORIZED BREAK OF STUDY FROM A PROGRAMME**

- 15.1 A student is permitted to go on break of study for a fixed period of one year as a single break in the entire course of study.
- 15.2 A student is normally not permitted to break the period of study temporarily. However, if a student happens to discontinue the programme temporarily during the middle of programme of study, for reasons such as personal accident or hospitalization due to ill health or in need of health care, he/she shall apply to the Head of the Institution in advance, in any case, not later than the last date for registering for the semester examination, through the Head of the Department stating the reasons for the break-of-study (for one academic semester or 6 months, whichever is earlier). However, a student detained for want of minimum attendance

requirement as per Clause 7 shall not be considered as permitted 'Break of Study' and Clause 15.3 is not applicable for such case.

- 15.3 The student is permitted to rejoin the programme after the break / prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Dean Academics in the prescribed format through the Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.
- 15.4 Authorized break of study will be counted towards the duration specified for passing all the courses (vide Clause 5.1 and 5.2) and for the purpose of classification of Degree (vide Clause 13).
- 15.5 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 5.1, irrespective of the period of break of study in order that he / she may be eligible, for the award of the degree (vide Clause 13).
- 15.6 In case of valid reasons (as stated in Clause 15.2) extended break-of-study may be granted by the Head of the Institution for a period not more than one year in addition to the earlier authorized break of study.
- 15.7 If a student does not report back to the Institute, even after the extended Break of Study, the name of the student shall be deleted permanently from the college enrollment. Such students are not entitled to seek readmission under any circumstances.

#### 16. SCHEME OF ASSESSMENT

Courses offered under B.E. / B.Tech. Programmes are assessed as given below:

Ι	<b>THEORY COURSES</b> <b>Continuous Assessment</b> <b>Distribution of marks for Continuous Assessment:</b> <i>Periodical Test I (10)</i> <i>Periodical Test II (10)</i> <i>Innovative Practices (30)</i>	Marks 50
	End Semester Examination Total Marks	50 100
Π	THEORY COURSES WITH LAB COMPONENT Continuous AssessmentDistribution of marks for Continuous Assessment:Distribution of marks for Continuous Assessment:Periodical Test I(10)Periodical Test II(10)Innovative Practices (30)(Laboratory Assessment & Report)End Semester Examination	Marks 50
	(OD rettars to res (I))	50
	(QP pattern as per (1)) Total Marks	100
ш	LABORATORY COURSES Continuous Assessment Distribution of marks for Continuous Assessment: Conduct of Experiment i. Preparation (20) ii. Experiment and Analysis of Results (20) iii. Record (10) Test – Cycle I (25) Test – Cycle I (25)	Marks 100
	Total Marks	100
IV	PROJECT WORK I Continuous Assessment Distribution of marks for Continuous Assessment: <u>Review I</u> Literature Survey (5) Identification of topic and Justification (5) Work plan (10) <u>Review II</u> Approach & Results (15) Comelucion (15)	Marks 50

	End Semester Examination <i>Report</i> <sup>#</sup> (20)	50
	Presentation (20)	
	Total Marks	100
V	PROJECT WORK II	Marks
	Continuous Assessment	50
	Distribution of marks for Continuous Assessment:	
	<u>Review I</u>	
	Progress (10)	
	<u>Review II</u>	
	Approach & Results (10) Review III	
	Conclusion & Final Presentation (10)	
	Report (15)	
	Publication of Paper in Conferences / Journals (5)	
	End Semester Examination	
	Presentation (30)	50
	Viva voce (20)	
	Total Marks	100
VI	LANGUAGE ELECTIVE	Marks
	(CONTINUOUS ASSESSMENT ONLY)	
	<u>Test 1</u>	
	Listening (5)	
	Speaking (10)	25
	Reading (5)	
	Writing (5)	
	Test 2	
	Listening (5)	
	Speaking (10)	25
	Reading (5)	
	Writing (5)	
	Oral Exam	50
	Total Marks	100
VII	ONE-CREDIT COURSE	Marks
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	50
	Quiz/ Assignment	50
	Total Marks	100

<sup>&</sup>lt;sup>#</sup> Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department

VIII	INDUSTRIAL TRAINING/ INTERNSHIP	
V 111	(CONTINUOUS ASSESSMENT ONLY)	Marks
	Assessment by Industry	30
	Viva-voce	20
	Presentation	30
	Case Study / Report	20
	Total Marks	100
IX	SOFT SKILLS	Marks
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	25
	Test II	25
	Final Examination	50
	Total Marks	100
	Grades (Excellent / Good / Satisfactory)	
X	VALUE ADDED / CERTIFICATE COURSES	Marks
	(CONTINUOUS ASSESSMENT ONLY)	
	Test I	25
	Test II	25
	Final Evaluation / Test	50
	Total Marks	100
	Grades (Excellent / Good / Satisfactory)	
XI	ENGINEERING GRAPHICS	Marks
	Continuous Assessment	100
	Distribution of marks for Continuous Assessment:	_ • •
	Exercise (Minimum 10 Exercises/Modelling)	60
	Model Examination	40
	Total Marks	100

**Optional Test:** A student becomes eligible to appear for an optional test conducted after the Periodical Test II, only under the following circumstances: (i) absent for Test I or Test II or both on account of medical reasons (hospitalization / accident / specific illness), or (ii) participation in the College / University / State / National / International level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned member of faculty who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are not conducted for the courses under the categories III, IV, V, VI, VII, VIII, IX, X and XI listed above.

#### 17. FIELD / INDUSTRIAL VISIT / INTERNSHIP

In order to provide the experiential learning to the students, Head of the Department shall take efforts to arrange at least two industrial visits / field visits. The students may also undergo in-plant training / internship during summer / winter vacation between III and VII semesters.

#### **18. PERSONALITY AND CHARACTER DEVELOPMENT**

Every student shall be required to undergo a minimum of 40 hours of Personality Development Programmes viz, NSS / NCC / YRC / YOGA / Sports and Games / Technical and Non-technical Club activities during the first year. The attendance of the personality and character development courses / events shall be maintained on the regular basis by the concerned First Year Co-ordinators and made available in the Office of the Controller of Examinations before the commencement of Semester examinations of Semester I or Semester II.

#### **19. DISCIPLINE**

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the End Semester / Continuous Assessments, he / she shall be liable for punitive action as prescribed by the Institution / University from time to time.

#### 20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The Institution reserves the right to revise/amend/change the Regulations, Curriculum, Syllabi, Scheme of Examinations and date of implementation and to introduce Additional Electives, Open Electives, One Credit Courses and Value Added Courses through the Academic Council.

#### PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

After graduation, the Graduates of Mechanical Engineering will be able to

- PEO I Familiarize the students with applications of fundamental Science, Technology, Engineering and Mathematics in day-to-day life and enable them to present their ideas with good communication and aptitude.
- PEO II Enable the students to design and develop product / process with appropriate research to provide solutions for requirements of industry and society.
- PEO III Assist the students to, be innovative, develop entrepreneurship or pursue higher education, be ethical in profession and create healthy environment.

#### PROGRAM OUTCOMES (PO)

- a. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b. **Problem Analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- f. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- k. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 1. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### PROGRAM SPECIFIC OUTCOMES (PSo)

- m. Design, analyse and evaluate the performance of mechanical systems.
- n. Choose the appropriate methodology, materials, tools and machinery to manufacture quality products at affordable cost.
- o. Address all the fluid flow and energy transfer related problems of mechanical systems.

PEOs	PO 1	PO 2	PO 3	<b>PO</b> 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	РО 11	PO 12	PSO 1	PSO 2	PSO 3
PEO I	3	2	2	2	1	2	2	1	2	3	2	2	3	3	3
PEO II	3	3	3	3	3	3	3	2	2	2	2	2	3	2	2
PEO III	2	3	3	3	3	3	3	3	2	2	2	2	3	3	3

**Correlation of PEOs with POs and PSOs** 

#### DEPARTMENT OF MECHANICAL ENGINEERING CURRICULAM DESIGN & INTERLINKING OF COURSES

360 ° FLEXIBLE LEARNING FRAME WORK



	DEPARTMENT OF	MEC	HAN	ICAI	L ENG	INEER	ING			
	Minimum C	redits	to be	Earn	ed : 1	70				
		I SEIV	IE911				Mavi	mum N	Aarke	
Code No.	Course	L	Т	Р	С	Hours /Week		FS	Total	Category
18ME101	ENGINEERING MATHEMATICS I	3	1	0	4	4	50	50	100	BS
18ME102	ENGINEERING PHYSICS I - STATICS	2	0	2	3	4	50	50	100	BS
18ME103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18ME104	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
18ME106	COMPUTER PROGRAMMING I	0	0	4	2	4	100	0	100	ES
18ME107	ENGINEERING DRAWING	0	0	4	2	4	100	0	100	ES
	Total	10	1	16	19	27				
	J	II SEN	1EST	ER						
<b>a</b> 1 1		Ŧ	Ŧ		a	Hours	Maxi	mum N	Marks	a i
Code No.	Course	L	T	Р	C	/Week	CA	ES	Total	Category
18ME201	ENGINEERING MATHEMATICS II	3	1	0	4	4	50	50	100	BS
18ME202	ENGINEERING PHYSICS II - DYNAMICS	2	1	0	3	3	50	50	100	BS
18ME203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18ME204	BASIC ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
18ME205	MANUFACTURING PROCESSES	2	0	2	3	4	50	50	100	PC
	LANGUAGE ELECTIVE	1	0	2	2	2	100	0	100	HSS
18ME206	COMPUTER PROGRAMMING II	0	0	4	2	4	100	0	100	ES
	Total	12	2	12	20	25				

	II	I SEN	AEST	ER						
		Ŧ	Ŧ	1	2	Hours	Maxi	mum N	Marks	<b>G</b> .
Code No.	Course	L	Т	Р	С	/Week	CA	ES	Total	Category
18ME301	ENGINEERING MATHEMATICS III	3	1	0	4	4	50	50	100	BS
18ME302	FLUID MECHANICS AND MACHINERY	2	1	2	4	5	50	50	100	ES
18ME303	ENGINEERING THERMODYNAMICS	3	1	0	4	4	50	50	100	ES
18ME304	MANUFACTURING TECHNOLOGY	2	0	2	3	4	50	50	100	PC
18ME305	KINEMATICS OF MACHINES	3	1	0	4	4	50	50	100	PC
18ME306	MACHINE DRAWING LABORATORY	1	0	2	2	3	100	0	100	PC
18ME307	COMPUTER AIDED MODELLING LABORATORY I	0	0	4	2	4	100	0	100	EEC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
	Total	14	4	12	23	30				
	IV	SEN	AEST	ER						
Cada Na	IV	SEN	AEST	ER	C	Hours	Maxi	mum N	Marks	Catagori
Code No.	IV Course	SEN L	AEST T	ER P	С	Hours /Week	Maxin CA	mum M ES	Marks Total	Category
<b>Code No.</b> 18ME401	IV Course NUMERICAL METHODS	SEN L 3	AEST T	<b>ER</b> <b>P</b> 0	<b>C</b>	Hours /Week 4	Maxin CA 50	mum M ES 50	Marks Total	Category BS
Code No. 18ME401 18ME402	IV Course NUMERICAL METHODS APPLIED HYDRAULICS AND PNEUMATICS	<b>SEN</b> <b>L</b> 3 2	T T 0	<b>ER P</b> 0 2	C 4 3	Hours /Week 4 4	Maxin CA 50 50	<b>mum M</b> <b>ES</b> 50 50	<b>Total</b> 100	Category BS PC
Code No. 18ME401 18ME402 18ME403	IV         Course         NUMERICAL METHODS         APPLIED HYDRAULICS AND         PNEUMATICS         DYNAMICS OF MACHINES	<b>SEN L</b> 3 2 2	<b>T</b> 1 0 1	<b>ER P</b> 0 2 2	C 4 3 4	Hours /Week 4 4 5	Maxin CA 50 50 50	<b>mum M</b> <b>ES</b> 50 50 50	<b>Varks Total</b> 100 100 100	Category BS PC PC
Code No. 18ME401 18ME402 18ME403 18ME403	IN         Course         NUMERICAL METHODS         APPLIED HYDRAULICS AND         PNEUMATICS         DYNAMICS OF MACHINES         STRENGTH OF MATERIALS	<b>SEN L</b> 3 2 2 2 2	<b>T</b> <b>T</b> 1 0 1 1 1	ER P 0 2 2 2	C 4 3 4 4	Hours /Week 4 4 5 5 5	Maxin CA 50 50 50 50	mum M ES 50 50 50 50	<b>Total</b> 100 100 100 100	Category BS PC PC PC
Code No. 18ME401 18ME402 18ME403 18ME403 18ME404 18ME405	IN         Course         NUMERICAL METHODS         APPLIED HYDRAULICS AND         PNEUMATICS         DYNAMICS OF MACHINES         STRENGTH OF MATERIALS         THERMAL ENGINEERING	<b>SEN</b> <b>L</b> 3 2 2 2 2 2	<b>T</b> 1 0 1 1 1 1 1 1 1 1	ER P 0 2 2 2 2 2	C 4 3 4 4 4 4	Hours /Week 4 4 5 5 5 5	Maxin CA 50 50 50 50 50	mum M ES 50 50 50 50 50	<b>Varks Total</b> 100 100 100 100 100 100	Category BS PC PC PC PC PC
Code No. 18ME401 18ME402 18ME403 18ME404 18ME404 18ME405 18ME406	IN         Course         NUMERICAL METHODS         APPLIED HYDRAULICS AND         PNEUMATICS         DYNAMICS OF MACHINES         STRENGTH OF MATERIALS         THERMAL ENGINEERING         MICROPROCESSORS AND         MICROCONTROLLER	<b>SEN</b> <b>L</b> 3 2 2 2 2 2 2 2	<b>T</b> T       1       0       1       1       0       1       0	ER P 0 2 2 2 2 2 2 2	C 4 3 4 4 4 3	Hours /Week 4 4 5 5 5 5 4	Maxin CA 50 50 50 50 50 50	mum M ES 50 50 50 50 50 50	Total         100         100         100         100         100         100         100         100         100         100         100         100         100	Category BS PC PC PC PC ES
Code No. 18ME401 18ME402 18ME403 18ME404 18ME404 18ME406 18ME406 18ME406	INVIDUATION         Course         NUMERICAL METHODS         APPLIED HYDRAULICS AND         PNEUMATICS         DYNAMICS OF MACHINES         STRENGTH OF MATERIALS         THERMAL ENGINEERING         MICROPROCESSORS AND         MICROCONTROLLER         COMPUTER AIDED MODELLING         LABORATORY II	<b>SEN L</b> 3 2 2 2 2 2 0	<b>T</b> T       1       0       1       1       0       0       0       0       0       0	ER P 0 2 2 2 2 2 4	C 4 3 4 4 4 3 2	Hours /Week 4 4 5 5 5 5 4 4	Maxin CA 50 50 50 50 50 50 100	mum M ES 50 50 50 50 50 50 0	Total         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100	Category BS PC PC PC PC ES EEC
Code No. 18ME401 18ME402 18ME403 18ME403 18ME404 18ME406 18ME406 18ME406 18ME407	IN         Course         NUMERICAL METHODS         APPLIED HYDRAULICS AND         PNEUMATICS         DYNAMICS OF MACHINES         STRENGTH OF MATERIALS         THERMAL ENGINEERING         MICROPROCESSORS AND         MICROCONTROLLER         COMPUTER AIDED MODELLING         LABORATORY II         ENVIRONMENTAL SCIENCE	<b>SEN L</b> 3 2 2 2 2 2 2 0 2	<b>T</b> 1 0 1 1 0 0 0 0 0	ER P 0 2 2 2 2 2 4 0	C 4 3 4 4 4 3 2 0	Hours /Week 4 4 5 5 5 5 4 4 4 2	Maxin CA 50 50 50 50 50 50 50 100	mum M ES 50 50 50 50 50 50 0 0	Varks         Total         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100	Category BS PC PC PC PC ES EEC ES
Code No. 18ME401 18ME402 18ME403 18ME403 18ME404 18ME405 18ME406 18ME407 18HS001 18GE401	IN         Course         NUMERICAL METHODS         APPLIED HYDRAULICS AND         PNEUMATICS         DYNAMICS OF MACHINES         STRENGTH OF MATERIALS         THERMAL ENGINEERING         MICROPROCESSORS AND         MICROCONTROLLER         COMPUTER AIDED MODELLING         LABORATORY II         ENVIRONMENTAL SCIENCE         SOFT SKILLS – BUSINESS ENGLISH	<b>SEN L</b> 3 2 2 2 2 2 0 0 2 0	<b>T</b> T       1       0       1       0       0       0       0       0       0       0       0       0	ER P 0 2 2 2 2 4 0 2	C 4 3 4 4 4 4 3 2 0 -	Hours /Week 4 4 5 5 5 4 4 4 2 2	Maxin CA 50 50 50 50 50 50 100 100 100	ES           50           50           50           50           50           50           50           50           0           0           0           0	Varks         Total         100	Category BS PC PC PC ES EEC ES EEC

		V SEI	MEST	ER						
G I N	9	-	T	D	G	Hours	Maxi	mum I	Marks	
Code No.	Course	L	Т	Р	C	/Week	CA	ES	Total	Category
18ME501	METROLOGY AND INSTRUMENTATION	2	0	2	3	3	50	50	100	PC
18ME502	DESIGN OF MACHINE ELEMENTS	3	1	0	4	4	50	50	100	PC
18ME503	COMPUTER AIDED MANUFACTURING I	2	0	2	3	4	50	50	100	PC
18ME504	HEAT AND MASS TRANSFER	3	1	2	5	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I				3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE II				3	3	50	50	100	PE
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
	Total	16	2	8	21	24				-
		VI SE	MEST	ER						
					_	Hours		C (		
	C	-	T	n	0	Hours	Maxi	mum I	Marks	Category
Code No.	Course	L	Т	Р	С	/Week	Maxii CA	mum M ES	Marks Total	Category
Code No.	Course PROFESSIONAL ETHICS IN ENGINEERING	<b>L</b> 2	<b>T</b> 0	<b>P</b> 0	<b>C</b> 2	/Week	Maxin CA 50	mum M ES 50	Marks Total 100	Category HSS
Code No. 18HS002 18ME602	Course PROFESSIONAL ETHICS IN ENGINEERING MECHATRONICS	L 2 2	<b>T</b> 0 0	<b>P</b> 0 2	C 2 3	/Week 2 4	Maxin CA 50 50	mum M ES 50 50	Marks Total 100 100	Category HSS PC
Code No. 18HS002 18ME602 18ME603	CoursePROFESSIONAL ETHICS IN ENGINEERINGMECHATRONICSFINITE ELEMENT ANALYSIS	L 2 2 3	<b>T</b> 0 0 1	P           0           2           0	C 2 3 4	Hours           /Week           2           4           4           4	Maxin CA 50 50 50	<b>ES</b> 50 50 50	Marks Total 100 100 100	Category HSS PC PC
Code No. 18HS002 18ME602 18ME603 18ME604	CoursePROFESSIONAL ETHICS IN ENGINEERINGMECHATRONICSFINITE ELEMENT ANALYSISDESIGN OF TRANSMISSION SYSTEMS	L 2 2 3 3 3	<b>T</b> 0 1 1	P         0           2         0           0         0	C 2 3 4 4	A         A           4         4           4         4	Maxin           CA           50           50           50           50           50           50	ES           50           50           50           50           50	Marks Total 100 100 100 100	Category HSS PC PC PC PC
Code No. 18HS002 18ME602 18ME603 18ME604 18ME605	CoursePROFESSIONAL ETHICS IN ENGINEERINGMECHATRONICSFINITE ELEMENT ANALYSISDESIGN OF TRANSMISSION SYSTEMSCOMPUTER AIDED MANUFACTURING II	L 2 2 3 3 2	T       0       1       1       0	P         0           2         0           0         2           2         2           2         2	C 2 3 4 4 3	A         A           4         4           4         4           4         4	Maxin CA 50 50 50 50 50	ES           50           50           50           50           50           50           50	Total           100           100           100           100           100           100           100           100	Category HSS PC PC PC PC PC
Code No. 18HS002 18ME602 18ME603 18ME604 18ME605	CoursePROFESSIONAL ETHICS IN ENGINEERINGMECHATRONICSFINITE ELEMENT ANALYSISDESIGN OF TRANSMISSION SYSTEMSCOMPUTER AIDED MANUFACTURING IIPROFESSIONAL ELECTIVE III	L 2 2 3 3 2	T       0       1       1       0	P         0           2         0           0         2           2         0           2         0	C 2 3 4 4 3 3	A         A           4         4           4         4           3         3	Maxin CA 50 50 50 50 50 50	ES           50           50           50           50           50           50           50           50           50           50	Marks           Total           100           100           100           100           100           100           100           100           100           100           100           100	Category HSS PC PC PC PC PC PE
Code No. 18HS002 18ME602 18ME603 18ME604 18ME605	CoursePROFESSIONAL ETHICS IN ENGINEERINGMECHATRONICSMECHATRONICSFINITE ELEMENT ANALYSISDESIGN OF TRANSMISSION SYSTEMSCOMPUTER AIDED MANUFACTURING IIPROFESSIONAL ELECTIVE IIIPROFESSIONAL ELECTIVE IV	L 2 2 3 3 2	T       0       1       0	P         0           2         0           0         2           2         0	C 2 3 4 4 3 3 3 3	A       2       4       4       4       4       3       3	Maxin CA 50 50 50 50 50 50 50	ES           50           50           50           50           50           50           50           50           50           50           50           50           50           50	Marks           Total           100           100           100           100           100           100           100           100           100           100           100           100           100           100           100	Category HSS PC PC PC PC PC PE PE
Code No. 18HS002 18ME602 18ME603 18ME604 18ME605 18ME605	CoursePROFESSIONAL ETHICS IN ENGINEERINGMECHATRONICSMECHATRONICSFINITE ELEMENT ANALYSISDESIGN OF TRANSMISSION SYSTEMSCOMPUTER AIDED MANUFACTURING IIPROFESSIONAL ELECTIVE IIIPROFESSIONAL ELECTIVE IVECOMPUTER AIDED ENGINEERING LABORATORY	L 2 3 3 2 0	T 0 1 1 0 0	P       0       2       0       2       0       2       4	C 2 3 4 4 3 3 3 2	A       2       4       4       4       4       3       3       4	Maxin CA 50 50 50 50 50 50 50 50 100	ES           50           50           50           50           50           50           50           50           50           50           50           50           50           50           50           50           50	Marks           Total           100           100           100           100           100           100           100           100           100           100           100           100           100           100           100           100	Category HSS PC PC PC PC PE PE PE PC
Code No. 18HS002 18ME602 18ME603 18ME604 18ME605 18ME608 18ME608 18GE601	CoursePROFESSIONAL ETHICS IN ENGINEERINGMECHATRONICSMECHATRONICSFINITE ELEMENT ANALYSISDESIGN OF TRANSMISSION SYSTEMSCOMPUTER AIDED MANUFACTURING IIPROFESSIONAL ELECTIVE IIIPROFESSIONAL ELECTIVE IIICOMPUTER AIDED ENGINEERING LABORATORYSOFT SKILLS - APTITUDE II	L 2 3 3 2 0 0 0	T 0 1 1 0 0 0 0	P         0           2         0           0         2           4         2	C 2 3 4 4 3 3 3 2 -	A       2       4       4       4       4       3       3       4       2	Maxin CA 50 50 50 50 50 50 50 50 100 100	ES           50           50           50           50           50           50           50           50           50           50           50           50           0           0	Tarks         Total         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100	Category HSS PC PC PC PC PE PE PE PC EEC

VII SEMESTER										
Code No.	Course	L	Т	Р	С	Hours /Week	Maximum Marks			
							CA	ES	Total	Category
18HS003	PRINCIPLES OF MANAGEMENT	2	0	0	2	2	50	50	100	HSS
18ME702	AUTOMOBILE ENGINEERING	3	0	0	3	3	50	50	100	PC
18ME703	OPERATIONS RESEARCH	3	1	0	4	4	50	50	100	PC
18ME704	INDUSTRIAL ROBOTICS	2	0	2	3	4	50	50	100	PC
	PROFESSIONAL ELECTIVE V				3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VI				3	3	50	50	100	PE
18ME707	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total		16	1	8	21	25				
VIII SEMESTER										
Code No.	Course	L	Т	Р	С	Hours /Week	Maximum Marks			Catago
							CA	ES	Total	Calegory
	PROFESSIONAL ELECTIVE VII				3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VIII				3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IX				3	3	50	50	100	PE
18ME804	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total		9	0	18	18	27				

#### ELECTIVES LANGUAGE ELECTIVES Hours/ **Maximum Marks** L Т Р С Week Code No. Course Category CA ES Total 18HSH01 HINDI HSS 18HSG01 GERMAN HSS 18HSJ01 JAPANESE HSS 18HSC01 CHINESE HSS 18HSF01 FRENCH HSS PHYSICS ELECTIVES NANOMATERIALS SCIENCE 18GE0P1 BS SEMICONDUCTOR PHYSICS AND 18GE0P2 BS DEVICES APPLIED LASER SCIENCE 18GE0P3 BS CHEMISTRY ELECTIVES CORROSION SCIENCE AND 18GE0C1 BS ENGINEERING POLYMER SCIENCE 18GE0C3 BS 18GE0C2 ENERGY STORING DEVICES BS MATHEMATICS ELECTIVES GRAPH THEORY AND 18GE0M1 BS COMBINATORICS ALGEBRA AND NUMBER 18GE0M2 BS THEORY MATHEMATICAL FINANCE AND 18GE0M3 BS QUEUEING THEORY DISCIPLINE ELECTIVES 18ME001 COMPUTER AIDED DESIGN PE DESIGN OF JIGS, FIXTURES AND 18ME002 PE PRESS TOOLS NON - TRADITIONAL 18ME003 MACHINING PROCESSES PE 18ME004 WELDING TECHNOLOGY PE
B.E. - MECH | Minimum Credits to be earned: 170 | Regulations 2018 Approved in XVIII Academic Council Meeting held on 28.12.2018

101/15007	ADVANCED STRENGTH OF									
18ME005	MATERIALS	3	0	0	3	3	50	50	100	PE
18ME006	PROCESS PLANNING AND COST									
TOMEUUU	ESTIMATION	3	0	0	3	3	50	50	100	PE
18ME007	INTERNAL COMBUSTION	2	0	0	2		50	50	100	DE
	ENGINES	3	0	0	3	3	50	50	100	PE
18ME008	REFRIGERATION AND AIR-									
	CONDITIONING	3	0	0	3	3	50	50	100	PE
18ME009	COMPOSITES MATERIALS	3	0	0	3	3	50	50	100	PE
	STATISTICAL QUALITY									
18ME010	CONTROL AND RELIABILITY	2	0	0	2		50	50	100	DE
	ENGINEERING	3	0	0	3	3	50	50	100	PE
18ME011	MECHANICAL VIBRATIONS	3	0	0	3	3	50	50	100	PE
18ME012	SUPPLY CHAIN MANAGEMENT	3	0	0	3	3	50	50	100	PE
101/0012	COMPUTER INTEGRATED									
18ME013	MANUFACTURING	3	0	0	3	3	50	50	100	PE
101/0014	ADVANCED CASTING AND									
18ME014	FORMING PROCESSES	3	0	0	3	3	50	50	100	PE
100 0001 5	INDUSTRIAL SAFETY									
18ME015	ENGINEERING	3	0	0	3	3	50	50	100	PE
18ME016	ADDITIVE MANUFACTURING	3	0	0	3	3	50	50	100	PE
18ME017	NON - DESTRUCTIVE TESTING	3	0	0	3	3	50	50	100	PE
18ME018	RENEWABLE ENERGY SOURCES	3	0	0	3	3	50	50	100	PE
18ME019	CRYOGENIC ENGINEERING	3	0	0	3	3	50	50	100	PE
18ME020	ENGINEERING TRIBOLOGY	3	0	0	3	3	50	50	100	PE
18ME021	POWER PLANT ENGINEERING	3	0	0	3	3	50	50	100	PE
18ME022	OPTIMIZATION TECHNIQUES	3	0	0	3	3	50	50	100	PE
101/10022	DESIGN FOR MANUFACTURE									
18ME023	AND ASSEMBLY	3	0	0	3	3	50	50	100	PE
18ME024	INDUSTRIAL ENGINEERING	3	0	0	3	3	50	50	100	PE
18ME025	INDUSTRIAL MAINTENANCE ENGINEERING	3	0	0	3	3	50	50	100	PE

	COMPLITATIONAL FLUID									
18ME026	DYNAMICS	3	0	0	3	3	50	50	100	PE
18ME027	FUELS AND COMBUSTION	3	0	0	3	3	50	50	100	PE
101/0000	PRODUCTION AND OPERATIONS									
18ME028	MANAGEMENT	3	0	0	3	3	50	50	100	PE
18ME029	GREEN MANUFACTURING	3	0	0	3	3	50	50	100	PE
1914020	PRODUCT DEVELOPMENT AND									
101/16/030	REVERSE ENGINEERING	3	0	0	3	3	50	50	100	PE
101/0001	NANOMATERIALS AND									
18ME031	NANOTECHNOLOGY	3	0	0	3	3	50	50	100	PE
18ME032	TOTAL QUALITY MANAGEMENT	3	0	0	3	3	50	50	100	PE
ENTREPRI	ENEURSHIP ELECTIVES									
18GE0E1	ENTREPRENEURSHIP									
	DEVELOPMENT I	3	0	0	3	3	50	50	100	PE
18GE0E2	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	50	50	100	PE
ODEN ELE	CTIVES									
OPEN ELE	CTIVES									
OPEN ELE 18ME0YA	CTIVES INDUSTRIAL PROCESS		0	0				-0	100	
OPEN ELE 18ME0YA	<b>CTIVES</b> INDUSTRIAL PROCESS ENGINEERING	3	0	0	3	3	50	50	100	PE
<b>OPEN ELE</b> 18ME0YA 18ME0YB	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING	3	0	0	3	3	50 50	50 50	100 100	PE PE
OPEN ELE 18ME0YA 18ME0YB 18ME0YC	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING	3 3 3	0 0 0	0 0 0	3 3 3	3 3 3	50 50 50	50 50 50	100 100 100	PE PE PE
OPEN ELE 18ME0YA 18ME0YB 18ME0YC	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING BASICS OF NON-DESTRUCTIVE	3 3 3	0 0 0	0 0 0 0	3 3 3	3 3 3	50 50 50	50 50 50	100 100 100	PE PE PE
OPEN ELE 18ME0YA 18ME0YB 18ME0YC 18ME0YD	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING BASICS OF NON-DESTRUCTIVE TESTING	3 3 3 3	0 0 0	0 0 0	3 3 3 3	3 3 3 3	50 50 50 50	50 50 50 50	100 100 100	PE PE PE PE
OPEN ELE 18ME0YA 18ME0YB 18ME0YC 18ME0YD 18ME0YE	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING BASICS OF NON-DESTRUCTIVE TESTING DIGITAL MANUFACTURING	3 3 3 3 3 3	0 0 0 0	0 0 0 0	3 3 3 3 3	3 3 3 3 3	50 50 50 50 50	50 50 50 50 50	100 100 100 100 100	PE PE PE PE PE
OPEN ELE           18ME0YA           18ME0YB           18ME0YC           18ME0YD           18ME0YE	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING BASICS OF NON-DESTRUCTIVE TESTING DIGITAL MANUFACTURING WORK STUDY AND	3 3 3 3 3	0 0 0 0	0 0 0 0	3 3 3 3 3	3 3 3 3 3	50 50 50 50 50	50 50 50 50 50	100 100 100 100 100	PE PE PE PE PE
OPEN ELE 18ME0YA 18ME0YB 18ME0YC 18ME0YD 18ME0YE 18ME0YF	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING BASICS OF NON-DESTRUCTIVE TESTING DIGITAL MANUFACTURING WORK STUDY AND ERGONOMICS	3 3 3 3 3 3	0 0 0 0 0	0 0 0 0 0	3 3 3 3 3 3	3 3 3 3 3 3	50 50 50 50 50 50	50 50 50 50 50 50	100 100 100 100 100	PE PE PE PE PE PE
OPEN ELE 18ME0YA 18ME0YB 18ME0YC 18ME0YD 18ME0YF 18ME0YF 18ME0YG	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING BASICS OF NON-DESTRUCTIVE TESTING DIGITAL MANUFACTURING WORK STUDY AND ERGONOMICS METROLOGY IN INDUSTRY	3 3 3 3 3 3 3	0 0 0 0 0 0	0 0 0 0 0 0	3 3 3 3 3 3 3	3 3 3 3 3 3 3	50 50 50 50 50 50 50 50	50 50 50 50 50 50 50	100 100 100 100 100 100	PE PE PE PE PE PE
OPEN ELE 18ME0YA 18ME0YB 18ME0YC 18ME0YD 18ME0YF 18ME0YF 18ME0YG	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING BASICS OF NON-DESTRUCTIVE TESTING DIGITAL MANUFACTURING WORK STUDY AND ERGONOMICS METROLOGY IN INDUSTRY PLANT LAYOUT AND MATERIAL	3 3 3 3 3 3 3 3	0 0 0 0 0 0	0 0 0 0 0 0	3 3 3 3 3 3 3	3 3 3 3 3 3 3	50 50 50 50 50 50 50	50 50 50 50 50 50 50	100 100 100 100 100 100	PE PE PE PE PE PE
OPEN ELE 18ME0YA 18ME0YB 18ME0YC 18ME0YD 18ME0YF 18ME0YF 18ME0YG 18ME0YH	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING BASICS OF NON-DESTRUCTIVE TESTING DIGITAL MANUFACTURING WORK STUDY AND ERGONOMICS METROLOGY IN INDUSTRY PLANT LAYOUT AND MATERIAL HANDLING	3 3 3 3 3 3 3 3 3	0 0 0 0 0 0 0	0 0 0 0 0 0 0	3 3 3 3 3 3 3 3	3 3 3 3 3 3 3 3	50 50 50 50 50 50 50 50	50 50 50 50 50 50 50 50	100 100 100 100 100 100 100	PE PE PE PE PE PE PE
OPEN ELE 18ME0YA 18ME0YB 18ME0YC 18ME0YC 18ME0YF 18ME0YF 18ME0YF 18ME0YH 18ME0YH	CTIVES INDUSTRIAL PROCESS ENGINEERING SAFETY ENGINEERING MAINTENANCE ENGINEERING BASICS OF NON-DESTRUCTIVE TESTING DIGITAL MANUFACTURING WORK STUDY AND ERGONOMICS METROLOGY IN INDUSTRY PLANT LAYOUT AND MATERIAL HANDLING CONCEPTS OF ENGINEERING	3 3 3 3 3 3 3 3 3	0 0 0 0 0 0 0	0 0 0 0 0 0 0	3 3 3 3 3 3 3 3	3 3 3 3 3 3 3 3	50 50 50 50 50 50 50 50	50 50 50 50 50 50 50 50	100 100 100 100 100 100 100	PE PE PE PE PE PE PE

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	OIL HYDRAULICS AND									
18ME0YJ	PNEUMATICS	3	0	0	3	3	50	50	100	PE
19MEOVIZ	ENERGY AUDITING AND									
IONIEUIK	MANAGEMENT	3	0	0	3	3	50	50	100	PE
18ME0YL	LEAN SIX SIGMA	3	0	0	3	3	50	50	100	PE
18MF0YM	HEATING VENTILATION AND									
	AIRCONDITIONING	3	0	0	3	3	50	50	100	PE
ONE CREE	DIT COURSES									
18ME0XA	GEOMETRIC DIMENSIONING									
	AND TOLERANCING	1	0	0	1	15	100	0	100	EEC
18ME0XB	LEAN MANUFACTURING	1	0	0	1	15	100	0	100	EEC
18ME0XC	PIPING ENGINEERING	1	0	0	1	15	100	0	100	EEC
18ME0XD	PROBLEM SOLVING									
	TECHNIQUES	1	0	0	1	15	100	0	100	EEC
18ME0XE	AUTOMOTIVE EXHAUST									
	SYSTEM	1	0	0	1	15	100	0	100	EEC
18ME0XF	CONTINUOUS IMPROVEMENT	1	0	0	1	15	100	0	100	EEC
18ME0XG	INDIAN PATENT LAW	1	0	0	1	15	100	0	100	EEC
18ME0XH	RAILWAY TRACK TECHNOLOGY	1	0	0	1	15	100	0	100	EEC
18ME0XI	GLASS ENGINEERING	1	0	0	1	15	100	0	100	EEC
18ME0XJ	TOOL DESIGN AND									
	MANUFACTURING	1	0	0	1	15	100	0	100	EEC
18ME0XK	5S-INTRODUCTION AND									
	IMPLEMENTATION	1	0	0	1	15	100	0	100	EEC
18ME0XL	ENERGY AUDITING AND									
	INSTRUMENTS	1	0	0	1	15	100	0	100	EEC
18ME0XM	INDUSTRIAL CONTROL		c.	-						
	VALVES	1	0	0	1	15	100	0	100	EEC
18ME0XN	INDUSTRIAL GEARBOX DESIGN	1	0	0	1	15	100	0	100	EEC

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ADDITIONAL	ONE CREDIT COURSE									
18GE0XA	ETYMOLOGY	1	0	0	1	15	100	0	100	EEC
18GE0XB	GENERAL PSYCHOLOGY	1	0	0	1	15	100	0	100	EEC
18GE0XC	NEURO BEHAVIORAL SCIENCE	1	0	0	1	15	100	0	100	EEC
18GE0XD	VISUAL MEDIA AND FILM MAKING	1	0	0	1	15	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLENCE	1	0	0	1	15	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	1	0	0	1	15	100	0	100	EEC
18GE0XG	HEALTH AND FITNESS	1	0	0	1	15	100	0	100	EEC
18GE0XH	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	1	0	0	1	15	100	0	100	EEC
18GE0XI	BLOG WRITING	1	0	0	1	15	100	0	100	EEC
18GE0XJ	INTERPERSONAL SKILLS	1	0	0	1	15	100	0	100	EEC
18GE0XK	COMMUNITY SERVICE AND LEADERSHIP	1	0	0	1	15	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	1	0	0	1	15	100	0	100	EEC
18GE0XM	NEW AGE INNOVATION AND ENTREPRENEURSHIP	1	0	0	1	15	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES	1	0	0	1	15	100	0	100	EEC
18GE0XO	SOCIAL PSYCHOLOGY	1	0	0	1	15	100	0	100	EEC

B.E. - MECH | Minimum Credits to be earned: 170 | Regulations 2018 Approved in XVIII Academic Council Meeting held on 28.12.2018

Range of

CREDITS PER SEMESTER	

### SUMMARY OF CREDIT DISTRIBUTION

G N	CATEGORY		CREDITS PER SEM					STER		TOTAL	CREDITS	To Cre	Total Credits	
<b>5.</b> No	CATEGORY	I	II	III	IV	V	VI	VII	VIII	CREDIT	in %	Min	Max	
1	BS	10	10	4	4	-	-	-	-	28	16%	15%	20%	
2	ES	7	5	8	3	-	-	-	-	23	15%	15%	20%	
3	HSS	2	2	-	-	-	2	2	-	8	5%	5%	10%	
4	PC	-	3	9	15	15	16	10	-	68	40%	30%	40%	
5	PE	-	-	-	-	6	6	6	9	27	16%	15%	20%	
6	EEC	-	-	2	2	-	-	3	9	16	8%	7%	10%	
	Total	19	20	23	24	21	24	21	18	170	100%	-	-	

#### 18ME101 ENGINEERING MATHEMATICS I 3104

#### **Course Objectives**

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems.

#### **Course Outcomes (COs)**

- 1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigenvectors.
- 2. Analyse various types of functions and their differentiation techniques involved in engineering fields
- 3. Implement different methods of integration used in engineering problems.
- 4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
- 5. Apply the concept of analytic function to estimate the integral in complex plane.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2												2	
2	1	2												2	
3	1	2												2	
4	1	2												2	
5	1	2												2	

#### Articulation Matrix

#### UNIT I

#### COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices : Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

#### UNIT II

#### CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

#### 40

#### 9 Hours

#### UNIT III

#### **INTEGRATION METHODS**

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

#### UNIT IV

#### APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hopitals Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

#### UNIT V

#### **COMPLEX ANALYSIS**

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchys Integral Formula - Classification of Singularities - Cauchy's Residue Theorem.

#### **Reference(s)**

- 1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
- 2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
- 3. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016.
- 4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
- 5. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.

#### 9 Hours

#### 9 Hours

**Total: 60 Hours** 

#### 18ME102 ENGINEERING PHYSICS I-STATICS 2023

#### **Course Objectives**

- Familiarise basic concepts and force systems
- Provide knowledge on statics of particles in space with moment
- Impart knowledge on equilibrium of rigid bodies
- Study the moment of surfaces and solids
- Learn the concepts of static friction

#### **Course Outcomes (COs)**

- 1. Implement the free body diagram technique to resolve the forces involved in the real world mechanical systems
- 2. Compute the moment created by the applied forces with reference to any centre/axis in 2D & 3D space.
- 3. Assess the appropriate support system for the given force system due to various reactions.
- 4. Calculate the centroid, centre of gravity for geometrical bodies and moment of inertia for two dimensional sections.
- 5. Analyse the mechanism of friction and various frictional forces involved in mechanical systems

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1											2		
2	2	1											2		
3	2	1											2		
4	2	1											2		
5	2	1											2		

#### **Articulation Matrix**

#### UNIT I

#### **BASIC CONCEPTS AND FORCE SYSTEM**

Introduction to mechanics - idealization of mechanics - laws of mechanics - principle of transmissibility. Force- types - system of forces - resultant forces - composition of forces - resolution of force - free body diagram.

#### UNIT II

#### STATICS OF PARTICLES AND FORCE SYSTEM

Equilibrium of particles. Moment of force, moment of couple - equilibrant moment about point. Simplification of force and couple systems.

#### UNIT III

#### **STATICS OF RIGID BODIES**

Equilibrium of rigid bodies in two dimensions. Trusses - method of joints and method of sections. Beams - types of loads, supports and their reactions. Two and three force members - frames.

# 5 Hours

**6 Hours** 

UNIT IV 6 Hours PROPERTIES OF SURFACES AND SOLIDS Centroid - Determination of area, volume and mass - Pappus and Guldinus theorems - moment of inertia of plane and areas - radius of gyration, parallel axis and perpendicular axis theorems. Product of inertia, mass moment of inertia.
UNIT V 6 Hours FRICTION Origin of friction - types - laws of friction - friction on horizontal and inclined planes, ladder and wedge friction - rolling resistance.
13 HoursEXPERIMENT 1Experimental verification of parallelogram law
2 3 Hours EXPERIMENT 2 Experimental verification of Lamis theorem
3 4 Hours EXPERIMENT 3 Experimental demonstration of principles of moments using bell crank lever apparatus.
4 3 Hours EXPERIMENT 4 Determination of equilibrant force using polygon law of forces
5 4 Hours EXPERIMENT 5 Experimental study of equilibrium of forces in concurrent co-planar systems.
6 3 Hours EXPERIMENT 6 Experimental analysis of the reaction forces of a simply supported beam and compare the same with analytical results.
7 3 Hours EXPERIMENT 7 Determination of centroid of laminas.
8 3 Hours EXPERIMENT 8 Determination of moment of inertia of plane area.
9 4 Hours EXPERIMENT 9

Determination of coefficient of friction between two surfaces.

### **Total: 60 Hours**

#### **Reference**(s)

- 1. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2007
- 2. N.H.Dubey, Engineering Mechanics- Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2013
- 3. Irving H. Shames, Engineering Mechanics Statics and Dynamics, Pearson Education Asia Pvt. Ltd., 2006
- 4. R.C.Hibbeller, Engineering Mechanics: Combined Statics & Dynamics, Prentice Hall, 2009
- 5. D. P. Sharma, Engineering Mechanics, Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2010.
- 6. S. Rajasekaran and G. Sankara subramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2005

#### 18ME103 ENGINEERING CHEMISTRY I 2023

#### **Course Objectives**

- To outline the importance and applications of metals and alloys
- To select and fabricate a suitable alloy for a mechanical application
- To choose and identify the elements using analytical techniques

#### **Course Outcomes (COs)**

- 1. Explain the concept of atomic structure and bonds in metallic structure.
- 2. Apply the concept of phase rule in metal-alloy system.
- 3. Outline the properties and applications of ferrous and nonferrous alloys.
- 4. Indicate the importance of heat treatment of steel.
- 5. Apply suitable analytical methods for the estimation of elements.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3													2	
2	2		2											2	
3	3	2												2	
4	2			2										2	
5	3			2										2	

#### UNIT I

#### ATOMIC STRUCTURE AND CRYSTALLIZATION

Atomic structure: Introduction to fundamental concepts - dual nature of the electrons - periodic table - types of atomic interaction (ionic, covalent, coordinate covalent, metallic and Vanderwaals interactions). Metallic crystal structure - ceramic crystal structure - polymer crystal structure.

#### UNIT II

#### PHASE RULE

Phase - component - degree of freedom - solubility limit - Gibbs phase rule - phase diagram - phase equilibrium applications - one component system (water system). Reduced phase rule: Two component systems (lead and silver system and Fe-Fe3C diagrams).

#### UNIT III

#### FERROUS AND NON-FERROUS ALLOYS

Alloys: Purpose of alloying - function and effects of alloying elements - properties of alloys - classification of alloys. Composition, types, properties and applications of ferrous alloys (Steel, cast iron and stainless steel) Non-ferrous alloys (Aluminium, copper, magnesium and nickel).

#### UNIT IV

#### HEAT TREATMENT

Heat treatment of steel: Annealing - stress relief - recrystallization and spheroidizing - normalizing - hardening - tempering of steel - isothermal transformation diagram (TTT diagram) - cooling curves - carburizing - nitriding - cyaniding - carbonitriding - flame and induction hardening.

#### **6 Hours**

**6 Hours** 

#### **5 Hours**

#### UNIT V SPECTROSCOPY Baar Lamberta laux Electromegnetic spectrum electronic vibrational rotation

Beer-Lamberts law - Electromagnetic spectrum - electronic - vibrational - rotational transitions. Principle - instrumentation (Block diagram) - applications of UV visible - IR spectroscopy. Spectrophotometric estimation of iron (colorimetry).

### FURTHER READING

Study the composition, properties and applications of different ferrous and non-ferrous alloys. Application of phase rule in mechanical engineering. Importance of analytical techniques for mechanical engineering.

1	2 Hours
EXPERIMENT 1	
Instruction about safety rules, reagent handling and precautions need to be followed in lab.	
2	4 Hours
EXPERIMENT 2	
Measurement of grain size using optical metallurgical microscope.	
3	4 Hours
FYDERIMENT 3	liouis
Exitination of conner content in brass by EDTA method	
Estimation of copper content in brass by EDTA method.	
4	4 Hound
	4 nours
EXPERIMENT 4	
Microstructure analysis of steel/cast iron.	
_	
5	4 Hours
EXPERIMENT 5	
Microstructure analysis of stainless steel	
6	4 Hours
EXPERIMENT 6	
Microstructure analysis of aluminium/copper	
7	4 Hours
EXPERIMENT 7	
Determination of hardenability using Jominy end quench test	
Determination of naturality using tomming one querien test.	
8	4 Hours
U EVDEDIMENT 0	7 110ul 5
<b>EXTERNIVIENT 0</b> Estimation of iron (thiographic method) in the given solution by supertrophotometric method	1
Estimation of non (unocyanate method) in the given solution by spectrophotometric method	1 • 60 Houma
	• 00 110uls

#### **Reference**(s)

- 1. William D Callister Jr., Materials Science and Engineering: An introduction, 7th Edition, John Wiley & Sons Inc., New York, 2007.
- 2. G.E.Dieter, Mechanical Metallurgy, McGraw Hill, 2007.
- 3. V.Raghavan, Materals Science and Engineering, Prentice Hall of India, Delhi, 2009.
- 4. P. C. Jain and Monica Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publisher, New Delhi, 2016.
- 5. SashiChawla, Text Book of Engineering Chemistry, DhanpatRai Publications, New Delhi, 2013.
- 6. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, TMH, 2009.

### 18ME104 BASICS OF ELECTRICAL ENGINEERING 2023

#### **Course Objectives**

- To understand the basic concepts of electrical elements and measuring instruments.
- To indicate the electrical properties of material.
- To illustrate the construction and operation of various electrical machines.
- To illustrate the construction and operation of various electrical drives.
- To understand the various components used in electrical installations.

#### **Course Outcomes (COs)**

- 1. Explain the basic concepts of electrical elements and measuring instruments.
- 2. Differentiate the various electrical properties of material.
- 3. Classify the static and dynamic machines and explain their operation.
- 4. Analyze the operation of electrical drives.
- 5. Analyze the functions of various components used in electrical systems

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2		1									1		
2	3	2		1									1		
3	1	1	3										1		
4	2	1		3									1		
5	3	2		1									1		

### UNIT I

#### ELECTRICAL ELEMENTS AND MEASURING INSTRUMENTS

Resistance, Inductance, Capacitance, Wires and Cables. Ammeter, Voltmeter, Wattmeter, Energy meter, Thermistor and Anemometer.

#### UNIT II

#### **ELECTRICAL PROPERTIES OF MATERIAL**

Resistivity, Conductivity, Temperature co-efficient, Permittivity and Thermoelectricity. Identification of Materials by conducting resistivity test, Ohms law and Kirchhoff Law.

#### UNIT III

#### ELECTRICAL MACHINES

Construction and operating characteristics: DC Motor, Single Phase Transformer, Three phase induction motor, Single phase induction motors, Synchronous Motor, and Stepper Motor.

#### UNIT IV

#### ELECTRICAL DRIVES

Components of Electrical Drives, Selection of electric motor for drives, VFD for pumps and fans, Servo motor drive.

#### **6 Hours**

**6 Hours** 

# 6 Hours

#### BE – Mech | Minimum credits to be earned: 170 | Regulation 2018, Approved in XVIII Academic Council Meeting Held on 28.12.2018

#### UNIT V

#### **ELECTRICAL INSTALLATIONS** Types of Protection devices: Fuses, MCB, ELCB, equipments for house wiring, simple house wiring

and pump motor wiring.

# 1

## **EXPERIMENT 1**

Measure the electric properties of the given material such as resistivity, conductivity, temperature coefficient of resistance, permittivity and thermo electricity. Identify the material by conducting resistivity measurement test.

### 2

# **EXPERIMENT 2**

Development of prototype electrical generator, motor and measure the voltage, speed and torque.

## 3

# **EXPERIMENT 3**

Measure the mechanical input power, electrical output power and efficiency of synchronous generator.

### 4

# **EXPERIMENT 4**

Measure the electrical input power, mechanical output power and efficiency of Variable frequency induction motor drive.

#### 5

# **EXPERIMENT 5**

Conduct an experiment to control the speed of stepper motor and servomotor drives.

## **Reference**(s)

- 1. T.K.Nagsarkar and M.S.Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
- 2. Laszlo Solymar, Donald Walsh, Richard R. A. Syms, Electrical Properties of materials, Oxford University press, 2014.
- 3. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010.
- 4. G.K.Dubey, G, Fundamental of Electrical Drives, Narosa publishing House, New Delhi, 2012.
- 5. B.L.Theraja, A.K.Theraja, A Text Book of Electrical Technology Volume II, S.Chand and Company Ltd, New Delhi, 2016.
- 6. V. D. Toro, Electrical Engineering Fundamentals, Prentice Hall India, 2014.

**6** Hours

**6 Hours** 

# **6** Hours

**6 Hours** 

**6 Hours** 

# **6 Hours**

# **Total: 60 Hours**

#### 18HS101 COMMUNICATIVE ENGLISH I 1022

#### **Course Objectives**

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

#### **Course Outcomes (COs)**

- 1. Use appropriate grammar & vocabulary that is expected at the BEC Preliminary exam level
- 2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature
- 3. Write straightforward, routine letters of a factual nature, and make notes on routine matters, such as taking/placing orders
- 4. Follow simple presentations/demonstrations
- 5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									1						
2									2						
3									3						
4										1					
5										2					

#### **Articulation Matrix**

#### UNIT I

#### GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

#### UNIT II

#### READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

# 50

# 9 Hours

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

#### UNIT IV

#### LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

#### UNIT V

#### **SPEAKING**

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making.

- 1. Goodbye party for Miss Pushpa T S Nissim Ezekiel
- 2. Our Casuarina Tree Toru Dutt
- 3 .Palanquin Bearers Sarojini Naidu
- 4. The Tyger William Blake
- 5. Ode on a Grecian Urn John Keats

#### **Reference**(s)

- 1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
- 2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
- 3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

#### 9 Hours

#### 9 Hours

Total: 45 Hours

9 Hours

# UNIT III

# WRITING

#### 18ME106 COMPUTER PROGRAMMING I 0042

#### **Course Objectives**

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

#### **Course Outcomes (COs)**

- 1. Implement C programs using operators, type conversion and input-output functions.
- 2. Apply decision making and looping statements in writing C programs.
- 3. Develop C programs using the concepts of Arrays and Strings.
- 4. Design applications using structures in C.
- 5. Apply the concepts of functions in writing C programs.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3			3								3		
2	2	3			3								3		
3	2	3			3								3		
4	1	3			3								3		
5	1	3			3								3		

1

# **EXPERIMENT 1**

Implement a C program which include a fundamental data types Integer, Float, Double and Character.

#### 2

## **EXPERIMENT 2**

Implement a C program to perform the arithmetic operations using primitive data types.

#### 3

## **EXPERIMENT 3**

Implementation of logical, relational, bitwise, increment/decrement and Conditional Operators in C.

#### 4

## **EXPERIMENT 4**

Implementation of simple if else Conditional Statement.

### 5

#### **EXPERIMENT 5**

Implementation of nested if else Conditional Statement.

# **6 Hours**

#### 6 Hours

**6 Hours** 

**3 Hours** 

6 EXPERIMENT 6 Implementation of Switch Case Statement.	3 Hours
7 EXPERIMENT 7 Implement a C program using for Looping Statement.	3 Hours
8 EXPERIMENT 8 Implement a C program using Do-While Looping Statement.	3 Hours
9 EXPERIMENT 9 Implement a C program using While Looping Statement.	3 Hours
10 EXPERIMENT 10 Implementation of Jumping Statements	3 Hours
11 EXPERIMENT 11 Implementation of One Dimensional Array.	3 Hours
12 EXPERIMENT 12 Implementation of Two Dimensional Array.	3 Hours
13 EXPERIMENT 13 Implement a C program to perform String Manipulation Functions.	3 Hours
14 EXPERIMENT 14 Implement a C program using structures.	6 Hours
<ul><li>15</li><li>EXPERIMENT 15</li><li>Implement a C program which includes four categories of functions and recursive functions.</li></ul>	6 Hours

Total: 60 Hours

# 18ME107 ENGINEERING DRAWING 0042

# **Course Objectives**

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on orthographic projections of points and lines.
- To familiarize on projection of planes and simple solids.
- To provide knowledge on section of solids and development of surfaces of simple solids.
- To impart skill on conversion of isometric view to orthographic projection and vice versa.

# **Course Outcomes (COs)**

- 1. Understand the engineering drawing concepts as per industrial standards.
- 2. Construct orthographic projections of points and lines.
- 3. Draw the projection of planes and simple solids.
- 4. Draw the section of solids and development of surfaces.
- 5. Draw the orthographic projection from isometric view and vice versa.

# Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2									1			1		
2	2									1			1		
3	2									1			1		
4	2									1			1		
5	2									1			1		

# UNIT I

# FUNDAMENTALS OF ENGINEERING DRAWINGS

Definition, standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimension of drawings. Construction of conic sections-ellipse, parabola and hyperbola using eccentricity method.

# UNIT II

# **PROJECTION OF POINTS**

Principles of projection, projection of points in four quadrants, first angle projection of straight lines - perpendicular to one plane, parallel and inclined to both planes.

# UNIT III

# **PROJECTION OF PLANES AND SOLIDS**

Projection of simple planes and projection of simple solids parallel, perpendicular and inclined to one plane using change of position method.

# UNIT IV

# SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Section of Solids - simple position with cutting plane parallel, perpendicular and inclined to one plane. Development of surfaces - simple and truncated solids.

# 10 Hours

12 Hours

**10 Hours** 

# 12 Hours

#### 54

### UNIT V ORTHOGRAPHIC PROJECTIONS AND ISOMETRIC VIEW

Orthographic projections and isometric view of components used in engineering applications.

#### **Reference**(s)

Total: 60 Hours

- 1. K Venugpoal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2011.
- 2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
- 3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46, 2008.
- 4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
- 5. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

#### 18ME201 ENGINEERING MATHEMATICS II 3104

#### **Course Objectives**

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

#### **Course Outcomes (COs)**

- 1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
- 2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems
- 3. Recognize the differentiation properties of vectors.
- 4. Identify the complex functions and their mapping in certain complex planes.
- 5. Use the concepts of integration to complex functions in certain regions.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1											1		
2	2	2											1		
3	2	1											1		
4	2	1											1		
5	2	1											1		

#### UNIT I

#### PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

#### UNIT II

#### **MULTIPLE INTEGRALS**

Double integrals, regions of integration, triple integrals, applications (Cartesian coordinates only-Greens theorem and Gauss Divergence theorem).

#### UNIT III

#### ANALYTIC FUNCTIONS

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

# 9 Hours

#### 9 Hours

## UNIT IV

# FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoullis equation, applications.

# UNIT V

# SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

# **Reference**(s)

# Total: 60 Hours

- 1. C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd, 2003.
- 2. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2015.
- 3. J. A. Brown and R. V. Churchill, Complex Variables and Applications , Sixth Edition, McGraw Hill, New Delhi, 1996.
- 4. B. S. Grewal, Higher Engineering Mathematics, Forty third Edition, Khanna Publications, New Delhi 2014.
- 5. Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014.

# 9 Hours

#### **18ME202 ENGINEERING PHYSICS II - DYNAMICS** 2103

#### **Course Objectives**

- Impart knowledge in kinematics of particles
- Familiarize the basic concepts of force, mass and acceleration •
- Determine the nature of force associated with work and energy •
- Summarize the motion of rigid bodies •
- Solve the realistic problems related to rigid body kinetics •

#### **Course Outcomes (COs)**

- 1. Determine the solution for the problems related to kinematics of particles.
- 2. Evaluate the relation existing among force, mass and acceleration of particles.
- 3. Calculate forces associated with work, energy, impulse and momentum.
- 4. Analyze the geometric motion of rigid bodies.
- 5. Apply the concepts of rigid body kinetics to solve engineering problems.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1											2		
2	2	1											2		
3	2	1											2		
4	2	1											2		
5	2	1											2		

#### UNIT I

#### **KINEMATICS OF PARTICLES**

Introduction to dynamics Rectilinear motion displacement, velocity and acceleration Equations of motion Curvilinear motion angular displacement, velocity and acceleration. Types of coordinates system rectangular, tangential and normal.

#### UNIT II

#### **KINETICS OF PARTICLES I: FORCE, MASS AND ACCELERATION**

Introduction to kinetics Newton second law of motion Equations of motion Problems on rectangular coordinates, normal and tangential components. Dynamic equilibrium Alembert principle.

#### UNIT III

#### KINETICS OF PARTICLES II: WORK ENERGY AND IMPULSE MOMENTUM

Principle of work conservative and non-conservative forces. Principle of energy potential energy, kinetic energy, conservation of energy. Principles of Impulse and Momentum principle of conservation of linear momentum. Impact direct, central, non-central, oblique coefficient of restitution.

**6 Hours** 

**6 Hours** 

#### UNIT IV

#### PLANE KINEMATICS OF RIGID BODIES

Introduction to planar kinematics Types of motion Rectilinear and curvilinear Translation motion, Rotational motion about a fixed axis, General plane motion Absolute and relative velocity Instantaneous centre of rotation and acceleration.

#### UNIT V

#### PLANAR KINETICS OF RIGID BODIES

Introduction to 2-D kinetics Force and Acceleration General equations of motion. Principle of work and Energy work done by a couple, spring principle of conservation of energy. Principle of impulse and momentum linear momentum.

#### **Reference**(s)

- 1. Beer, Johnston, Mazurek, Cornwells and Sanghi, Vector Mechanics for Engineers: Statics, Dynamics, 10th Edition, Tata McGraw Hill Noida, Uttar Pradesh, 2013.
- 2. N.H. Dubey, Engineering Mechanics Statics and Dynamics, First Edition, McGraw-Hill Education India Private Ltd., New Delhi, 2012.
- 3. R.C. Hibbeler, Engineering Mechanics: Dynamics, 13th Edition, Prentice Hall, 2012.
- 4. J.L. Meriam and L.G. Kraige, Engineering Mechanics: Dynamics, 7th Edition, Wiley India Private Limited, 2013.
- 5. Irving H. Shames, Engineering Mechanics Statics and Dynamics, 4th Edition, Pearson India, 2011.
- 6. www.nptel.iitm.ac.in/video.php?subjectId=122104015.

#### **6 Hours**

# 6 Hours

**Total: 45 Hours** 

#### 18ME203 ENGINEERING CHEMISTRY II 2023

#### **Course Objectives**

- To understand the importance of electrochemistry in batteries and corrosion control.
- To realize the structure property relationship with properties of polymers.
- To identify the utility of smart materials in engineering applications.

#### **Course Outcomes (COs)**

- 1. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems.
- 2. Analyze the type of corrosion, factors influencing rate of corrosion on metals and identify a suitable corrosion control method.
- 3. Realize the importance of polymers based on its source, properties and applications.
- 4. Recognize the applications of glass, ceramics, cement, abrasives and refractories in engineering applications.
- 5. Identify the properties and applications of composites and smart materials.

#### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2											2	
2	3	2	1	2										2	
3	2		2											2	
4	2		2	1										2	
5	2		2	1										2	

#### UNIT I

#### ELECTROCHEMISTRY

Electrodes Electrode potential (single & standard electrode potential). Cells: half cell cell reactions cell representation types (difference between electrochemical and electrolytic cells). Types of electrodes Calomel electrode determination of single electrode potential electrochemical series and its importance and ion-selective electrode (glass electrode measurement of pH using glass electrode). Batteries: Difference between cell and a battery Primary and secondary batteries Construction and working of Lead acid and Lithium battery.

#### UNIT II

#### **CORROSION SCIENCE**

Corrosion: types of corrosion: chemical (types of oxide layer: stable, unstable, volatile and porous, Pilling-Bedworth rule) and electrochemical corrosion (hydrogen evolution and oxygen absorption mechanism). Types of electrochemical corrosion: Galvanic corrosion and differential aeration corrosion (pitting, stress, waterline and pipeline). Galvanic series and its applications. Factors influencing corrosion rate. Corrosion control methods: Sacrificial anode and impressed current cathodic protection. Metallic coating (galvanizing and tinning).

# 6 Hours

Determination of molecular weight of a polyvinyl alcohol using Ostwald viscometer.

#### BE – Mech | Minimum credits to be earned: 170 | Regulation 2018, Approved in XVIII Academic Council Meeting Held on 28.12.2018

#### **6 Hours**

# 7 Hours

# **6 Hours**

**5** Hours

# 4 Hours

#### 4 Hours

#### 4 Hours

## 4 Hours

#### 4 Hours

# **EXPERIMENT 6**

**EXPERIMENT 5** 

Testing of thermal stability of polymer using TGA Analyzer.

Measurement of rate of corrosion on Zinc/mild steel in aerated/ neutral/ acidic/ alkaline solution by weight loss method.

# 4

5

6

# **EXPERIMENT 4**

Determination of strength of hydrochloride acid present in the given solution by pH measurement.

2

1

**EXPERIMENT 2** 

# 3

# **EXPERIMENT 3**

Determine the strength of mixtures of acid using a conductivity cell.

STRUCTURE, CHARECTERISTICS AND APPLICATION OF POLYMERS

# UNIT IV

moulding.

UNIT III

# **ENGINEERING MATERIALS**

Glass and ceramics: Types and properties of glass and ceramic materials. Portland cement: Properties setting and hardening of cement special cement water proof and white cement properties and uses. Abrasives: Definition Moh scale of hardness classification of abrasives natural abrasives artificial abrasives (silicon carbide and boron carbide). Refractories : Definition classification properties of refractories preparation, properties and uses of high alumina bricks, magnesite and zirconia bricks.

Monomers polymers polymerization functionality degree of polymerization classification of polymers polymer molecular weight. Types of polymerization: addition, condensation and copolymerization. Structure, properties and applications of thermosetting (epoxy resin and alkalite) and thermoplastics (polyvinyl chloride and polytetrafluoroethylene).Compounding of plastics injection and extrusion

# UNIT V

# **ADVANCED MATERIALS**

Composites: Introduction to composites classification, properties, application and morphology of fibre reinforced composites, metal matrix composites and ceramic composites. Smart material: Introduction to smart materials, properties and applications of shape memory alloys and phase changing materials.

# **EXPERIMENT 1**

Estimation of iron in the given sample by potentiometric method using saturated calomel electrode and Preparation of 1N oxalic acid and 1M sodium carbonate solutions

### 4 Hours

### 7 EXPERIMENT 7

Determination of molecular structure of given sample using FTIR spectroscopy.

Total: 60 Hours

## **Reference**(s)

- 1. William D Callister Jr., Materials Science and Engineering: An introduction, 7th Edition, John Wiley & Sons Inc., New York, 2007.
- 2. G.E. Dieter, Mechanical Metallurgy, McGraw Hill, 2007.
- 3. V.Raghavan, Materals Science and Engineering, Prentice Hall of India, Delhi, 2009
- 4. P.C. Jain and Monica Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publisher, New Delhi, 2016.
- 5. Sashi Chawla, Text Book of Engineering Chemistry, Dhanpat Rai Publications, New Delhi, 2013.
- 6. J.C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, TMH, 2009.

#### 18ME204 BASIC ELECTRONICS ENGINEERING 2023

#### **Course Objectives**

- To understand the basic concepts of semiconductor diodes and transistors.
- To illustrate the construction and operation of feedback amplifiers and oscillators.
- To learn the fundamentals of operational amplifiers and digital electronics.

#### **Course Outcomes (COs)**

- 1. Apply the diodes in rectifier and regulator applications and also analyze its performance.
- 2. Simplification of Boolean expressions using K-map and implementation of combinational & sequential circuits.
- 3. Illustrate the working of analog IC with different configurations and analyze its characteristics.
- 4. Apply special electronics devices in circuit design.
- 5. Interface DC, servo, stepper motor with electronic devices.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2		1									2		
2	3	2		1									2		
3	1	1	3										2		
4	2	1		3									2		
5	3	2		1									2		

#### UNIT I

#### **ELECTRONIC DEVICES**

Diode construction and working, application of diode, clipper, clamper and rectifier. BJT-construction and working, BJT as switch and amplifier. CRO, Function generator, multimeter and power supply.

### UNIT II

#### **DIGITAL CIRCUITS**

Number system, Boolean theorem, logic gates, Simplification of logic function, Combinational circuits- Adder, subtractor, Encoder, decoder, multiplexer, demultiplexer. Sequential circuits- latch, flip-flop, counter.

#### UNIT III

**ANALOG ICS** 

Op-Amp (IC 741) - characteristics, application of Op-Amp adder, subtractor, comparator, ADC and DAC. Timer - (555) Astable and monostable multivibrator.

#### **6 Hours**

#### **6 Hours**

**6 Hours** 

#### 63

UNIT IN	V 6	Hours
SPECIA Introdu Diagra Groune	AL ELECTRONIC DEVICES uction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; am, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of V d.	Block /irtual
UNIT V INTER Interfa Interfa	6 <b>EFACING ACTUATORS</b> acing DC motor with electronic devices, Interfacing SERVO motor with electronic devices.	Hours
1 EXPE Design	<b>6 ERIMENT 1</b> n of regulated power supply. (5v,9v, 12v)	Hours
2 EXPE BJT as	<b>ERIMENT 2</b> s switch and amplifier in Automatic Street light.	Hours
3 EXPE Combi	6 ERIMENT 3 inational circuit as adder, subtractor, encoder, decoder in vending machine.	Hours
4 EXPE Sequer	6 ERIMENT 4 ntial circuit as counter in water level controller.	Hours
5 EXPE Applic	<b>6 E</b> ERIMENT 5 cation of op-Amp in measurement of temperature.	Hours
D.C	Total: 60	Hours
l.	David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice India	e Hall,
2.	J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McC Hill, 2010.	Graw-
3.	S. Salivahanan, N.Suresh Kumar and A.Vallavaraj, Electronic Devices and Circuits McGraw-Hill Education, 2008	, Tata

- 4. D. Roy Choudhry, Shail Jain Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
- 5. M. Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011.

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#### 18ME205 MANUFACTURING PROCESSES 2 0 2 3

#### **Course Objectives**

- To study the sand casting and special casting processes sand casting processes and practice mould preparation
- To learn various metal joining processes and gain welding skills.
- To provide the knowledge on various bulk deformation processes and its applications.
- To expose knowledge on sheet metal forming processes and special forming processes and to make small sheet metal parts.
- To learn about the various plastics moulding and forming processes and to make simple plastic part.

#### **Course Outcomes (COs)**

- 1. Choose the suitable casting process to produce the simple casting components and prepare mould with core
- 2. Select the suitable welding equipment and weld the given material.
- 3. Select the suitable bulk deformation process based on application.
- 4. Explain the sheet metal forming processes and make simple sheet metal components.
- 5. Identify the suitable moulding and forming processes of plastics for produce simple plastic parts

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2					1		1	1				2	
2	2	2					1		1	1				2	
3	2	2												2	
4	2	2							1	1				2	
5	2	2							1	1				2	

#### **Articulation Matrix**

#### UNIT I

#### **CASTING PROCESSES**

Introduction to production processes and its classifications - Pattern Types and Allowances. Moulding sand - Types, Properties and Testing. Moulding machines and its types. Melting furnaces - Induction. Fettling and cleaning. Sand casting defects. Special casting processes - Die casting, Centrifugal casting and Investment casting

#### UNIT II

#### **METAL JOINING PROCESSES**

Introduction to welding processes and its classifications - Principle of Gas welding and its flames -Principle of arc welding. Principle of Resistance welding - Spot, butt and seam. Principle of Gas metal arc welding, Submerged arc welding, Tungsten Inert Gas welding, Plasma arc welding, Thermit welding, Electron beam welding and Friction welding -Six weld defects - Brazing and soldering.

# 65

### 6 Hours

#### UNIT III

#### **BULK DEFORMATION PROCESSES** Introduction - Hot and cold working of metals - Forging processes - Open and close die forging,

# UNIT IV

SHEET METAL FORMING AND SPECIAL FORMING PROCESSES

Introduction - Shearing, bending and drawing operations - Stretch forming operations - Principle of special forming processes - Hydro forming, Rubber pad forming, Metal spinning, Explosive forming, Magnetic pulse forming, Peen forming and Super plastic forming.

Forging equipment and operations. Rolling-Types of Rolling mills, shape rolling operations, Tube

piercing and Defects. Principle of Extrusion and its types. Principle of rod and wire drawing.

#### UNIT V

#### MOULDING AND FORMING OF PLASTICS

Introduction to plastics - Moulding of Thermoplastics - Principle and applications of Injection moulding and its types, Blow moulding, Rotational moulding, Thermoforming and Extrusion. Moulding of Thermosets - Principle and applications of Compression moulding and Transfer moulding - Bonding of Thermoplastics - Fusion and solvent methods.

1	3 Hours
<b>EXPERIMENT 1</b> To demonstrate the various patterns used in sand casting and prepare a mould using split pat sand casting process.	tern in
2 EXPERIMENT 2 Casting of aluminium components	3 Hours
<b>3</b> <b>EXPERIMENT 3</b> Fabrication of simple structural shapes using manual Metal Arc Welding	3 Hours
4 EXPERIMENT 4 Fabrication of simple structural shapes using TIG and MIG welding	3 Hours
5 EXPERIMENT 5 Manufacturing of Simple sheet metal components using shearing and bending operations	3 Hours
6 EXPERIMENT 6 Drawing of cup shaped product	3 Hours
7 EXPERIMENT 7 To make a simple thermoplastic component using injection Moulding	3 Hours

### **6 Hours**

# **5 Hours**

**6 Hours** 

# To make a simple component using compression Moulding

**EXPERIMENT 8** 

## 9

8

# **EXPERIMENT 9**

Extrusion of rod drawing

# 10

# **EXPERIMENT 10**

To make a pet bottle using Blow Moulding

## **Reference**(s)

- 1. P.N. Rao, Manufacturing Technology vol. I, Tata McGraw-Hill Publishing Company Private Limited, New Delhi, 2010.
- 2. Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology, Pearson Education Limited, New Delhi, 2013.
- 3. J.P. Kaushish, Manufacturing Processes, Prentice Hall of India Learning Private Limited, New Delhi, 2013.
- 4. P.C. Sharma, Manufacturing Technology I, S Chand and Company Private Limited, New Delhi,2010.
- 5. S.K. Hajra Choudhury, Elements of Workshop Technology Vol. I, Media Promoters & Publishers Private Limited, Mumbai, 2013
- 6. http://nptel.ac.in/courses/112107144/1

**Total: 60 Hours** 

**3 Hours** 

**3 Hours** 

### 18ME206 COMPUTER PROGRAMMING II 0 0 4 2

#### **Course Objectives**

- To understand the basics of C++ and Java primitives, operators, and expressions, conditional and looping statements.
- To understand and apply the concepts of classes, inheritance, interfaces and packages.
- To develop programs using Stings and exception handling.

### **Course Outcomes (COs)**

- 1. Implement C++ and java programs using data types, operators, arrays, control and looping statements.
- 2. Apply class, objects, methods and inheritance in C++.
- 3. Develop java programs using the concepts of its basic primitives, class and methods.
- 4. Design applications using inheritance, interface and package.
- 5. Apply the concepts of strings and exception handling.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3			3								3		
2	2	3			3								3		
3	2	3			3								3		
4	1	3			3								3		
5	1	3			3								3		

1 EXPERIMENT 1 Working with basic data types and arrays.	3 Hours
2 EXPERIMENT 2 Implementation of control statements.	3 Hours
3 EXPERIMENT 3 Implementation of looping statements.	3 Hours
4 EXPERIMENT 4 Implementation of class and objects.	3 Hours
5 EXPERIMENT 5	3 Hours

Working with constructor and destructor.

6 EXPERIMENT 6 Implementation of types of Inheritance.	3 Hours
7 EXPERIMENT 7 Working with call by value and call by reference.	3 Hours
8 EXPERIMENT 8 Implementation of friend function.	3 Hours
9 EXPERIMENT 9 Implementation of overloading.	3 Hours
10 EXPERIMENT 10 Working with basic data types, static variables and arrays.	3 Hours
11 EXPERIMENT 11 Program on Classes and objects.	6 Hours
12 EXPERIMENT 12 Working with Methods.	6 Hours
13 EXPERIMENT 13 Implementation of Inheritance.	6 Hours
14 EXPERIMENT 14 Implementation of Overloading and Overriding.	6 Hours
15 EXPERIMENT 15 Implementation of Packages.	6 Hours Total: 60 Hours
	rotan. ov mours

#### 18ME301 ENGINEERING MATHEMATICS III 3104

#### **Course Objectives**

- To gain knowledge on Fourier series and Laplace transform through practical applications.
- To understand the concepts of Fourier series and Boundary conditions, which will enable them to model and analyze the physical phenomena.
- To develop the foundations of probabilistic and statistical analysis mostly used in varied applications in Mechanical engineering

#### **Course Outcomes (COs)**

- 1. Develop Fourier series for different types of functions.
- 2. Derive and obtain the solution of wave, heat equation and boundary value problems.
- 3. Analyze and solve engineering problems using Laplace Series.
- 4. Apply the concepts of probability distributions in an appropriate place of science and Engineering.
- 5. Apply different statistical process control charts.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2											1		
2	3	3											1		
3	2	2											1		
4	2	2											1		
5	2	3											1		

#### UNIT I

#### FOURIER SERIES

Introduction-periodic functions- properties, even and odd functions- special wave form: square wave, half wave rectifier, full wave rectifier, saw-toothed wave and triangular wave - Eulers formulae for full range Fourier series, Fourier series for functions of period 21 -Dirichlets conditions - sum of Fourier series- Theorem for the convergence of Fourier series (statement only)- Fourier series of a function with its periodic extension - Half range Fourier series: construction of half range sine series, construction of half range cosine series. Parsevals identity (statement only).

#### UNIT II

#### APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Classification of partial differential equations of second order-solution of: one dimensional wave equation, one dimensional heat equation, two dimensional heat equation and vibration of circular membrane.

#### 70

#### 9 Hours
#### *BE* –*Mech* |*Minimum* credits to be earned: 170 |*Regulation* 2018, Approved in XVIII Academic Council Meeting Held on 28.12.2018

#### 9 Hours

# Laplace Transform: Applications, advantages and sufficient conditions for existence of Laplace transform- general properties of Laplace transform-Laplace transform of periodic function. Inverse Laplace Transform: general properties of inverse Laplace transform - use of partial fraction method to find of inverse Laplace transform - convolution -application of Laplace transform to differential equations with constant coefficients.

#### UNIT IV

#### **PROBABILTY THEORY**

Probability: Classical definition and its limitations- axiomatic definition-some elementary deductionfrequency interpretation of probability -addition rule for 2 events (proof) and its extension to more than 2 events (statement only)- conditional probability and independent events -extension to more than 2 events (pairwise and mutual independence)- multiplication rule-Bayes theorem (statement only). Random variables: Definition of random variable- continuous and discrete random variablesprobability density function & probability mass function for single variable only- distribution function and its properties (without proof)- definitions of expectation and variance, properties- some important discrete distributions: Binomial & Poisson distributions.

#### UNIT V

#### MATHEMATICAL STATISTICS

Population and sample - Sampling distributions. Statistical estimation of parameters, confidence intervals. Testing of hypotheses - one-sample and two-sample inferences. Applications to statistical quality control and reliability analysis.

#### **Reference**(s)

- 1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
- 2. Johnson Richard A. and Bhatacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996
- 3. O'Neil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995
- 4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993
- Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 3rd Edition, 1995

#### UNIT III

#### LAPLACE TRANSFORM

### 9 Hours

#### 9 Hours

#### Total: 60 Hours

#### 18ME302 FLUID MECHANICS AND MACHINERY 2124

#### **Course Objectives**

- To impart knowledge on the properties of fluid and fluid statics principles
- To calculate the rate of flow and energy losses in flow through pipes.
- To emphasise the concepts of boundary layer theory and the importance of dimensional analysis
- To educate the working principles and performance analysis of fluid pumps.
- To provide knowledge on the working principle and performance curves of hydraulic turbines

#### **Course Outcomes (COs)**

- 1. Explain the fluid properties and the pressure measurement using fundamental laws of fluid mechanics
- 2. Analyse the volume rate of flow and losses occur in a flow through pipes.
- 3. Apply the concept of boundary layer, Dimensional analysis and Modal analysis on the fluid structures
- 4. Select a suitable pump for a given application and evaluate the operating characteristics of Hydraulic pumps
- 5. Select a suitable turbine for a given application and evaluate the operating characteristics of Hydraulic turbines

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3		2					2						3
2	3	3		2					2						3
3	3	2		2	1				2						3
4	2	2		2					2						3
5	2	2		2					2						3

#### Articulation Matrix

#### UNIT I

#### FLUID PROPERTIES AND FLUID STATICS

Basics: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure, compressibility and bulk modulus. Types of fluids, Types of fluid flow. Fluid statics-Fluid pressure at a point, Variation of pressure with a static fluid, Hydrostatic law Pressure head, Pascal's law, Measurement of pressure, Piezometric tube Manometry

#### UNIT II

#### FLUID KINEMATICS AND DYNAMICS

Concept of control volume - continuity equation, Bernoullis equation and its applications-Momentum Equation- Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli Darcy Weisbach equation friction factor- Moody diagram- commercial pipes- minor losses- Flow through pipes in series and parallel.

## 6 Hours

#### BE – Mech | Minimum credits to be earned: 170 | Regulation 2018, Approved in XVIII Academic Council Meeting Held on 28.12.2018

#### **6 Hours**

#### **6 Hours**

#### **6 Hours**

#### 2 Hours

2

UNIT III

Analysis.

UNIT IV

UNIT V

**HYDRAULIC PUMPS** 

Rotary pumps -classification.

HYDRAULIC TURBINES

#### **EXPERIMENT 2** Verification of Bernoullis theorem and Determine the coefficient of discharge using Venturimeter

Boundary layer concepts-Types of boundary layer thickness -Lift and Drag of an aerofoil -Need for dimensional analysis -Methods of dimensional analysis using Buckingham pi theorem -Similitude -Types of similitude-Dimensionless parameters-Application of Dimensionless parameters-Model

Euler's equation - Theory of roto-dynamic machines-Centrifugal pumps working principle- velocity triangle -work done by the impeller - performance curves - Reciprocating pump- working principle

Classification of turbines heads and efficiencies velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles work done by water

on the runner draft tube. Specific speed unit quantities performance curves for turbines.

#### 3 **3 Hours EXPERIMENT 3** Determination of friction factor for a given set of pipes 4 **3 Hours EXPERIMENT 4**

Determine the coefficient of discharge for a rotometer and orificemeter

#### 5

#### **EXPERIMENT 5**

Determination of lift and drag force of an aerofoil.

#### 6

#### **EXPERIMENT 6**

Performance test on tangential flow impulse turbine against constant head.

1

**EXPERIMENT 1** 

Visualize the flow using Reynolds apparatus

FLUID FLOW OVER BODIES AND DIMENSIONAL ANALYSIS

**3** Hours

## 4 Hours

7	3 Hours
EXPERIMENT 7	
Performance test on Francis turbine against constant head	
8	3 Hours
	5 110015
EXPERIMENT 8	
Performance test on reaction (Kaplan) turbine	
9	3 Hours
EVDEDIMENT ()	0 110 010
Performance test on centrifugal pump.	
10	3 Hours
EXPERIMENT 10	
Derformense test en submersible numm (Case numm	
renormance test on submersible pump/Gear pump.	
	Total: 75 Hours

- 1. Yunus A. Cengel, and John M. Cimbala, Fluid Mechanics, Third edition, Mc Graw Hill Education (India) Pvt. Ltd, 2014.
- 2. Dr R.K. Bansal , A text book of Fluid Mechanics and Hydraulic Machines, Tenth Edition, Laxmi Publications, New Delhi, 2018.
- 3. Frank .M. White, Fluid Mechanics, McGraw Hill Publishing Company Ltd, New Delhi, 8th Edition. 2017
- 4. R.C.Hibbler, Fluid Mechanics, Pearson, First edition, 2017.
- 5. S.K. Som and G. Biswas, Introduction to Fluid Machines, 3rd Edition, McGraw-Hill Education, 2017.
- 6. https://nptel.ac.in/courses/112105183/.

**Reference(s)** 

#### 18ME303 ENGINEERING THERMODYNAMICS 3104

#### **Course Objectives**

- To study the fundamentals of thermodynamics and zeroth law
- To provide the knowledge on first law of thermodynamics
- To impart the knowledge on second law of thermodynamics and entropy
- To study the thermodynamic properties of pure substances and its phase change processes
- To learn about gas power cycles and properties of gas mixtures

#### **Course Outcomes (COs)**

- 1. Exemplify the basic concepts and zeroth law of thermodynamics
- 2. Apply the first law of thermodynamics to closed and open systems
- 3. Solve the problems related to cycles and cyclic devices using second law of thermodynamics
- 4. Determine the thermodynamic properties of pure substances and its phase change processes
- 5. Evaluate the air standard performance of heat engines and properties of gas mixtures

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3													3
2	3	3					1						2		3
3	3	3					2								3
4	3	3			1		2						2		3
5	3	3	2	1	1	2	2						2		3

#### UNIT I

#### INTRODUCTION AND ZEROTH LAW OF THERMODYNAMICS

Macroscopic and Microscopic approaches, Definitions and concepts- heat, work, thermodynamic equilibrium, system and types, surroundings, Properties- intensive and extensive properties, Path and point functions, Energy- macroscopic and microscopic modes of energy, Thermodynamic processes and cycle, State postulate, Zeroth law of thermodynamics- temperature scale, perfect gas scale.

#### UNIT II

#### FIRST LAW OF THERMODYNAMICS

First law of thermodynamics, first law for Closed systems - constant pressure process, constant volume process, constant temperature process, adiabatic process, polytropic process, throttling process. First law for open systems -Steady state flow processes, Steady flow energy equation (SFEE), Application of SFEE-turbines and compressors, nozzles and diffusers, throttling valves, heat exchangers

#### **10 Hours**

#### UNIT III

#### SECOND LAW OF THERMODYNAMICS

Limitations of first law of thermodynamics, Second law of thermodynamics- Kelvin - Planck and Clausius statements, Heat Engine, heat pump and refrigerator, Reversibility and irreversibility- irreversible and reversible processes, Carnot's principles, Carnot cycle, Carnot engine, Thermodynamic temperature scale, Clausius inequality, Entropy- principle of entropy increase, Availability & irreversibility.

#### UNIT IV

#### **PROPERTIES OF PURE SUBSTANCES**

Thermodynamic properties of fluids. Pure substance-phases - Phase change processes, Property diagrams - pressure-volume (P-v), pressure-temperature (P-T), temperature volume (T-v), temperature-entropy (T-s) and enthalpy-entropy (h-s) diagrams. Steam tables - Problems on flow and non-flow processes. Ideal gas - equation of state, Van der Waals equation and compressibility chart.

#### UNIT V

#### GAS MIXTURES AND GAS POWER CYCLES

Thermodynamics of ideal gas mixture- mixture of ideal gas, mixture of perfect gases, Dalton's law of partial pressure, Amagat's law, Thermodynamic properties, Psychrometric properties and processes - Psychrometric chart. Air standard cycles Otto, Diesel and Dual cycles- Calculation of mean effective pressure and air standard efficiency.

#### FOR FURTHER READING

Thermodynamic property relations- Maxwell relations, TDS equations, The Clapeyron equation, Joule-Thompson expansion.

#### **Total: 60 Hours**

8 Hours

9 Hours

**10 Hours** 

#### **Reference**(s)

- 1. Y. Cengel and Boles, Thermodynamics An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2011.
- 2. P.K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2017.
- 3. J.P. Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2016.
- 4. R.K. Rajput, Engineering Thermodynamics, Laxmi Publications Pvt. Ltd., New Delhi, 2017.
- 5. Gordon J. Van Wylen, Richard E. Sonntag, Fundamentals of Classical Thermodynamics, December 31st 1978, John Wiley & Sons.
- 6. https://onlinecourses.nptel.ac.in/noc18\_ae05/preview.

#### 18ME304 MANUFACTURING TECHNOLOGY 2023

#### **Course Objectives**

- To learn the metal cutting theory, measure the forces acting on the single point tool and calculate various forces involved in it.
- To familiarize about the construction, working and operations of centre, semi-automatic, automatic lathes. Also gain basic working skills for making simple components in centre and semi automatic lathe.
- To provide working skill and knowledge on construction and working of milling and gear cutting machines.
- To impart the knowledge on working of reciprocating, drilling, boring machines and provide working skill in slotting and drilling machines.
- To familiarize about the construction and working of broaching, grinding, fine finishing processes and to provide working skills in grinding machines

#### **Course Outcomes (COs)**

- 1. Explain the metal cutting theory and calculate the various forces acting on the lathe turning tool using Merchant circle.
- 2. Select and explain the suitable type of lathe machine based on the application and make simple components using lathe machines.
- 3. Identify and explain the suitable type of milling & gear cutting machines for the given components and produce simple components using these machines.
- 4. Choose the suitable reciprocating & drilling machine for the production of components and make simple components using these machines.
- 5. Identify and explain the suitable finishing process based on the application and produce simple components using grinding machines .

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3					1		2	1		1		2	
2	2	3							2	1		1		2	
3	2	2							2	1		1		2	
4	2	2							2	1		1		2	
5	2	2							2	1		1		2	

#### **Articulation Matrix**

#### UNIT I

#### METAL CUTTING THEORY

Introduction - Orthogonal, Oblique Cutting and types of chip formation. Mechanisms of metal cutting - Chip thickness ratio and Shear plane. Merchant's Circle - Deriving the forces, calculations. Cutting tool - Properties and materials, wear. Single point tool nomenclature, tool life and its calculations. Cutting fluids -properties.

#### *BE* –*Mech* |*Minimum* credits to be earned: 170|*Regulation* 2018, *Approved in XVIII Academic Council Meeting Held on* 28.12.2018

#### 6 Hours

#### 6 Hours

#### 6 Hours

#### 5 Hours

#### 3 Hours

#### 3 Hours

#### 3 Hours

#### **3 Hours**

#### 3 Hours

**3 Hours** 

#### **EXPERIMENT 5**

Machining of Pentagonal/Hexagonal/octagonal sides from cylindrical work piece using Milling machine

#### 6

#### **EXPERIMENT 6**

Preparation of spur gear from cylindrical work piece using gear hobbing machine.

#### UNIT II

#### LATHE, SEMI AUTOMATS AND AUTOMATS

Introduction - Types- Centre Lathe - Construction, specification, operations. Mechanisms - Thread cutting. Work holding devices - Centres, chucks, carrier and catch plate and face plates. Calculation of machining time. Capstan and turret lathes - Introduction and turret indexing mechanism. Automats - single spindle, multi spindle and their types.

#### UNIT III

#### MILLING MACHINE AND GEAR CUTTING MACHINES

Milling - Introduction, types, specifications, up milling, down milling and operations. Indexing - simple and differential indexing methods. Gear cutting-gear milling, gear shaper and gear hobbing machine.

#### UNIT IV

#### RECIPROCATING MACHINES, DRILLING AND BORING MACHINES

Shaper, Planer and Slotter - Introduction, types, specification and crank and slotted link quick return mechanisms. Drilling - Introduction, types, specifications, construction of universal drilling machine, types of drills and nomenclature of twist drill. Introduction to horizontal boring machine.

#### UNIT V

#### **BROACHING AND FINISHING PROCESSES**

Broaching - Introduction and types. Finishing processes - Grinding -Introduction and Types. grinding wheel- selection, glazing, loading, dressing and truing. Fine finishing processes - Honing, lapping, buffing and super finishing.

## 1

#### **EXPERIMENT 1**

Measurement of cutting forces acting on the tool during turning operation using dynamometer.

#### 2 EXPERIMENT 2

Exercise on step turning using orthogonal and oblique cutting tool.

### 3

4

5

#### **EXPERIMENT 3**

**EXPERIMENT 4** 

Exercise on grooving, thread cutting and boring using centre lathe

Exercise on turning, drilling and tapping using capstan lathe.

7 EXPE Machir	<b>ERIMENT 7</b> ning an internal key way using Slotter machine.	Hours
8 EXPE Exercis	<b>ERIMENT 8</b> se on drilling and tapping operation using drilling machine.	Hours
9 EXPE Machir	<b>ERIMENT 9</b> ning a metal flat using surface grinding machine.	Hours
10 EXPE Machin	3 ERIMENT 10 ning a shaft using cylindrical grinding machine. Total: 60	Hours Hours
Refere	ence(s)	110415
1.	J. P. Kaushish, Manufacturing Processes, Prentice Hall India Learning Private Limited Delhi, 2013.	l., New
2.	Serope Kalpakjian and Steven R Schmid, Manufacturing Engineering and Tech Pearson Education Limited., New Delhi, 2014.	nology,

- 3. P. N. Rao, Manufacturing Technology- Metal Cutting and Machine Tools, Tata McGraw Hill Publishing Company Private Limited., New Delhi, 2013
- 4. S. K. Hajra Choudhury, Elements of Workshop Technology. Vol. II, Media Promoters & Publishers Private Limited., Mumbai, 2013.
- 5. P.C Sharma, Manufacturing Technology II, S. Chand & Company Limited. New Delhi, 2012.
- 6. http://nptel.ac.in/courses/112105126/1

#### 18ME305 KINEMATICS OF MACHINES 3104

#### **Course Objectives**

- To impart the knowledge on the concept of simple mechanisms.
- To provide knowledge on kinematic analysis of simple mechanisms.
- To study and construct the cam profile for the various types of follower motion.
- To learn the kinematics terminologies of spur gear and calculate speed ratio of various types of gear train.
- To introduce the concept of friction drives in kinematic of machines.

#### **Course Outcomes (COs)**

- 1. Identify the simple mechanisms based on given application.
- 2. Find velocity and acceleration of simple mechanisms.
- 3. Construct the cam profile for different types of follower motion.
- 4. Identify the kinematic terminologies of spur gear and calculate speed ratio of various types of gear train.
- 5. Estimate the amount of power transmitted by friction drive.

#### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2											2	1		
2	2	1										2	1		
3	1	2										2	1		
4	3	2										2	1		
5	2	2										2	1		

#### UNIT I

#### FUNDAMENTALS OF MECHANISMS

Basic Terminology - Kinematic link, Pair, joints, Structure, Machine, Degree of freedom, Grubler & Kutzbach Criterion - Inversions of four bar mechanism, Mechanical advantage - Transmission Angle, Inversion of single slider and double slider crank mechanisms.

#### UNIT II

#### KINEMATIC ANALYSIS OF MECHANISMS

Relative velocity of kinematic link, Rubbing Velocity of kinematic pair, Coriolis component of Acceleration. Construction of velocity and acceleration diagram by graphical method (Relative Velocity Method), Four bar mechanism, slider crank mechanisms and complex mechanism.

#### UNIT III

#### CAM AND FOLLOWER MECHANISMS

Introduction - Terminology, Classifications, Types of follower motion - Uniform velocity Motion, Simple Harmonic Motion, Uniform Acceleration and Retardation Motion and Cycloidal Motion-Construction of cam profile - Knife edge follower, Roller and flat faced follower.

#### 9 Hours

9 Hours

#### UNIT IV

UNIT V

#### **GEAR AND GEAR TRAIN** Gears - Terminology, Law of gearing, Length of path of contact, Length of arc of contact, contact

train-speed calculation by tabular method.

### 9 Hours

**Total: 60 Hours** 

9 Hours

## **FRICTION DRIVES** Introduction-Friction clutch, types -single plate and Multi plate clutch. Flat Belt Drives Velocity, slip, creep and Centrifugal effect of belt, length of open and cross belt drives, Maximum power

ratio. Gear trains- Speed ratio, train value. Simple gear train, compound gear train, Epicyclic gear

#### **Reference**(s)

- 1. S.S Rattan, Theory of Machines, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2014.
- 2. J. J. Uicker, G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, New York, 2011
- 3. Sadhu Singh, Theory of Machines, Second Edition, Pearson Education, 2012.

transmitted, ratio of driving tension in flat belt drives - V Belt drives.

- 4. Ballaney PL, Theory of Machines and Mechanisms, Khanna Publishers, New Delhi, 2005.
- 5. Rao J S and Dukkipati, Mechanism and Machine Theory, Wiley- Eastern Ltd., New Delhi, 2006.
- 6. https://nptel.ac.in/courses/112104121/1

#### 18ME306 MACHINE DRAWING LABORATORY 1022

#### **Course Objectives**

- To provide knowledge on reading of machine drawing with Geometric Dimensioning and Tolerancing (GD & T)
- To familiarize the representation of various machine element drawings
- To impart the significance of sectional views and its representation in drawings
- To provide knowledge on assembly drawings of mechanical supporting components
- To develop skill to draw the assembly drawings of machine tool and automobile components

#### **Course Outcomes (COs)**

- 1. Describe the basics of machine drawing and GD&T.
- 2. Represent the machine elements in industrial drawings.
- 3. Explain the concept of sectional views in drawings.
- 4. Draw the sectional views of mechanical supporting components.
- 5. Sketch the assembly drawings of machine tool and automobile components.

#### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2					1		2		2			1		
2	2					2		2		2			1		
3	2					2		2		3			1		
4	3					3		3		3			1		
5	3					3		3		3			1		

#### UNIT I

#### INTRODUCTION TO MACHINE DRAWING AND GD

Importance of Machine Drawing - BIS-SP 46 Drawing codes - Classification of Machine Drawings: Assembly drawing, production drawing, detailed drawing, catalogues drawing, patent drawing - Geometric constraint and symbols - Fundamentals of Limits, Tolerances, Fits, surface roughness and its indication in drawings - Elementary weld symbols

#### UNIT II

#### **REPRESENTATION OF MACHINE ELEMENTS**

Representation of hexagonal bolt and nut - Forms and proportions of rivet heads: chain and zigzag type - Representation of screws, taper keys, pins.

#### UNIT III

#### INTRODUCTION OF SECTIONAL VIEWS

Sectional views: cutting plane and its representation, hatching of sections, full section, half section, local sections, revolved sections, thin sections - Sectional views of single parts: pedestal bearing, shaft support, bracket

#### **5 Hours**

## 8 Hours

#### UNIT IV ASSEMBLY DRAWINGS OF MECHANICAL SUPPORTING COMPONENTS

Reading of detailed drawings: Bill of materials, Assembly concept, sectional views of assembled drawings - Joint: Strap joint with Gib and Cotter - Coupling: Unprotected type flanged coupling -Gland and stuffing box.

#### UNIT V

#### ASSEMBLY DRAWINGS OF MACHINE COMPONENTS

Machine tool parts: Screw jack, Plummer block, Machine Vice, Tail stock - Automobile component: Piston and connecting rod of Petrol engine.

#### **Reference(s)**

- 1. Gary R. Bertoline, Eric N. Wiebe, Technical Graphics Communication, IR WIN Graphic Series, 4th edition, Tata McGraw Hill, 2017
- 2. Brian Griffths, Engineering Drawing for Manufacture, Kogan Page Science, 2012
- 3. N.D. Bhatt, Machine Drawing, Charotar Publishing House Pvt. Ltd., 2014
- 4. K.R. Gopalakrishna, Machine Drawing, Subash stores, 20th edition, 2012
- 5. https://nptel.ac.in/syllabus/112106075/

#### **15 Hours**

**12 Hours** 

#### **Total: 45 Hours**

#### 18ME307 COMPUTER AIDED MODELLING LABORATORY I 0 0 4 2

#### **Course Objectives**

- To provide knowledge and skills to draw orthographic projections of simple components using geometric modeling software
- To impart knowledge for creating three dimensional assembly models of few automotive and machine components using CAD Software.
- To provide knowledge on generating 3D assembly models of few machine elements using CAD software.
- To provide knowledge on three dimensional model of simple mechanism and animation using CAD software.
- To expose the knowledge to prepare the technical documents for the given components using software.

#### **Course Outcomes (COs)**

- 1. To provide knowledge and skills to draw orthographic projections of simple components using geometric modeling software.
- 2. To impart knowledge for creating three dimensional assembly models of few automotive and machine components using CAD Software
- 3. To provide knowledge on generating 3D assembly models of few machine elements using CAD software
- 4. To provide knowledge on three dimensional model of simple mechanism and animation using CAD software
- 5. To expose the knowledge to prepare the technical documents for the given components using software.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1					3				2	1			2		
2					3				2	1			2		
3					3				2	1			2		
4					3				2	1			2		
5					3				2	1			2		

#### **Articulation Matrix**

#### 1

#### **EXPERIMENT 1**

Create an orthographic view of machine components from the given isometric drawings.

#### 2 EXPERIMENT 2

Construct a three dimensional assembly model of bearing.

6 Hours

3 6 Hours
<b>EXPERIMENT 3</b> Generate a three dimensional shaft and coupling assembly model by considering tolerance in each Component.
4 6 Hours EXPERIMENT 4 Create a three dimensional assembly model of Piston and Connecting Rod.
5 6 Hours EXPERIMENT 5 Build a three dimensional assembly model of power drive system.
6 6 Hours EXPERIMENT 6 Create a three dimensional assembly model of two wheeler suspension system.
7 6 Hours EXPERIMENT 7 Construct a three dimensional assembly model of control valve.
8 6 Hours EXPERIMENT 8 Generate a three dimensional assembly model of Jig/fixture.
9 6 Hours EXPERIMENT 9 Create a three dimensional assembly model of simple mechanism and animate its working using modeling software.
10       6 Hours         EXPERIMENT 10       6 Hours         Create technical documents for an I.C engine assembly using 3D via software.       Total: 60 Hours
Reference(s)         1. Creo Parametric 2.0 for Engineers and Designers, Prof Sham Tickoo, Prabhakar Singh.

2. Geometric Modelling: Theoretical and Computational Basis towards Advanced CAD Applications, Fumihiko Kimura.

#### 18GE301 SOFT SKILLS - VERBAL ABILITY 0020

#### **Course Objectives**

- To help students gain adequate proficiency in vocabulary
- To read and understand unabridged text
- To help students become proficient in basic writing skills related to work place communication

#### **Course Outcomes (COs)**

- 1. Take up verbal ability part of the placement tests with confidence
- 2. Write with confidence in professional and workplace communication
- 3. Distinguish fact from opinion by reading passages from a text

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										1					
2											2				
3									2						

#### UNIT I

#### **15 Hours**

**15 Hours** 

**Total: 30 Hours** 

#### INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

#### UNIT II

#### **BASICS OF VERBAL APTITUDE**

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

#### **Reference**(s)

- Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press, 2012.
- 2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books, 1991.
- 3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

#### 18ME401 NUMERICAL METHODS 3104

#### **Course Objectives**

- To analyze a mathematical problem and determine which numerical technique to use to solve it.
- To understand the methods to solve polynomial equations and implement the mathematical ideas for interpolation numerically
- To summarize and apply the methodologies involved in solving problems related to ordinary and partial differential equations

#### **Course Outcomes (COs)**

- 1. Compute the errors; apply the numerical methods to solve nonlinear equations and system of equations.
- 2. Analyze the Finite difference -Forward and backward difference table.
- 3. Understand numerical differentiation and integration .
- 4. Determine numerical solutions of ordinary differential equations.
- 5. Evaluate partial differential equations using numerical techniques.

Articu	lation	Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3											1		
2	2	2											1		
3	2	2											1		
4	2	2											1		
5	2	3											1		

#### UNIT I

#### APPROXIMATION

Approximation in numerical computation: Truncation and rounding errors- fixed and floating-point arithmetic - propagation of errors.Numerical solution of algebraic equations: Bisection method -Regula-Falsi method - Newton-Raphson method. Numerical solution of a system of linear equations: Gauss elimination method - Matrix inversion- LU Factorization method - Gauss-Seidel iterative method

#### UNIT II

#### INTERPOLATION

Interpolation: Newton forward/backward interpolation- Lagranges - Newtons divided difference Interpolation.

#### UNIT III

#### NUMERICAL DIFFERENTIATION

Numerical single and double integration: Trapezoidal rule- Simpsons 1/3 rule - Expression for corresponding error terms.

#### 9 Hours

#### 9 Hours

#### UNIT IV

#### NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION

Numerical solution of ordinary differential equation: Eulers method - Runge-Kutta methods- Milnes Predictor-Corrector methods- Adams Predictor-Corrector methods - Finite Difference method.

#### UNIT V

#### NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATION

Finite difference solution of parabolic equations by Crank-Nicholson method-elliptic equations by iterative methods-hyperbolic equations by explicit finite difference method. Total: 60 Hours

#### **Reference**(s)

- 1. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Third Edition, Eastern Economy Edition, 2009.
- 2. Grewal B. S, Numerical Methods in Engineering and Science with Programms in C & C++, Ninth Edition, Khanna Publications, 2010.
- 3. Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Seventh Edition, Pearson Education, New Delhi, 2006.
- 4. Jain M.K, Iyangar S.R.K and Jain R.K Numerical Methods for Scientific and Engineering Computation New Age International (P) Ltd, New Delhi, 2005.
- 5. S.S. Sastry, Introductory Methods of Numerical Analysis, Fifth Edition, PHI Learning Pvt. Ltd, 2012.
- 6. Burden R. L and Douglas Faires J, Numerical Analysis Theory and Applications, Cengage Learning, Ninth Edition, 2005.

## 9 Hours

#### 18ME402 APPLIED HYDRAULICS AND PNEUMATICS

2023

#### **Course Objectives**

- To learn about fluid power systems and its fundamentals.
- To impart knowledge on various types of hydraulic pumps and actuators.
- To learn about various fluid power control components and its functions.
- To study about various types of pneumatic components and servo system.
- To learn fluid power circuit design methods and its applications.

#### **Course Outcomes (COs)**

- 1. Explain the fluid power system and its fundamentals.
- 2. Identify suitable hydraulic pumps and actuators for different applications.
- 3. Choose the suitable fluid power control components for various applications.
- 4. Choose the suitable pneumatic components for different applications.
- 5. Design fluid power circuit for given applications

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3											1		2	
2	3		2									1		2	
3	2	2	3									1		2	
4	3		1									1		2	
5	1	2	3		2							2		2	

#### UNIT I

#### FLUID POWER SYSTEMS AND FUNDAMENTALS

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Properties of hydraulic fluids-Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow- Reynolds number.

#### UNIT II

#### HYDRAULIC SYSTEM AND COMPONENTS

Sources of Hydraulic Power: Pumping theory - Pump classification - Gear pump, Vane Pump, piston pump, construction and working of pumps - pump performance . Fluid Power Actuators: Linear hydraulic actuators - Types of hydraulic cylinders - Single acting, Double acting, special cylinders like tandem, Rodless, Telescopic, Cushioning mechanism, Rotary actuators- Gear, Vane and Piston motors

#### UNIT III

#### **CONTROL COMPONENTS**

Construction and function of Control Components : Direction control valve - 3/2, 4/2, Shuttle and check valve. Pressure control valve: pressure reducing valve-pilot operated, relief valve - pilot operated and sequence valve. Flow control valve: pressure compensated and non-pressure

#### 4 Hours

**6 Hours** 

7 Hours

#### 89

**6 Hours** 

7 Hours

compensated valves. Accumulators and Intensifiers: Types -weight and spring loaded - Accumulator circuits. Intensifier - Intensifier circuit.

#### UNIT IV

#### PNEUMATIC SYSTEM COMPONENTS AND SERVO SYSTEMS

Pneumatic Components: Compressors- Piston compressor working, Filter, Regulator and Lubricator Unit. Air control valves: Quick exhaust valve and Muffler. Pneumatic actuators-types. Servo systems : Hydro Mechanical servo systems, Electro hydraulic servo systems. Fluidics-Introduction.

#### UNIT V

DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS

Introduction to PLC - ladder diagrams, PLC applications in fluid power control. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

1	2 Hours
EXPERIMENT 1	
Identification of fluid power system components with its symbols.	
2	2 Hours
EXPERIMENT 2	
A study on pascals law with one application	
3	3 Hours
EXPERIMENT 3	e mours
Simulation of single and double acting cylinder	
Simulation of single and double acting cynneer.	
Λ	2 Hours
	5 nours
EXPERIMENT 4	
Simulation of rotary actuator.	
-	2.11
5	3 Hours
EXPERIMENT 5	
Construction and simulation of basic hydraulic circuit using various control components.	
6	3 Hours
EXPERIMENT 6	
Construction and simulation of hydraulic circuit using intensifier and accumulator.	
7	<b>3 Hours</b>
EXPERIMENT 7	
Construction and simulation of basic pneumatic circuit, with and without quick exhaust valve	
8	3 Hours
EXPERIMENT 8	
Construction and simulation of pneumatic circuit with and without muffler	
construction and simulation of phoantage encourt, with and without marrier.	

#### **EXPERIMENT 9**

Simulation of speed control circuits and sequential circuit.

#### 10

9

#### **EXPERIMENT 10**

Design a simple circuit using cascade method and verify theoretically.

#### **Reference**(s)

- 1. Anthony Esposito, Fluid Power with Applications, Pearson Education New Delhi, 2011
- 2. S. R. Majumdar, Oil Hydraulics, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2004.
- 3. James L. Johnson, Introduction to Fluid Power, Delmar Thomson Learning, 2003.
- 4. S. R. Majumdar, Pneumatic systems Principles and maintenance, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2008
- 5. S.Illango, V. Soundarrajan, Introduction to Hydraulics and Pneumatics, Prentice hall of India, New Delhi, 2007.
- 6. https://www.youtube.com/watch?v=8xd7cWvMrvE

#### 4 Hours

4 Hours

**Total: 60 Hours** 

#### 18ME403 DYNAMICS OF MACHINES 2124

#### **Course Objectives**

- To impart knowledge in dynamic analysis of simple mechanism and design of flywheel.
- To provide knowledge on balancing of rotating and reciprocating masses.
- To study the working principle of governor and gyroscope.
- To learn the concept of free and forced vibration.
- To learn the concept of transverse and torsional vibration.

#### **Course Outcomes (COs)**

- 1. Perform dynamic analysis of simple mechanism and design of flywheel.
- 2. Estimate the balancing mass for rotating and reciprocating masses by using the force and couple polygon.
- 3. Compute the range of speed for governor and gyroscopic effect of ship and aero plane
- 4. Evaluate the natural frequency of single degrees of freedom system subjected to free and forced vibration.
- 5. Calculate the natural frequency of transverse and torsional vibration of single, two and three rotors system.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2											2		
2	2	2										1	2		
3	3	2											2		
4	2	2										1	2		
5	1	2										1	2		

#### **Articulation Matrix**

#### UNIT I

#### DYNAMIC FORCE ANALYSIS OF MECHANISMS

Principle of superposition, Condition for dynamic analysis, Dynamic analysis of four bar & slider crank mechanism - Engine force analysis. Turning moment diagram for steam & ICEngine. Energy stored in flywheel, Dimension of flywheel rim, Flywheel in punching press.

#### UNIT II

#### BALANCING

Introduction - Static balancing and dynamic balancing, Balancing of Rotating mass-several masses in same and different plane-Balancing of reciprocating mass-Swaying couple, Tractive force, Hammer Blow. Balancing of coupled locomotives.

#### UNIT III

#### **GOVERNOR AND GYROSCOPE**

Governor Terminology, Working principle, Types - Watt, Porter and Proell governor, Characteristics of Governor-sensitiveness, Hunting, Ichoronisn, Stability. Gyroscope- Gyroscopic effect, gyroscopic couple, gyroscopic effect on aero planes and naval ships.

#### 6 Hours

**6 Hours** 

**6 Hours** 

**6 Hours** 

#### UNIT IV

#### **FUNDAMENTALS OF VIBRATION**

Introduction-Terminology, Classification, elements of vibration, free undamped vibration, Free Damped vibration (Viscus Damping) - Damping ratio and logarithmic decrement. Forced damped vibration - Magnification factor. Vibration isolation and transmissibility.

#### UNIT V

#### TRANSVERSE AND TORSIONAL VIBRATION

Transverse vibration of shafts and beams, Shaft carrying several loads, whirling of shafts. Torsional vibration- effect of inertia on torsional vibration-Torsionally equivalent Shaft, single rotor, two rotor and three rotor system.

1	3 Hours
EXPERIMENT 1	
Determine the moment of inertia of object by flywheel.	
2	3 Hours
EXPERIMENT 2	
Dynamic analysis of four bar mechanism using CAD software	
3	3 Hours
EXPERIMENT 3	
Exercise on Balancing of reciprocating masses in slider crank mechanism.	
4	3 Hours
EXPERIMENT 4	
Exercise on Balancing of four rotating masses placed on different plane.	
5	3 Hours
EXPERIMENT 5	
Determine the characteristics and effort of Porter and Proell Governors.	
6	3 Hours
EXPERIMENT 6	
Analyze the gyroscopic effect using Gyroscope and verify its laws.	
7	3 Hours
EXPERIMENT 7	
Determination of natural frequency of single degree of freedom system.	
8	3 Hours
EXPERIMENT 8	
Determine the frequency of forced vibration using electro dynamic shaker.	
9	3 Hours
EXPERIMENT 9	
Determination of critical speed of shaft with concentrated loads (Whirling of shaft)	

#### 10 EXPERIMENT 10

Determine the natural frequency of cantilever beam.

#### **Reference**(s)

Total: 75 Hours

- 1. S. S. Rattan, Theory of Machines, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2014.
- 2. John J Uichker and Joesph E. Shigley, Theory of Machines and Mechanism, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2005.
- 3. Ashok G Ambekar, Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2009.
- 4. R. L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2005.
- 5. Sadhu Singh, Theory of Machines, Prentice Hall of India, New Delhi, 2007.
- 6. https://nptel.ac.in/courses/112104114/9

#### 18ME404 STRENGTH OF MATERIALS 2124

#### **Course Objectives**

- To provide knowledge about stress distribution and strains in regular and composite structures subjected to axial loads
- To familiarize about two dimensional stress systems and stresses in thin cylinders
- To give input on shear force, bending moment diagrams and evaluate the bending stress in different beams under transverse loading
- To impart knowledge on finding slope and deflection of beams and buckling of columns for different boundary conditions
- To provide awareness on stresses on shafts and helical springs based on theory of torsion

#### **Course Outcomes (COs)**

- 1. Find the stress distribution and strains in regular and composite structures subjected to axial loads.
- 2. Evaluate the compound stresses in two dimensional systems and thin cylinders
- 3. Assess the shear force, bending moment and bending stresses in beams under transverse loading
- 4. Evaluate the slope and deflection of beams and buckling loads of columns under different boundary conditions
- 5. Apply torsion equation in design of circular shafts and helical springs

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1									1	1		
2	3	2	2									2	2		
3	3	2	2									2	2		
4	3	2	2									2	2		
5	3	1	2									2	2		

#### UNIT I

#### STRESS, STRAIN AND DEFORMATION OF SOLIDS

Introduction to material properties, Stress-strain curve for ductile and brittle materials, Hooke's law, Stresses and strains due to axial force in Stepped and Composite bars, Stresses due to thermal effect in composite bars, Factor of safety, Poisson-ratio, Elastic constants and their relationship

#### UNIT II

#### STRESSES IN TWO DIMENSIONS

State of stresses at a point, Normal and shear stresses on inclined planes, Principal planes and Principal stresses, Plane of maximum shear stress, Mohr's circle for bi-axial stress with shear stress. Hoop and longitudinal stresses in thin cylindrical vessels, Maximum Shear stress, Changes in dimensions and volume

#### **6 Hours**

#### *BE* –*Mech* |*Minimum* credits to be earned: 170|*Regulation* 2018, *Approved in XVIII Academic Council Meeting Held on* 28.12.2018

**6 Hours** 

**6 Hours** 

**6 Hours** 

**3 Hours** 

**3 Hours** 

**3** Hours

**3 Hours** 

#### UNIT III

#### SHEAR FORCE, BENDING MOMENT AND STRESSES IN BEAMS

Types of supports, Loads and beams, Shear force and Bending Moment in Cantilever, simply supported and overhanging beams, Point of contra flexure. Theory of Simple Bending, Bending stress and stress variation along the length and section of the beam, Section modulus.

#### UNIT IV

#### **DEFLECTION OF BEAMS AND COLUMNS**

Slope and Deflection of cantilever and simply supported beams by Double integration method and Macaulay's method. Types of Columns, Equivalent length, Euler and Rankine's formulae, Slenderness ratio

#### UNIT V TORSION IN SHAFT AND HELICAL SPRING

Torsion of circular solid and hollow shafts, shear strength, angle of twist and torsional stiffness. Closed coil helical spring-stresses and deflection under axial load, Maximum shear stress in spring section including Wahl's Factor

1		
EXPERIMENT 1		

Find the hardness of the material using Rockwell hardness tester

2	3 Hours
EXPERIMENT 2	

Calculate the hardness of the material using Brinell hardness tester

3	3 Hours
EXPERIMENT 3	
Calculate the hardness of the material using micro Vickers hardness tester	

#### 4

#### **EXPERIMENT 4**

Plot stress-strain curve by observing the tensile behaviour of the given specimen

#### 5

#### **EXPERIMENT 5**

Study the deflection of a simply supported beam and compare the experimental values of deflection with the theoretical values.

#### 6 3 Hours EXPERIMENT 6

Determine the compressive strength of the materials

#### 7

#### **EXPERIMENT 7**

Calculate the strains in cylindrical vessels subjected to internal pressure through thin cylinder test setup

8 EXPERIMENT 8	3 Hours
Experimentally determine the strain energy of a material subjected to impact loading	
9	3 Hours
<b>EXPERIMENT 9</b> Determination of spring constant through load vs deflection curve	
10	3 Hours
EXPERIMENT 10	
Experimental analysis of a bar under torsion to obtain stiffness and angle of twist	Total: 75 Hours
Reference(s)	
<ol> <li>S.S. Rattan, Strength of Materials, McGraw Hill Education (India) Private I Third Edition, 2017</li> </ol>	Limited, Chennai,

- 2. F.P. Beer and R. Johnston, McGraw Hill Education India Private Limited, Seventh edition, 2017
- 3. S.S. Bhavikatti, Strength of Materials, Vikas Publishing House, New Delhi, Fourth edition, 2013
- 4. Egor P. Popov, Engineering Mechanics of Solids, Pearson India Education Services Pvt Ltd, New Delhi, 2015
- 5. William Nash and Nilanjan Malik, Strength of Materials (Schaum's Outline Series), McGraw Hill Education, Fourth Edition, 2017
- 6. https://onlinecourses.nptel.ac.in/noc18\_ce17/preview

97

#### 18ME405 THERMAL ENGINEERING 2124

#### **Course Objectives**

- To study the components, systems and performance of internal combustion engines
- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of Brayton cycle and steam power cycles
- To provide knowledge on steam nozzles and steam turbines
- To impart knowledge on working principles and performance of air compressors
- To apply the thermodynamic concepts into refrigeration and air conditioning systems

#### **Course Outcomes (COs)**

- 1. Recognize the components and compute the performance of internal combustion engines
- 2. Illustrate the working of Brayton and steam power cycles in T-S diagram and formulate its efficiency
- 3. Resolve the problems involving steam nozzles and steam turbines
- 4. Compare the working and performance of reciprocating and rotary compressors
- 5. Estimate the capacity of refrigeration and air conditioning system

#### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3					2								3
2	2	3	2		2		2								3
3	2	3	2		2										3
4	2	3	2				2								3
5	2	3	2		2		2								3

#### UNIT I

#### **INTERNAL COMBUSTION ENGINES**

Internal combustion engines - classification, components and functions - Fuel supply systems - Ignition Systems - Lubrication system and cooling system - Performance calculation - Heat balance sheet.

#### UNIT II

#### **POWER PLANT CYCLES**

Gas turbine power plant cycle - Brayton cycle, expression for efficiency, work ratio. Modifications of Brayton cycle with intercooler, reheater and regenerator. Steam power plant cycle - Rankine cycle, modifications with reheater and regenerator.

#### UNIT III

#### STEAM NOZZLES AND TURBINES

Flow of steam through nozzles - shapes of nozzles, effect of friction, critical pressure ratio. Impulse and reaction turbines - compounding of turbines - velocity diagrams for simple and multistage turbines.

## 6 Hours

**6 Hours** 

#### 99

#### UNIT IV

#### **AIR COMPRESSORS**

## Multistage air compressor, Work of compression. Rotary compressors - Centrifugal, vane and roots blower, screw compressors.

#### UNIT V

#### **REFRIGERATION AND AIR-CONDITIONING**

Vapour compression refrigeration cycle - Effect of operating conditions on COP, performance calculations. Working principle of vapour absorption system- Ammonia-water, Lithium bromide-water systems (Elementary treatment only), comparison between vapour compression and absorption systems. Cooling load calculations, Concept of RSHF, GSHF, ESHF, Air conditioning systems.

Classification and working principle - work of compression with and without clearance, volumetric efficiency, isothermal efficiency and isentropic efficiency of reciprocating air compressors.

#### FOR FURTHER READING

Introduction to Super charger and turbo charger - Twin charging, Two-speed and two-stage superchargers. Emissions in an IC engine - Exhaust gas analysis, pollution control norms.

1	3 Hours
EXPERIMENT 1	
Experimental study on port timing and valve timing diagram of IC engines.	
2	3 Hours
EXPERIMENT 2	
Experimental study on performance test of 4-Stroke diesel engine	
3	3 Hours
FXPERIMENT 3	5 110015
Experimental study on heat balance test of 4-Stroke diesel engine	
Experimental study on near outline test of a stroke areset engine	
4	3 Hours
EXPERIMENT 4	
Experimental study on performance test of 4-Stroke Petrol engine	
5	3 Hours
EXPERIMENT 5	
Morse test on multi-cylinder petrol engine	
6	3 Hours
EXPERIMENT 6	
Study of steam turbines and steam nozzles	
7	3 Hours
' EVDEDIMENT 7	5 110015
<b>EXPERIMENT</b> / Experimental study on performance of two stage reciproceting air compressor	
Experimental study on performance of two stage recipiocating all compressor	

#### 6 Hours

#### **6 Hours**

#### 8

#### **EXPERIMENT 8**

Experimental study on rotary compressors

#### 9

#### **EXPERIMENT 9**

Experimental study on determination of Coefficient of Performance of refrigeration system

#### 10

#### **EXPERIMENT 10**

Experimental study on determination of Coefficient of Performance of Air-conditioning system

#### **Reference**(s)

- 1. R.K. Rajput, Thermal Engineering, 10th edition, Lakshmi Publications, 2018
- 2. Mahesh M Rathore, Thermal Engineering, 1st edition, Tata McGraw Hill Education Private Limited, 2010
- 3. Ed. Frank Kreith, The CRC Handbook of Thermal Engineering, CRC Press LLC, 2000
- 4. Yunus A Cengel, Robert H Turner and John M Cimbala, Fundamentals of Thermal-Fluid Sciences, 5th edition, McGraw-Hill Education, 2016

#### **3 Hours**

**3 Hours** 

#### 3 Hours

#### Total: 75 Hours

#### **18ME406 MICROPROCESSORS AND** MICROCONTROLLER

2023

#### **Course Objectives**

- To acquire basic knowledge about Microprocessors and Microcontrollers. ٠
- To study the architectures of microprocessor •
- To study the architectures of microcontroller. •
- To impart the programming skills on 8085 and 8051 microprocessors. •
- To understand the Programming analyzing concept of various peripheral interfacing with • 8085.

#### **Course Outcomes (COs)**

- 1. Identify the various types of microprocessors and microcontrollers.
- 2. Explain the fundamental concepts of the microprocessor.
- 3. Explain and use the basic concepts of the microcontroller.
- 4. Develop the logical programmes using 8085 and 8051 microprocessors.
- 5. Analyse the various peripheral interfacing with 8085.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3				1								1		
2	2		2										1		
3	2	2	1		2								1		
4	2	2	2		2								1		
5	2	2	3		2								1		

### UNIT I

8085 CPU

Functional Building Blocks of Processor - 8085 Pin Diagram - 8085 Architecture - Instruction set -Addressing modes -Timing diagrams - Assembly language programming - Stack - Interrupts.

#### **UNIT II**

#### **8085 INTERFACING**

Memory interfacing - Interfacing, I/O devices - Interfacing Serial I/O (8251) - Parallel I/O (8255) -Keyboard / Display controller (8279).

#### **UNIT III**

#### **PERIPHERALS INTERFACING**

ADC/DAC interfacing - Inter Integrated Circuits interfacing (I2C Standard) - Case studies: Traffic Light control, LED display interface using 8085 microprocessor.

#### **6 Hours**

**6 Hours** 

#### 101

#### *BE* –*Mech* |*Minimum* credits to be earned: 170 |*Regulation* 2018, *Approved in XVIII Academic Council Meeting Held on* 28.12.2018

**6 Hours** 

#### Ports and Circuits - Timing Diagram - External Memory - Interrupts. UNIT V **6 Hours 8051 PROGRAMMING AND APPLICATIONS** Special Function Registers(SFRs) - 8051 Instruction Set - Addressing Modes - Assembly Language Programming - I/O Port Programming - Case studies : Interfacing - Sensors, Stepper Motors using 8051 Micro-Controller. 1 4 Hours **EXPERIMENT 1** Programs for 8/16 bit Arithmetic operations (Addition / Subtraction) (Using 8085). 2 2 Hours **EXPERIMENT 2** Programs for 8 bit Arithmetic operations (Multiplication / Division) (Using 8085). 3 4 Hours **EXPERIMENT 3** Program for finding Ascending order and Descending order (Using 8085). 4 4 Hours **EXPERIMENT 4** Program for finding Maximum and Minimum number (Using 8085). 5 4 Hours **EXPERIMENT 5** Interfacing and Programming of 8279 6 2 Hours **EXPERIMENT 6** Interfacing and Programming of 8255 7 2 Hours **EXPERIMENT 7** Interfacing of Analog to Digital Converter (ADC) using 8085 microprocessor. 8 2 Hours **EXPERIMENT 8** Interfacing of Digital to Analog Converter (DAC) using 8085 microprocessor. 9 2 Hours **EXPERIMENT 9** Programming Arithmetic operation (Addition / Subtraction) using 8051 microcontroller. 10 4 Hours **EXPERIMENT 10**

Functional Building Blocks of 8051 Micro-controller - 8051 Micro-controller Hardware - I/O Pins,

**UNIT IV** 

**8051 MICROCONTROLLER** 

Programming Arithmetic operation (Multiplication / Division) using 8051 microcontroller.

**Total: 60 Hours** 

#### **Reference**(s)

- 1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and application with 8085, Penram International Publishing, New Delhi, 2012.
- 2. John Uffenbeck, The 80x86 Family, Design, Programming and Interfacing, Pearson Education, New Delhi, 2012.
- 3. Mohammed Ali Mazidi and Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education Asia, New Delhi, 2013.
- 4. A. K. Ray and K. M. Burchandi, Intel Microprocessors Architecture Programming and Interfacing, McGraw Hill International Edition, New Delhi, 2000.
- 5. M. Rafi Quazzaman, Microprocessors Theory and Applications, Intel and Motorola, Prentice Hall of India, New Delhi, 2003.
- 6. https://onlinecourses.nptel.ac.in/noc19\_ee11/preview

#### 18ME407 COMPUTER AIDED MODELLING LABORATORY II

#### 0042

#### **Course Objectives**

- To provide skills to create drafting from part and assembly models.
- To impart the skill to create surface models of automotive/ machine components
- To provide knowledge on generating models of sheet metal components .
- To provide knowledge to create simulation of assembly models/mechanisms
- To expose the knowledge to prepare the technical documents of complete assembly using Product Lifecycle Management (PLM) concepts

#### **Course Outcomes (COs)**

- 1. Create orthographic projections of components/assembly from part/assembly models
- 2. Construct three dimensional surface models of automotive/ machine components.
- 3. Construct the three dimensional sheet metal models of automotive /machine elements
- 4. Create the simulation of mechanisms and analyze its collisions
- 5. Prepare the technical documents for the given component/assembly using PLM concepts

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1					3				2	1			2		
2					3				2	1			2		
3					3				2	1			2		
4					3				2	1			2		
5					3				2	1			2		

#### 1

#### **EXPERIMENT 1**

Create a detailed orthographic view of machine components from part/ assembly models with tolerances

#### 2

#### **EXPERIMENT 2**

Create the detailed 2D orthographic sectional views from 3D part/assembly models with geometrical features

#### 3

#### **EXPERIMENT 3**

Generate a three dimensional surface models of automotive components

#### 4

#### **EXPERIMENT 4**

Create a three dimensional surface models of pet bottles for specific capacities.

## 6 Hours

**6 Hours** 

#### **6 Hours**

5 EXPERIMENT 5 Build sheet metal models of automotive components.	6 Hours
6 EXPERIMENT 6 Build sheet metal models of Air Conditioning Systems.	6 Hours
7 EXPERIMENT 7 Create simulation of slider crank mechanisms and analyze its collisions.	6 Hours
8 EXPERIMENT 8 Create simulation of hydraulic /pneumatic systems analyze its collisions	6 Hours
9 EXPERIMENT 9 Create a three dimensional assembly model and generate the detailed document with PL	6 Hours
10 EXPERIMENT 10 Prepare technical documents for an I.C. Engine Assembly with PLM concepts.	6 Hours
Reference(s)	otal: 60 Hours
1. Creo Parametric 2.0 for Engineers and Designers, Prof Sham Tickoo, Prabhakar	r Singh.
2. Geometric Modelling: Theoretical and Computational Basis towards Adv Applications, Fumihiko Kimura	vanced CAD
<ol> <li>Theory of Modeling and Simulation, Bernard P. Zeigler, Herbert Praehofe Kim, 2000</li> </ol>	er, Tag Gon

4. Product Lifecycle Management: 21st Century Paradigm for Product Realisation, John Stark, Springer, 2005

#### 18HS001 ENVIRONMENTAL SCIENCE 2000

#### **Course Objectives**

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

#### **Course Outcomes (COs)**

- 1. Explain the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
- 2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
- 3. Identify the existing environmental challenges related to pollution and its management
- 4. Select suitable strategies for sustainable management of components of environmental science
- 5. Correlate the impacts of population and human activities on environment

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2											1		
2	1	1											1		
3	2	2					1						1		
4	1												1		
5	2												1		

#### UNIT I

#### NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification) - water logging - salinity - case studies. Energy resources: renewable(solar, wind, tidal, geothermal and hydroelectric power) - non renewable energy sources

#### UNIT II

#### ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: forest ecosystem - desert ecosystem - ecological succession. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity - field study

#### 106

**6 Hours**
#### **UNIT III**

#### **ENVIRONMENTAL POLLUTION**

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - marine pollution - thermal pollution - noise pollution. Disaster management: causes - effects - control measures of floods - earthquake - cyclone - landslides

#### UNIT IV

#### SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - urban problems related to energy. Environmental ethics - issues and possible solutions - solid waste management - causes - effects - 3R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. Environment protection act: Air (Prevention and control of pollution) act - wildlife protection act.

#### UNIT V

#### HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - women and child welfare programmes - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

#### FOR FURTHER READING

Human rights: E - waste and biomedical waste -Identification of adulterants in food materials

#### **Reference**(s)

- 1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Editon, New Age International Publishers, New Delhi, 2014.
- 2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R., Environment. 8th edition. John Wiley & Sons, 2012.
- 3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
- 4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L., Environmental and Pollution Science, Academic Press, 2011.
- 5. A. K. De, Environmental Chemistry, 7th Edition, New age international publishers, New Delhi, 2014.

#### 6 Hours

7 Hours

# 5 Hours

**Total: 30 Hours** 

#### **18GE401 SOFT SKILLS-BUSINESS ENGLISH**

#### **Course Objectives**

- To acquire command of both the receptive skills (Listening, Reading) and the productive • skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

#### **Course Outcomes (COs)**

- 1. Listen, Read, Speak, and Write Business English at the level of independent users
- 2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

		011 111													
CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									1						
2										2					

### Articulation Matrix

### UNIT I

#### LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information Scanning - reading for gist - understanding sentence structure error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

#### UNIT II

#### WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating organising a larger unit of discourse - giving information - expressing and justifying opinions speculating - comparing and contrasting - agreeing and disagreeing

#### **Total: 30 Hours**

**Reference**(s) 1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

# 0020

**15 Hours** 

#### **18ME501 METROLOGY AND INSTRUMENTATION** 2023

#### **Course Objectives**

- To study the concepts of measurement and characteristics of instruments.
- To learn the method of linear and angular measurements. •
- To provide knowledge on measurement of thread and gear terminologies using suitable instruments.
- To study the use of laser and advances in metrology for linear geometric dimensions. •
- To provide knowledge on measurement of mechanical parameters using suitable instruments. •

#### **Course Outcomes (COs)**

- 1. Explain the basic concepts of measurement and characteristics of measuring instruments.
- 2. Practice the appropriate linear and angular measurements using precision measuring instruments.
- 3. Examine the major terminologies for screw thread, gear and roundness measurement.
- 4. Apply the advanced techniques in metrology to calculate the geometric dimensions.
- 5. Explain the methods used to measure the mechanical parameters.

### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2							2	1		1		2	
2	2	2							2	1		1		2	
3	2	2							2	1		1		2	
4	2	2			2				2	1		1		2	
5	2	2							2	1		1		2	

#### UNIT I

#### **BASICS OF METROLOGY**

Introduction - Types of measuring system - Standards of measurements - Line, End and wavelength. Calibration, Characteristics of measuring instruments. Errors in Measurement - Types, Methods of measurement - Care of Measuring Instruments.

#### UNIT II

#### LINEAR AND ANGULAR MEASUREMENTS

Linear Measuring Instruments: Vernier Caliper, Vernier Height and Vernier Depth Gauge, Inside, Outside and Depth Micrometer, Slip Gauge, Limit Gauge - Comparator: Mechanical, Pneumatic and Electrical - Angular Measurements: Bevel protractor, Sine bar, Angle Decker, Autocollimator.

#### 109

# 4 Hours

#### 7 Hours

# 7 Hours

# 6 Hours

### **3 Hours**

# **3 Hours**

# **3 Hours**

### **3 Hours**

# **3 Hours**

# **EXPERIMENT 6**

Differentiate the work piece by its surface roughness value.

microscope / Profile projector / Parkinson gear rolling tester.

#### UNIT III

### FORM MEASUREMENTS

Thread Measurement: Terminologies, Errors - External Thread Measurement: Pitch Gauge, Tool Maker's microscope, Floating Carriage micrometer with One, Two and Three wires method - Internal Thread Measurements. Gear Measurement: Terminologies, Errors, Gear Tooth Vernier caliper, Profile Projector, Base pitch measuring instrument, David Brown Tangent Comparator, Parkinson Gear Tester - External and Internal Radius measurements - Roundness measurement: Circumferential confining gauge, Assessment using V block and Rotating centers. Straightness and Flatness Measurement.

#### UNIT IV

### ADVANCES IN METROLOGY

Interferometer: NPL Flatness, Laser, Michelson - Coordinate Measuring Machine: Basic concept, Types, Constructional features, Probes, Accessories - Surface Roughness Measurement - Machine Tool Metrology.

#### UNIT V

#### **MEASUREMENT OF MECHANICAL PARAMETERS**

Measurement of Force - Principle, analytical balance, platform balance, proving ring. Torque - Prony brake, hydraulic dynamometer. Measurement of Power: Linear and Rotational - Pressure Measurement: Principle, use of elastic members, Bridgeman gauge, Mcleod gauge, Pirani gauge -Temperature Measurement: bimetallic strip, thermocouples, metal resistance thermometer, pyrometers.

#### 1 **3 Hours EXPERIMENT 1**

Comparing the accuracy of vernier caliper, vernier height gauge and micrometer to check the various dimensions of a given specimen.

# 2

# **EXPERIMENT 2**

Checking the dimensional limits of ten similar components using mechanical comparator.

# 3

# **EXPERIMENT 3**

Measurement of taper angle of a given specimen by direct and indirect method.

4

#### **EXPERIMENT 4** Measurement of screw thread specifications by direct and indirect method.

# 5

#### **EXPERIMENT 5** Measurement of gear tooth specifications by using Gear tooth vernier calliper / Tool maker

# 6

7 EXPERIMENT 7 Measurement of Straightness of a given job by using Autocollimator and Interferometer.	3 Hours
8 EXPERIMENT 8 Machine tool alignment test on Lathe / Milling machine / Drilling machine.	3 Hours
9 EXPERIMENT 9 Measurement of torque in a cantilever beam.	3 Hours
10 EXPERIMENT 10 Temperature measurement by using Bimetallic strip / Thermocouples / Pyrometer.	3 Hours
Reference(s)	u. oo mouns
<ol> <li>Bewoor, Vinay Kulkarni, Metrology &amp; Measurement, Tata McGraw Hill Company Pvt. Ltd., New Delhi, 2009.</li> </ol>	Publishing
2. Alan S. Morris, The Essence of Measurement, Prentice Hall of India, New Delhi,	2001.
3. R. K. Jain, Engineering Metrology, Khanna Publishers, New Delhi, 2009.	

- 4. A. K. Jayal, Instrumentation and Mechanical Measurements, Galgotia Publications, New Delhi, 2000.
- 5. T. G. Beckwith, N. Lewis Buck, Mechanical Measurements, Addison Wesley, New Delhi, 2008.

111

#### 18ME502 DESIGN OF MACHINE ELEMENTS 3104

### **Course Objectives**

- To learn the design procedure of machine elements subjected to simple and variable loads.
- To study the design procedure of shafts and couplings.
- To provide knowledge on the design of bolted and welded joints
- To provide knowledge on the design of helical, leaf and torsional springs subjected to constant and variable loads.
- To study the selection procedure of sliding and rolling contact bearings.

#### **Course Outcomes (COs)**

- 1. Design machine elements subjected to simple and variable loads.
- 2. Design shaft and couplings for various engineering applications.
- 3. Design bolted and welded joints subjected to static load.
- 4. Design helical, leaf and torsional springs subjected to constant and variable loads
- 5. Select suitable bearings for axial and radial loading conditions from manufacturers catalogue.

### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3									1	2		
2	1	2	2	1								1	2		
3	2	2	3	1								1	2		
4	3	2	2	1								1	2		
5	3	2	2	1								1	2		

#### UNIT I

### STEADY AND VARIABLE STRESSES

Introduction to the design process - Design of straight and curved beams - C -frame and Crane hook.Stress concentration - Design for variable loading - Soderberg, Goodman, Gerber methods and combined stresses - Theories of failure.

#### UNIT II

#### **DESIGN OF SHAFTS AND COUPLINGS**

Design of shafts based on strength, rigidity and critical speed. Design of rigid flange coupling -Design of flexible coupling.

#### UNIT III

#### DESIGN OF JOINTS

Design of bolted joints - stresses due to static loading, eccentric loading. Design of welded joints - Butt and Fillet welded Joints - Strength of parallel and transverse fillet welded Joints - Eccentrically loaded joints.

# 10 Hours

**10 Hours** 

#### UNIT IV

#### **DESIGN OF SPRINGS**

Types, End connections and design parameters. Design of helical springs - Circular and noncircular wire - Concentric springs. Design of leaf and torsional springs under constant and varying loads -Wahl's stress factor.

#### UNIT V

#### **DESIGN OF BEARINGS**

Types and selection criteria - Design of journal bearings - Design of rolling contact bearing - Ball and roller bearing.

#### **Total: 60 Hours**

#### **Reference(s)**

- 1. V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2010.
- 2. J. E. Shigley and C. R. Mischke, Mechanical Engineering Design, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2011
- 3. R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, John Wiley & Sons, New Delhi, 2011.
- 4. R. L. Norton, Design of Machinery, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2004.
- 5. M. F. Spotts, T. E. Shoup and I. E. Hornberger, Design of Machine Elements Pearson Education, 2006
- 6. Faculty of Mechanical Engineering, PSG College of Technology, Design Data Book, M/s.Kalai kathir Achchagam, 2013.

8 Hours

### 18ME503 COMPUTER AIDED MANUFACTURING I 2023

#### **Course Objectives**

- To educate the concept, applications and emerging trends in CNC machines
- To impart the knowledge on construction and working of Computer Numerical Control (CNC) Machines, maintenance and retrofitting of CNC machines.
- To provide knowledge on interfacing, communication and control of CNC drives.
- To impart the knowledge on CNC programming basics
- To introduce programming of CNC turning center.

#### **Course Outcomes (COs)**

- 1. Explain the Various concepts and select the suitable CNC for the given application.
- 2. Explain the construction, working and maintenance of CNC machine tools
- 3. Assess the interfacing drives, feedback devices used in CNC machine tools using programmable logic control (PLC) and other peripherals
- 4. Understand the various concepts in CNC programming
- 5. Formulate the programs to manufacture components in CNC turning center for popular controller

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2							2	1		1		2	
2	2	2							2	1		1		2	
3	2	2			1				2	1		1		2	
4	2	2			1				2	1		1		2	
5	2	2			1				2	1		1		2	

#### **Articulation Matrix**

#### UNIT I

#### FUNDAMENTALS OF CNC MACHINES

Introduction to Computer Numerical Control: Evolution of CNC Technology, CNC Systems - An Overview of Fundamental aspects of machine control, Different types of CNC machines - Advantages, disadvantages and applications of CNC machines- DNC and Adaptive control

#### UNIT II

#### CONSTRUCTION OF CNC AND MOTION CONTROL

Constructional features and applications - Linear motion and Recirculating ball bearings - CNC controller and Interpolator - Maintenance and retrofitting. Tool magazines, ATC, APC, Chip conveyors.

#### UNIT III

### **DRIVES AND CONTROL**

Spindle and feed drives - Sensors -Position, Encoders, Proximity, Limit switch -Interfacing system - Microcontroller and PLC based -Introduction to Graphical User interface -Communication protocol - RS232, RS 485, USB, Ethernet -PLC -Ladder diagram -Peripherals -Timer, Counter, Encoder interface, Human Machine Interface.

#### **6 Hours**

**6 Hours** 

# UNIT V PROGRAMMING OF CNC TURNING CENTRE Single pass and canned cycle -Turning, facing and threading -Multi-pass canned cycle -Rough and Finish turning, facing, boring, pattern repeating, , threading, drilling, peck drilling, high speed drilling cycle, grooving - Subprogram. **EXPERIMENT 1** Simulation and NC part program generation on facing and step turning

**EXPERIMENT 2** Simulation and NC part program generation on taper turning and profile turning

# **EXPERIMENT 3**

Simulation and NC part program generation on grooving cycle and thread cutting

### 4

5

3

1

2

# **EXPERIMENT 4**

Simulation and NC part program generation on drilling and boring cycle

# **EXPERIMENT 5**

To make one of the following product: Push fit assembly/simple cylinder piston assembly/milling tool holder/needle valve spool

# **Reference(s)**

- 1. P. Radhakrishnan, S. Subramanyan and V. Raja, CAD/CAM/CIM, New Age International Private Ltd, NewDelhi, 2008
- 2. P. Radhakrishnan, Computer Numerical Control Machines, New Central Book Agency, 2004.
- 3. HMT, Mechatronics, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2010.
- 4. Mikell P. Groover, Automation, Production System and Computer Integrated Manufacturing, Prentice Hall of India, New Delhi, 2008
- 5. M. M. M. Sarcar, Computer Aided Design and Manufacturing, Prentice Hall of India, New Delhi, 2008.
- 6. Mikell P. Groover, Mitchell Weiss and Roger N. Nagel G Odrey, Industrial Robotics, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2007

#### **6 Hours**

# **6 Hours**

# **5 Hours**

**5** Hours

**5** Hours

**5** Hours

#### **10 Hours**

**Total: 60 Hours** 

# UNIT IV

**BASICS OF CNC PROGRAMMING** 

Cutting tool Inserts - Materials, Classification, Nomenclature and Selection - Tool holders and Work holding devices - Coordinate system - Structure of a part program - G & M Codes -Programming for FANUC and SIEMENS controller. tool offset, work offset, cutter radius compensation

#### 18ME504 HEAT AND MASS TRANSFER 3125

#### **Course Objectives**

- To familiarize conduction heat transfer mechanisms
- To expose the mechanisms of free and forced convection
- To develop the shape factor algebra for black body radiation and grey body radiation
- To demonstrate the phase change heat transfer and calculate the performance of heat exchanging devices
- To explain diffusion and convective mass transfer

#### **Course Outcomes (COs)**

- 1. To recall the partial differential equations and electrical analogy and solve the problems in conduction heat transfer
- 2. To identify the correlation to find the heat transfer rate in free and forced convection
- 3. To use shape factor algebra and electrical analogy to find the heat transfer rate in radiation
- 4. To integrate the concepts of phase change heat transfer & compare the thermal performance of heat exchangers using LMTD or NTU approach
- 5. To find the mass transfer rate in diffusion and convective mass transfer applications

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1		2								3
2	2	3	2	2	1		2								3
3	3	3	2	2			2								3
4	2	3	2	2			2								3
5	2	3	2	2			2								3

#### **Articulation Matrix**

#### UNIT I

#### CONDUCTION

Basic concepts - mechanism of heat transfer. Conduction - Fourier's law, general differential equation in cartesian and cylindrical coordinates, one dimensional steady state heat conduction, conduction through plane wall, cylinders and spherical systems. Composite Systems. Extended surfaces.

#### UNIT II

#### CONVECTION

Basic concepts - Heat transfer coefficients, boundary layer concept. Forced convection - nondimensional numbers, external flow- flow over plates, cylinders and spheres, internal flow- laminar and turbulent flow. Free convection- non-dimensional numbers, flow over vertical plate, horizontal plate.

## UNIT III

### RADIATION

Laws of radiation- Stefan-Boltzmann law, Kirchhoff's law - Black body radiation - Grey body radiation - Shape factor algebra - Electrical analogy - Radiation shields.

# 10 Hours

9 Hours

# PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS

Boiling: Modes- correlations used. Condensation: Nusselt theory, types, correlations used. Heat exchangers : Types, heat exchanger analysis, fouling factor, LMTD (Logarithmic mean temperature difference) and Effectiveness - NTU (number of transfer units) Method - Overall heat transfer coefficient.

### UNIT V

1

#### MASS TRANSFER

Basic concepts - Diffusion mass transfer - Fick's law of diffusion, Steady state molecular diffusion. Convective mass transfer- correlations. Momentum, heat and mass transfer analogy.

#### FOR FURTHER READING

Two dimensional steady state heat conduction. Use of Heisler Chart, Unsteady state conduction. Numerical methods in heat conduction.

<b>EXPERIMENT 1</b> Determination of thermal conductivity for one dimensional steady state conduction	
2	3 Hours
EXPERIMENT 2	
Determination of heat transfer co-efficient by unsteady heat transfer	
3	3 Hours
EXPERIMENT 3	
Determination of heat transfer co-efficient by natural convection	
4	3 Hours
EXPERIMENT 4	
Determination of heat transfer co-efficient by forced convection	
5	3 Hours
EXPERIMENT 5	
Determination of Stefan-Boltzmann constant	
6	3 Hours
EXPERIMENT 6	
Determination of emissivity using emissivity apparatus	
7	3 Hours
EXPERIMENT 7	
Determination of overall heat transfer for film wise and drop wise condensation	
8	3 Hours
EXPERIMENT 8	

Determination of overall heat transfer co-efficient for a parallel and counterflow heat exchanger

#### UNIT IV

# **3 Hours**

**10 Hours** 

#### **3 Hours**

### 9 EXPERIMENT 9

Experimentation on mass transfer

### 10

# **EXPERIMENT 10**

Determination of overall heat transfer co-efficient for a fluidized bed heat transfer

### **Reference**(s)

- 1. Yunus A. Cengel, Heat and Mass Transfer: a Practical Approach, Tata McGraw Hill publishing Company private limited, New Delhi, 2017
- 2. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 2008
- 3. C. P. Kothandaraman and S. Subramanyan, Fundamentals of Heat and Mass Transfer, New Age International private limited, New Delhi, Rev. 3rd edition, 2006
- 4. Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt, Principles of Heat and Mass Transfer, ISBN: 978-1-119-38291-1 October 2017
- 5. R. K. Rajput, Heat and Mass Transfer, S Chand and Company, New Delhi, 2007
- 6. https://nptel.ac.in/courses/112101097/

3 Hours

**Total: 90 Hours** 

### 18GE501 SOFT SKILLS - APTITUDE I 0020

### **Course Objectives**

• Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

#### **Course Outcomes (COs)**

- 1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
- 2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
- 3. Apply different techniques to find the distance, speed and time of various moving objects.
- 4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									2	2					
2									2	2					
3									2	2					
4									2	2					

### UNIT 1

# NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process- Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility-Number of zeros in an expression.

### UNIT 2

### PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

### UNIT 3

### **AVERAGES AND AGES**

Introduction-Average of different groups-Addition or removal of items and change in average-Replacement of some of the items.

#### UNIT 4

# **RATIO, PROPORTIONS AND VARIATION**

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios-Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

### 4 Hours

#### 2 Hours

2 Hours

#### BE – Mech | Minimum credits to be earned: 170 | Regulation 2018, Approved in XVIII Academic Council Meeting Held on 28.12.2018

### 4 Hours

# 2 Hours

#### 2 Hours

# 2 Hours

# 2 Hours

### 2 Hours

2 Hours

### 2 Hours

#### **Total: 30 Hours**

# UNIT 5

### **PROFIT AND LOSS**

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

#### UNIT 6

# **TIME AND WORK**

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

### UNIT 7

# TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

### UNIT 8

# **CODING AND DECODING**

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

### UNIT 9

# **SEQUENCE AND SERIES**

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

# **UNIT 10**

# **DATA SUFFICIENCY**

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

# **UNIT 11**

# DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction-Plotting diagrams.

### **UNIT 12**

# **CRITICAL REASONING**

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

#### **Reference**(s)

- 1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
- 2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
- 3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
- 4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
- 5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
- 6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

#### **18HS002 PROFESSIONAL ETHICS IN** ENGINEERING

#### 2002

#### **Course Objectives**

- To understand Human Values and ethical theory. •
- To understand codes of ethics, work place responsibilities, rights, engineering • experimentation, global issues and contemporary ethical issues.
- To understand personal ethics, legal ethics, cultural ethics and engineers responsibility.

#### **Course Outcomes (COs)**

- 1. Articulate engineering ethics theory with sustained lifelong learning.
- 2. Adopt a good character and follow high professional ethical life.
- 3. Contribute to shape a better character by following ethical actions.
- 4. Confront and resolve moral issues occurred during technological activities.
- 5. Resolve moral and ethical problems through exploration and assessment by established experiments.

### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1								3	2		2				
2								2	2		2				
3								2	2		2				
4								2	2		2				
5								2	1		3				

#### UNIT I

### **HUMAN VALUES**

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others -Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment -Empathy

### **UNIT II**

#### ENGINEERING ETHICS AND PROFESSIONALISM

Scope of Engineering Ethics- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlbergs and Gilligan's theory -Consensus and controversy - Profession and Professionalism - Models of Professional Roles -Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse.

#### UNIT III

#### ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law -Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl

**6 Hours** 

**6 Hours** 

#### UNIT IV

#### WORKPLACE RESPONSIBILITIES AND RIGHTS

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate Climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights -Employee rights.

#### UNIT V

#### **GLOBAL ISSUES**

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

#### FOR FURTHER READING

Sample code of ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

#### **Reference**(s)

- 1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
- 2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
- 3. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi, 2006.
- 4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
- 5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
- 6. http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics

#### **6 Hours**

### 6 Hours

**Total: 30 Hours** 

#### **18ME602 MECHATRONICS** 2023

### **Course Objectives**

- To introduce the concept and working of sensors used in mechatronic system.
- To study the interface of actuators with mechatronic system. •
- To provide knowledge on feedback mechanism for improving the reliability of mechatronic • system.
- To impart knowledge on working and programming of microcontroller in mechatronic systems
- To learn the Programmable Logic Controller (PLC) used in mechatronic systems.

### **Course Outcomes (COs)**

- 1. Interface the different types of sensor with mechatronics system
- 2. Control position and speed of actuators used in mechatronics system.
- 3. Design a feedback controller for mechatronics system.
- 4. Programming the microcontroller to control actuators and sensor.
- 5. Programming PLC to develop a mechatronic system.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2												3		
2	2												3		
3	2	3	1									2	3		
4	2	3	1									2	3		
5	3	2	2									2	3		

#### UNIT I

#### SENSOR

Components of mechatronics system, Sensor-terminology - Potentiometer, Linear Variable differential transformer, strain gauge, Piezoelectric sensor, Optical encoder, Hall effect sensor, thermistor.

#### **UNIT II**

#### **ACTUATOR**

Mechanical Actuation system - cam, gear, belt & chain, Ball screw, Pneumatic & hydraulic Actuation system. Electrical actuation system -relay & solenoid, working & control of Stepper & servo motor.

### UNIT III

#### **FEEDBACK CONTROL**

Open loop system, closed loop system, Transfer Function, Mathematical Modeling of Mechanical & Electrical system, First order system, second order system, Proportional control, derivative control, Integral control, PID control.

**6 Hours** 

#### 124

**6 Hours** 

UNIT IV MICROCONTROLLER	6 Hours
Architecture of 8051- I/O Pins, Ports and Circuits, memory, counter, Timer, Interrupt, Instru Moving data, Logical ,arithmetic operation, Jump & call instruction, Examples -Windscr motion, Car engine management.	action set- een wiper
UNIT V	6 Hours
<b>PROGRAMMABLE LOGIC CONTROLLER</b> Basic Structure - Input / Output Processing - Programming - Mnemonics - Timers, Internal counters - Shift Registers - Master and Jump Controls. Examples -Pick and place robot. barrier system.	relays and Car park
1	3 Hours
<b>EXPERIMENT 1</b> Interfacing ultrasonic sensor with microcontroller to measure non-contact displacement	
2	3 Hours
<b>EXPERIMENT 2</b> Interfacing Encoder with microcontroller to measure position of DC motor.	
3	3 Hours
<b>EXPERIMENT 3</b> Programming microcontroller to control the position of servo motor.	
4	3 Hours
<b>EXPERIMENT 4</b> Design and simulation of pneumatic circuit using fluidsim software.	
5	3 Hours
<b>EXPERIMENT 5</b> Design and simulation of PID controller for mechatronics system in MATLAB.	
6	3 Hours
EXPERIMENT 6	
Design and development of temperature control system using microcontroller	
7	3 Hours
<b>EXPERIMENT 7</b> Programming microcontroller for speed control of stepper motor.	
8	3 Hours
EXPERIMENT 8	

Programming microcontroller for speed control of DC motor.

### 9 EXPERIMENT 9

Design and simulation of double acting cyclinder circuit using PLC

### 10

# **EXPERIMENT 10**

Design and simulation of meter-in and meter-out circuit in Fluidsim.

### **Reference**(s)

- 1. W. Bolton, Mechatronics, Pearson Education, New Delhi, 2012.
- 2. Godfrey Onwubolu, Mechatronics: Principles and Applications Butterworth-Heinemann Ltd, 2005.
- 3. Nitaigour Premchand Mahalik, Mechatronics : Principles, Concepts and Applications, Tata McGraw Hill Publishing Company Pvt.
- 4. Krishna Kant, Microprocessors & Microcontrollers, Prentice Hall of India, 2007.
- 5. K. P. Ramachandran, G. K. Vijayaraghavan, and M. S. Bala-Sundram, Mechatronics: Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd., New Delhi 2008.
- 6. http://nptel.iitm.ac.in/courses/Webcourse-contents/IITroorkee/industrialengineering/index.htm

3 Hours

**3 Hours** 

**Total: 60 Hours** 

#### 18ME603 FINITE ELEMENT ANALYSIS 3104

#### **Course Objectives**

- To impart basic knowledge in finite element method.
- To provide knowledge in 1D elements.
- To provide knowledge in 2D elements.
- To study heat conduction problems using finite element method.
- To provide knowledge in higher order and isoparametric elements.

#### **Course Outcomes (COs)**

- 1. Apply the numerical methods to formulate the simple finite element problems.
- 2. Apply one dimensional finite element method to solve bar, beam and truss type problems.
- 3. Apply finite element method for plane stress, plane strain and axisymmetric conditions.
- 4. Determine temperature distribution of one and two dimensional heat transfer problems using one and two dimensional finite elements.
- 5. Apply the numerical methods to formulate the higher order and isoperametric problems.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	3									1	2		
2	3	2	3									1	2		
3	3	2	3									1	2		
4	3	2	3									2	2		
5	3	2	3									1	2		

#### UNIT I

#### INTRODUCTION

Relevance and scope of finite element methods - strain vs displacement relations - stresses and equilibrium - natural and essential boundary conditions - Rayleigh-Ritz - Galerkin method- FEM procedure - Discretisation of domain-element shapes, types, size, location, and numbers.

#### UNIT II

#### **ONE-DIMENSIONAL (1D) ELEMENTS**

Coordinate system types-global, local and natural. shape function of 1D bar element -Finite element formulation - stiffness matrix, load vector, boundary condition and assembly of global equation-1D bar element and two node truss element- problems in the 2D truss. Introduction to beam element.

#### UNIT III

#### **TWO-DIMENSIONAL (2D) ELEMENTS**

Shape function for linear triangular element-Finite element formulation- Constant Strain Triangular (CST) element -plane stress, plane strain - axisymmetric elements - problems.

#### **10 Hours**

**10 Hours** 

#### UNIT IV

#### HEAT TRANSFER APPLICATIONS

Shape function for 1D and 2D triangular element heat conduction - stiffness matrix, load vector and assembly of the global equation for 1D and 2D triangular element heat conduction, heat generation with convective boundary conditions for the linear element.

#### UNIT V

#### HIGHER ORDER AND ISOPARAMETRIC ELEMENT

Selection of order of polynomial-linear, simplex, complex and multiplex elements. Mesh refinement methods and convergence requirements. Iso, Sub and Super parametric element. Shape functions for a 2-D four noded and eight noded Isoparametric rectangular element using the natural coordinate system - problems. Gaussian quadrature method-problems.

#### FOR FURTHER READING

Construct the FEA steps for the structural and thermal analysis of machine elements.

#### **Reference**(s)

- 1. S. S. Rao, Finite Element Method in Engineering, Elsevier India, 2017.
- 2. David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2017
- 3. Robert D. Cook, s. David, Malkucs Michael E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New Delhi, 2001.
- 4. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements Engineering, Pearson Education, New Delhi, 2011.
- 5. S. S. Bhavikati, Finite Element Analysis, New Age International Publishers, 2015

#### 9 Hours

#### 8 Hours

**Total: 60 Hours** 

#### 18ME604 DESIGN OF TRANSMISSION SYSTEMS 3104

#### **Course Objectives**

- To study the design procedure of belt and rope drive
- To learn the design procedure of spur and helical gear drives
- To learn the design procedure of bevel and worm gear drives
- To study the design procedure of multistage gear box
- To familiarize the students for design of I.C. Engine Components

### **Course Outcomes (COs)**

- 1. Design of belt and rope drives.
- 2. Design of spur and helical gear drives.
- 3. Design of bevel and worm gear drives.
- 4. Draw the kinematic and ray diagrams for multi stage gear boxes.
- 5. Design of mechanisms and I.C. Engine Components.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2										1			
2	2	2												2	
3	2	2										1			
4	2	2										1			
5	2	2										1			

#### UNIT I

#### **DESIGN OF FLEXIBLE ELEMENTS**

Need for power transmission - Types and classification of transmission systems, Applications, Limitations. Belt drives - Types, materials and construction, Selection of flat and V-belts from manufacturer catalogue. Wire Ropes- Construction, Rope lay, Stresses in wire rope, Failure of ropes.

#### UNIT II

#### **DESIGN OF SPUR AND HELICAL GEARS**

Spur and Helical gears- Introduction, Gear design, Force analysis, Tooth stresses - Failure in gears.

#### UNIT III

#### DESIGN OF BEVEL AND WORM GEARS

Bevel Gear- Introduction, Types, Geometry, Angle relations, Basic dimensions, Force analysis. Worm Gear -Introduction, Types, Geometry, Basic dimensions - Forces on worm and worm wheel -Modes of failures.

#### 9 Hours

# 9 Hours

#### UNIT IV

#### **DESIGN OF GEAR BOXES**

Gear Box - Geometric progression - Standard step ratio - Ray diagram - Kinematics layout. Design of multi stage gear boxes, Calculation of number of teeth and overlapping speed.

#### UNIT V

#### DESIGN OF MECHANISMS AND I.C. ENGINE COMPONENTS

Design of Ratchet & pawl mechanism and Geneva mechanism. Design of I.C engines components such as piston and connecting rod.

#### **Total: 60 Hours**

#### **Reference**(s)

- 1. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2017.
- 2. R. L. Norton, Design of Machinery, Fifth Edition, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2013.
- 3. T. J. Prabhu, Design of Transmission Elements, Mani Offset, Chennai, 2015.
- 4. B. J. Hamrock, B. Jacobson and S. R. Schmid, Fundamentals of Machine Elements, Third Edition, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2014.
- 5. S. G. Kulkarni, Machine Design, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2010.

# 9 Hours

### 18ME605 COMPUTER AIDED MANUFACTURING II 2023

#### **Course Objectives**

- To study the principle and applications of automated material handling and automated inspection
- To learn the concept of economics and testing of machine tools.
- To provide exhaustive skill on programming of CNC machining center.
- To learn the concept of NC code generation through CAD models.
- To educate the concept, applications macro and parametric programming.

#### **Course Outcomes (COs)**

- 1. Compare and select suitable automated material handling system and automated inspection methods for given applications.
- 2. Understand the economics factors and testing of CNC machines.
- 3. Formulate the programs to manufacture prismatic components using CNC machining centers for popular controller.
- 4. Understand the NC code generation through CAD models in CAM Software.
- 5. Apply the Macro and parametric programming for the given application.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2													2	
2	2													2	
3	2													2	
4	2													2	
5	2													2	

#### **Articulation Matrix**

#### UNIT I

#### COMPUTER INTEGRATED MANUFACTURING

Industrial Robot - robot anatomy, robot control systems, and other specifications, end effectors. Automated Guided Vehicle (AGV) Systems and Automated Storage and retrieval system (AS/RS) - basic components, types and its application. Automated inspection principles- Off line & on line inspection, distributed inspection & final inspection.

#### UNIT II

#### **ECONOMICS AND TESTING OF MACHINE TOOLS**

Factors influencing selection of CNC Machines Cost of operation of CNC Machines Practical aspects of introducing CNC machines in industries. Geometrical alignment test, national and international test charts, testing of CNC machine tools

#### UNIT III

#### PROGRAMMING OF CNC MACHINING CENTRE

Machining cycles - Linear and circular interpolation, Contouring, rectangular and circular pocketing, drilling, peck drilling, high speed drilling, tapping , boring, back boring, counter boring.

# 6 Hours

#### **6 Hours**

#### BE – Mech | Minimum credits to be earned: 170 | Regulation 2018, Approved in XVIII Academic Council Meeting Held on 28.12.2018

UNIT V MACRO PROGRAMMING AND ADVANCED LEARNING Introduction macro programming variables and its types, Introduction to parametric progra Comparison to sub- programming, canned cycles and computer programming. Integration of axes features - programming, methodology.	<b>6 Hours</b> mming - addition
1 EXPERIMENT 1 Simulation and NC part program generation on linear and circular interpolation	5 Hours
2 EXPERIMENT 2 Simulation and NC part program generation on contour milling	5 Hours
<b>3</b> <b>EXPERIMENT 3</b> Simulation and NC part program generation on drilling and peck drilling	5 Hours
4 EXPERIMENT 4 Simulation and NC part program generation on Mirror imaging in CNC Milling	5 Hours

**EXPERIMENT 5** 

To make one of the following product: compression mould die/Injection mould die/simple mechanism/motor or turbine impeller assembly **Total: 60 Hours** 

# **Reference**(s)

5

- 1. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
- 2. P. M. Agrawal and V. J. Patel, CNC Fundamentals and Programming, Charotar Publishing House Pvt. Ltd., 2014.
- 3. P. Radhakrishnan, Computer Numerical Control Machines, New Central Book Agency, 2004.

#### **PROGRAMMING USING CAM**

CNC part programming using CAD/CAM software and interfacing with CNC machines - Component modeling, machine selection, tool selection, coordinate reference, step by step procedure, cutter location data, simulation, post processer.

# **10 Hours**

#### 18ME608 COMPUTER AIDED ENGINEERING LABORATORY 0042

#### **Course Objectives**

- To expose knowledge on the FEA software as a tool for the analysis of bars, trusses and beams.
- To model complex geometries and load conditions for the determination of stresses and strains.
- To perform plane stress, plane strain and axisymetric simulations using FEA software.
- To apply the knowledge of torsion, buckling and dynamics to solve dynamic problems using FEA software.
- To obtain temperature distribution for heat conduction using FEA software.

#### **Course Outcomes (COs)**

- 1. Analysis of bars, trusses and beams using FEA software.
- 2. Analysis complex geometries and load conditions for the determination of stresses and strains.
- 3. Apply plane stress, plane strain and axisymetric conditions using FEA software.
- 4. Torsional analysis of shafts, buckling of columns and dynamic analysis of simple structure using FEA software.
- 5. Thermal analysis of determining temperature distribution and thermal stresses using FEA software.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2												2		
2	2												2		
3	2												2		
4	2												2		
5	2													2	

#### 1

# **EXPERIMENT 1**

Structural analysis of a stepped bard to determine nodal displacements, stresses reaction forces.

#### 2

# **EXPERIMENT 2**

Analysis of simple and complex trusses to find displacements, stresses and reaction forces for the given loadings.

#### 3

# **EXPERIMENT 3**

Analysis of cantilever beam, simply supported beam and fixed beam under different boundary and loading conditions.

# 4 Hours

#### 4 Hours

#### 134

#### *BE* –*Mech* |*Minimum* credits to be earned: 170 |*Regulation* 2018, *Approved in XVIII Academic Council Meeting Held on* 28.12.2018

4 Hours

4 Hours

4 Hours

4 Hours

4 Hours

# **EXPERIMENT 4**

# Analysis of corner angular plate with holes for the determination of Von mises stress and maximum deformation under static loading with one hole fixed and the other hole pressure loaded.

# **EXPERIMENT 5**

Determination of Von mises stress and the maximum deformation that occur when a steel plate with holes is loaded as shown. The plate is constrained in y direction at bottom section and distributed load of 20 N pulling in the y-direction. The plate is made of steel with a Youngs modulus of  $20 \times 10^4$  N/mm<sup>2</sup> and the Poissons ratio of 0.3.

6	4 Hours
EXPERIMENT 6	
Analysis of a compound bar under compression.	

#### 7

4

5

### **EXPERIMENT 7**

Stress analysis of a thin plate with hole with uniform load along any one direction in plane stress.

8 EXPERIMENT 8 Analysis of a long cylindrical pressure vessel under plane strain.	4 Hours
9 EXPERIMENT 9 Analysis of a closed cylinder under pressure Axisymmetric	4 Hours
10 EXPERIMENT 10 Analysis of shaft subjected to twisting moments.	4 Hours
<b>11</b> <b>EXPERIMENT 11</b> To solve a simple buckling problem to determine the deflection and reaction forces.	4 Hours

### 12

# **EXPERIMENT 12**

Modal analysis of Cantilever, Simply supported and Fixed beams under different boundary conditions

### 13

# **EXPERIMENT 13**

Temperature distribution in circular and radial fins.

#### 4 Hours

# **EXPERIMENT 14**

Temperature distribution in 2D and 3 D components under different boundary conditions for a heat conduction analysis.

### 15

#### **EXPERIMENT 15**

Coupled temperature and stress analysis of a compound object to determine the thermal stresses.

#### **Reference**(s)

- 1. Stinivasan, K. C. Sambana adn RK Datti, Finite Element Analysis using Ansys 11.0, Paleti PHI Learning Pvt. Ltd, 2010.
- 2. Esam M. Alawadhi, Finite Element Simulations Using ANSYS, CRC Press, 2016.
- 3. Meung K, Finite Element Methods with Programming and Ansys, Lulu Com 2013
- 4. Saeed Moaveni, Finite Element Analysis Theory and Applications with Ansys, Pearson Education, 2014.

# 4 Hours

**Total: 60 Hours** 

### 18GE601 SOFT SKILLS-APTITUDE II 0020

#### **Course Objectives**

• Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

#### **Course Outcomes (COs)**

- 1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
- 2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
- 3. Analyse objects involving cubes and cuboids in determining the number of sides colored.
- 4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
- 5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									2	2					
2									2	2					
3									2	2					
4									2	2					
5									2	2					

#### UNIT 1

### PERMUTATION AND COMBINATION

Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination.

# UNIT 2

### PROBABILITY

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

#### UNIT 3

### SYLLOGISM AND VENN DIAGRAM

Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

### UNIT 4

### SIMPLE INTEREST AND COMPOUND INTEREST

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound Interest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

#### 2 Hours

2 Hours

# 2 Hours

# UNIT 5

#### **MIXTURES AND ALLIGATION**

Definition-Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

#### UNIT 6

UNIT 7

#### **CUBE AND LOGARITHM**

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

<b>DATA INTERPRETATION</b> Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.	
UNIT 8	2 Hours
<b>PROGRESSION AND LOGICAL REASONING</b> Arithmetic progression-Geometric progression-Harmonic progression-Theorems progressions.	related with
UNIT 9 PROPLEM ON ACES	2 Hours
Introduction-Basic concept-Usage of Percentage and Averages -Applications.	
UNIT 10	2 Hours
ANALYTICAL REASONING Introduction-Basic concept-Non verbal Analytical Reasoning -Arrangements.	
UNIT 11	2 Hours
<b>BLOOD RELATION</b> Introduction-Basic concept-Kinds of relation-Tree diagram -Relations.	
UNIT 12	2 Hours
VISUAL REASONING Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image	
UNIT 13	2 Hours
<b>SIMPLIFICATIONS</b> Introduction-Basic concepts-Arithmetic operations-Fountion solving methods-Puzzles	
Introduction Basic concepts-Antimience operations-Equation solving inculous-1 uzzles.	otal: 30 Hours

# 2 Hours

2 Hours

4 Hours

#### **Reference**(s)

- 1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
- 2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
- 3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
- 4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
- 5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
- 6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

#### 18HS003 PRINCIPLES OF MANAGEMENT 2002

#### **Course Objectives**

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

#### **Course Outcomes (COs)**

- 1. Students will be able to understand the basic concepts of Management.
- 2. Have some basic knowledge on planning process and its Tools & Techniques.
- 3. Ability to understand management concept of organizing and staffing.
- 4. Ability to understand management concept of directing.
- 5. Ability to understand management concept of controlling.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									2		3				
2									2		2				
3									2		2				
4									3		2				
5									2		2				

# 

### INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management Science or Art Manager Vs Entrepreneur-types of managers-Managerial roles and skills Evolution of Management Scientific, Human Relations, System and Contingency approaches Types of Business organization- Sole proprietorship, partnership, Company-public and private sector enterprises-Organization culture and Environmen Current Trends and issues in Management.

#### UNIT II

#### PLANNING

Nature and purpose of planning-Planning process-Types of planning-Objectives-Setting objectives-Policies- Planning premises - Strategic Management- Planning Tools and Techniques-Decision making steps and process.

# 6 Hours

#### **6 Hours**

# **6 Hours**

Foundations of individual and group behaviour-Motivation-Motivation theories- Motivational satisfaction-Job enrichment-Leadership-types and theories of techniques-Job leadership-Communication-Process of communication-Barrier in communication Effective communication-Communication and IT.

#### UNIT V

### CONTROLLING

System and process of controlling-Budgetary and non-Budgetary control techniques-Use of Computers and IT in Management control-Productivity problems and management-Control and Performance-Direct and preventive control-Reporting.

#### **Reference**(s)

- 1. Robbins S, Management, (13th ed.), Pearson Education, New Delhi, 2017.
- 2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
- 3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
- 4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007.
- 5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

#### UNIT III

#### ORGANISING

Structure Types Line and staff authority Departmentalization delegation of authority Centralization and decentralization Job Design-Human Resource Management HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management. UNIT IV

# Nature and purpose Formal and informal organization Organization chart Organization

DIRECTING

# **6 Hours**

#### **Total: 30 Hours**

### 18ME702 AUTOMOBILE ENGINEERING 3003

### **Course Objectives**

- To impart knowledge on the constructional details and principle of operation of various automobile components.
- To provide knowledge on the working of fuel supply and engine auxiliary system in various automobiles.
- To learn the function of various components in transmission and drive lines of a vehicle.
- To study the concept and working of steering, brakes and suspension systems in automobile.
- To impart knowledge on electrical and electronic systems of automobiles.

### **Course Outcomes (COs)**

- 1. Demonstrate the operating principles and constructional details of various automobile components.
- 2. Explain the function of fuel supply and engine auxiliary systems
- 3. Explain the function of various components in transmission and drive lines of a vehicle.
- 4. Identify and explain the types of steering system, suspension system and braking system.
- 5. Interpret the functioning of electrical and electronic systems in automobiles

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1		3									2	
2	2	2	1		3									2	
3	2	2	1		3									2	
4	2	3	2		2									2	
5	2	2	2		2									2	

#### **Articulation Matrix**

#### UNIT I

### VEHICLE STRUCTURE AND ENGINES

Types of Automobiles - vehicle construction, chassis, frame and body. Vehicle aerodynamics (various resistances and moments involved). Engine -Types and Construction. Lubrication system - Types and construction.

### UNIT II

### FUEL SUPPLY AND ENGINE AUXILIARY SYSTEMS

Spark ignition engine- Electronic fuel injection system, mono-point and multi Point injection systems. Compression ignition engine-Inline fuel injection system, Common rail direct fuel injection system. Engines Supercharger, turbo charger, engine emission control by 3 Way catalytic controller. Emission norms (Euro and BS)

#### 9 Hours

9 Hours

#### 141

#### **UNIT III**

#### TRANSMISSION AND DRIVE LINES

Clutch- Types- single plate clutch, multi plate clutch. Gearbox - Types- synchromesh gearbox, sliding mesh gear box, constant mesh gearbox. Automatic transmission system. Fluid flywheel, torque convertors, propeller shaft, slip joint, universal Joints, differential and rear axle drives - hotchkiss drive and torque tube drive.

#### UNIT IV

#### STEERING, BRAKES AND SUSPENSION

Wheels and Tyre Construction. Steering geometry and types of steering - rack and pinion steering gear, recirculating ball type steering gear and Power steering - construction and working principle. Suspension systems - Types - rear suspension and front suspension. Braking systems-Types- disc brake, drum brake, hydraulic brake and air brake.

#### UNIT V

#### **ELECTRICAL AND ELECTRONIC SYSTEMS**

Electrical systems, battery types, construction and working principle of lead acid battery. Generator, starting motor and drives. Lighting, ignition (Battery, Magneto Coil and Electronic type), regulators, cut outs. Different electronic control unit used in the engine management, block diagram of the engine management system. IoT in automobiles and its application.

#### FOR FURTHER READING

Active Suspension System (ASS), Electronic Brake Distribution (EBD), Electronic Stability Program(ESP), Traction Control System (TCS), Global Positioning System (GPS), Electric, Hybrid vehicle.

#### **Total: 45 Hours**

#### **Reference**(s)

- 1. Crouse and Anglin, Automotive Mechanism, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2003.
- 2. Newton, Steeds and Garet, Motor vehicles, Butterworth Publishers, 2000.
- 3. S. Srinivasan, Automotive Mechanics, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2003.
- 4. Joseph Heitner, Automotive Mechanics, East-West Press, 2006.
- 5. H. M. Sethi, Automobile Technology, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2007.
- 6. Kirpal Singh, Automobile Engineering Volume.1 and 2, Standard Publishers, New Delhi, 2013.

#### 9 Hours

# 9 Hours
#### **18ME703 OPERATION RESEARCH** 3104

#### **Course Objectives**

- To impart knowledge on the basics of linear programming techniques. •
- To understand the transportation and assignment models. •
- To provide knowledge on network models and project management. •
- To learn the concept of queuing model and problems associated in it. •
- To familiarize the sequencing and replacement models. •

#### **Course Outcomes (COs)**

- 1. Formulate and select the suitable method to solve the linear programming problem.
- 2. Solve the different transportation and assignment based models.
- 3. Draw the network models and solve it.
- 4. Select the suitable queuing model and solve the given applications.
- 5. Find the total elapsed time and optimum replacement policy.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3														2
2	1	2	2												2
3	1	2	1												2
4		3			2										2
5			2		1										2

#### UNIT I

#### LINEAR PROGRAMMING

Operations Research - Introduction, Scope, Objectives, Phases, and its limitations. Linear Programming Problem(LPP) Formulation, Graphical method, Simplex method. Artificial variable techniques - Big-M method and two-phase method.

#### UNIT II

#### TRANSPORTATION AND ASSIGNMENT MODEL

Transportation - Introduction, Initial basic feasible solutions - Northwest corner rule, Least cost method, and Vogel's approximation method. Optimality test using MODI method. Assignment -Introduction and Hungarian method for optimal solution. Travelling salesman problem.

#### UNIT III

#### NETWORK MODELS AND PROJECT MANAGEMENT

Network models - Introduction, Rules for construction and errors. Shortest route - Dijkstra's algorithm, Minimal spanning tree - Kruskal's algorithm, Maximum flow models. Project management - CPM and PERT networks.

9 Hours

9 Hours

#### 9 Hours

#### 143

#### 144

# UNIT IV

#### **OUEUING MODELS**

#### UNIT V

population.

#### SEQUENCING AND REPLACEMENT MODEL

Sequencing Problem - Introduction, Types - n jobs with 2 machines and n jobs with 3 machines. Replacement Models - Introduction, Types, Replacement of items that deteriorate with time, Value of money changing with time and not changing with time, Optimum replacement policy - Individual and Group replacement policy.

Queuing model - Introduction, Elements, Kendall's Notation, Parameters, Single Server and multiserver models, Poisson input, Exponential service, Constant rate service, Finite and Infinite

#### FOR FURTHER READING

Application of queuing models in the banking sector, Formulate LPP for transporting goods from factory to customers. Software packages such as LINDO, LINGO, and TORA.

#### Total: 60 Hours

#### **Reference(s)**

- 1. Frederick S. Hiller, Gerald J. Liberman, Introduction to Operations Research: Concepts and Cases, 8th edition, Tata McGraw-Hill Publishing Company Private Limited, 2010.
- 2. Hamdy A. Taha, Operation Research An Introduction, Pearson Publications, 2010.
- 3. Prem Kumar Gupta, D. S. Hira, Introduction to Operations Research, S.Chand and Co, 2004.
- 4. R. Panneerselvam, Operations Research, second edition, Prentice Hall of India, 2010.
- 5. K. Levy Ferdinand, D. Wiest Jerome, A Management Guide To PERT/CPM, With GERT /PDM/DCPM and Other Networks, 7th Edition, PHI Learning Private Limited, 2009.
- 6. Wagner, Operations Research, Prentice Hall of India, 2000.

#### 9 Hours

#### 18ME704 INDUSTRIAL ROBOTICS 2023

#### **Course Objectives**

- To learn the construction and fundamentals of robots.
- To provide knowledge on types of drives and end effectors in robots.
- To impart knowledge on sensors and machine vision system.
- To study the kinematics of robots and its programming method.
- To provide knowledge on the applications of robots in industries.

#### **Course Outcomes (COs)**

- 1. Identify the components and construction of robot manipulator.
- 2. Select a suitable drive and an end effector for industrial robots.
- 3. Choose sensors and machine vision system for industrial robots.
- 4. Formulate forward & inverse kinematics and construct program for robots.
- 5. Discuss the usage and applications of robots in industries.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2												2		
2	2												2		
3	2												2		
4	2												2		
5	2												2		

#### UNIT I

#### FUNDAMENTAL OF ROBOTICS PROCESS

Robot-Definition-Robotics and Automation - Law of robotics -Robot Anatomy -Co-ordinate Systems, Work Envelope, classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Pay Load - Need for Robots

#### UNIT II

#### **ROBOT DRIVE SYSTEM AND END EFFECTORS**

Pneumatic Drives, Hydraulic Drive, Mechanical Drives and Electrical Drives. End Effectors - Grippers -Pneumatic gripper, Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers, and Mechanical Grippers -Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers.

#### UNIT III

#### SENSORS AND MACHINE VISION SYSTEMS

Sensors - types - tactile sensors, proximity and range sensors, contact and non-contact sensors, velocity sensors, touch and slip sensors, force and torque sensors. Robotic vision systems, imaging components, image representation, picture coding, object recognition and categorization, visual inspection.

# 6 Hours

**6 Hours** 

#### ROBOT KINEMATICS AND PROGRAMMING

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) - Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effecter commands, and Simple programs.

#### UNIT V IMPLEMENTATION AND APPLICATION

Implementation of Robots in Industries - Various Steps- Application of robots in machining -Welding -Assembly - Material handling - Loading and unloading - hostile and remote environments. Inspection and future application

#### 1 **EXPERIMENT 1**

Study of various types of robots.

#### 2

UNIT IV

#### **EXPERIMENT 2**

Geometric Modeling: As an example of a geometric modeling system a SCARA robot is modeled in a common modeling language using an industrial robot simulation system

## 3 **EXPERIMENT 3** Identification of various component in pneumatic and hydraulic drive system 4

#### **EXPERIMENT 4**

Automating the operation of a machine vice according to specified need using pilot valves.

# 5 **EXPERIMENT 5**

Load cell measurement

#### 6

#### **EXPERIMENT 6**

Displacement measurement using LVDT

#### 7

#### **EXPERIMENT 7**

Forward and Inverse Kinematics: The forward and inverse kinematics of the SCARA robot are derived and calculated in a simulation software.

### 8

#### **EXPERIMENT 8**

Offline Programming: The previously modelled SCARA robot is then programmed offline, also using the industrial robot simulation system.

#### **6 Hours**

### **6 Hours**

**3 Hours** 

#### **3 Hours**

### **3 Hours**

#### **3 Hours**

## **3** Hours

**3 Hours** 

#### **3 Hours**

#### 9 EXPERIMENT 9

Programming a parallel kinematic robot for a pick and place application

### 10

### **EXPERIMENT 10**

Programming the robot for a drilling application

#### **Reference**(s)

- 1. M. P. Groover, Industrial Robotics Technology, Programming and Applications, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2nd Edition, 2012.
- 2. D. Richard, Klafter, A. Thomas, Chmielewski and Michael Negin, Robotics Engineering, An Integrated Approach, Prentice Hall of India, New Delhi, 2010.
- 3. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics Control, Sensing, Vision and Intelligence, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2003
- 4. Yoram Koren, Robotics for Engineers, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2004.
- 5. James G. Keramas, Robot Technology Fundamentals, Cengage Learning, 2011.
- 6. https://nptel.ac.in/courses/112103174/39

## 3 Hours

**3 Hours** 

# Total: 60 Hours

#### 18ME707 PROJECT WORK I 0 0 6 3

#### **Course Objectives**

- To develop skills to formulate a technical project.
- To give guidance on the various tasks of the project and standard procedures.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
- To provide guidelines to prepare technical report of the project.

#### **Course Outcomes (COs)**

- 1. Formulate a real world problem, identify the requirement and develop the design solutions.
- 2. Identify technical ideas, strategies and methodologies.
- 3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- 4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- 5. Prepare technical report and oral presentations.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	2			2	1								
2	2	2	1	3		2					2	2			
3			3	2	2			2			2	2			
4		1		2	3	1	2	2							
5									3	3		2			

#### **Articulation Matrix**

00189

#### 18ME804 PROJECT WORK II

#### **Course Objectives**

- To develop skills to formulate a technical project.
- To develop skills to formulate a technical project.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
- To provide guidelines to prepare technical report of the project.

#### **Course Outcomes (COs)**

- 1. Formulate a real world problem, identify the requirement and develop the design solutions.
- 2. Identify technical ideas, strategies and methodologies.
- 3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- 4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- 5. Prepare technical report and oral presentations.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	2			2	1								
2	2	2	1	3		2					2	2			
3			3	2	2			2			2	2			
4		1		2	3	1	2	2							
5									3	3		2			

#### **Articulation Matrix**

#### **18HSH01 HINDI**

#### 1022

#### **Course Objectives**

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day-to-day situations
- To help students acquire the ability to understand a simple technical text in Hindi

#### **Course Outcomes (COs)**

- 1. Construct simple sentences and use vocabulary required for day-to-day conversation.
- 2. Distinguish and understand the basic sounds of Hindi language.
- 3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										2					
2										2					
3										2					

#### UNIT I

#### 9 Hours

9 Hours

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg - Table of Alphabet - Vocabulary.

#### UNIT II

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

#### UNIT III

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense -Assertive & Negative Sentences - Interrogative Sentences.

#### UNIT IV

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes -Directions - Seasons - Professions.

#### UNIT V

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

**Total: 45 Hours** 

# 9 Hours

### 9 Hours

#### **Reference**(s)

- 1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
- 2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications(P)Ltd., New Delhi, 2009
- 3. Videos, Stories, Rhymes and Songs

#### 1022 18HSG01 GERMAN

#### **Course Objectives**

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios •

#### **Programme Outcomes (POs)**

PO10. Communicate effectively on complex engineering activities with the engineering community and society by writing effective reports, design documents, make efficient presentations, and to provide or receive clear instructions.

#### **Course Outcomes (COs)**

- 1. listen and identify individual sounds of German
- 2. use basic sounds and words while speaking
- 3. read and understand short passages on familiar topics
- 4. use basic sentence structures while writing
- 5. understand and use basic grammar and appropriate vocabulary in completing language tasks

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										2					
2										2					
3										3					
4										2					
5										3					

#### **Articulation Matrix**

#### **UNIT I**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

#### UNIT II

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

#### UNIT III

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

#### UNIT IV

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

#### UNIT V

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

### **Total: 45 Hours**

#### 9 Hours

9 Hours

# 9 Hours

# 9 Hours

#### **Reference**(s)

- 1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015
- 2. Langenscheidt Eurodictionary German English / English German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009
- 3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

#### 18HSJ01 JAPANESE

1022

#### **Course Objectives**

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

#### **Course Outcomes (COs)**

- 1. Recognise and write Japanese alphabet
- 2. Speak using basic sounds of the Japanese language
- 3. Apply appropriate vocabulary needed for simple conversation in Japanese language
- 4. Apply appropriate grammar to write and speak in Japanese language
- 5. Comprehend the conversation and give correct meaning

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										2					
2										2					
3										2					
4										2					
5										2					

#### UNIT I

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

#### UNIT II

9 Hours

9 Hours

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers).

#### UNIT III

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

#### UNIT IV

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

#### UNIT V

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

#### Total: 45 Hours

#### **Reference**(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

#### 9 Hours

### 9 Hours

#### 18HSC01 CHINESE

#### **Course Objectives**

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

#### **Course Outcomes (COs)**

- 1. listen and identify individual sounds of Chinese
- 2. use basic sounds and words while speaking
- 3. read and understand short passages on familiar topics
- 4. use basic sentence structures while writing
- 5. understand and use basic grammar and appropriate vocabulary in completing language tasks

#### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										2					
2										2					
3										3					
4										2					
5										3					

#### UNIT I

#### 9 Hours

1022

Hello | 1.Initials and Finals of Chinese | b,p,m,f,d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3.Chinese Syllables | 4.Tone S

#### UNIT II

#### 9 Hours

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

#### UNIT III

#### 9 Hours

1. What""'s your name - In the school; -In the classroom; -In the school | The Interrogative Pronoun | 2 The Sentence | 3 Interrogative Sentences with

#### UNIT IV

#### 9 Hours

She is my Chinese teacher | In the library | The Interrogative Pronouns | The Structural Particle | The interrogative Particle

#### UNIT V

#### 9 Hours

Her daughter is 20 years old this year | 1.The Interrogative Pronoun | 2. Numbers below 100 | 3.Indicating a Change | The Interrogative Phrase

#### **Total: 45 Hours**

#### 18HSF01 FRENCH

1022

#### **Course Objectives**

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

#### **Course Outcomes (COs)**

- 1. To help students acquire familiarity in the French alphabet & basic vocabulary
- 2. listen and identify individual sounds of French
- 3. Use basic sounds and words while speaking
- 4. Read and understand short passages on familiar topics
- 5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										2					
2										2					
3										3					
4										2					
5										3					

#### UNIT I ENTRER EN CONTACT

Lalangue francaise, alphabets, les numeros, les jours, les mois. Grammaire Les verbes s "appeler,etre, avoir, less articles definis, indefinis Communication - Saluer, s"informer sur quelquun, demander de se presenter Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l"annee, les professions

#### UNIT II

#### PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) - Adjectifs les propositions de lieu Communication - Chercher un logement, d'ecrire son voisin, s''informer sur un lodgement Lexique - L''habitat, les pieces, l''equipement, la description physique

#### 9 Hours

#### UNIT III VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

#### UNIT IV

#### COMPRENDRE SON ENVIRONNEMENT LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l'imparfait Communication - Propose quelqu'''un de faire quelque chose, raconteur une sortie au passe parler un film Lexique - Les sorties, la famille, art, les vetements et les accessoires

#### UNIT V

#### **GOUTER A LA CAMPAGNE**

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, argent.

**Total: 45 Hours** 

#### **Reference**(s)

- 1. Saison A1, Methode de francais
- 2. Hachette FLE

### 9 Hours

9 Hours

#### 18GE0P1 NANOMATERIALS SCIENCE 3003

#### **Course Objectives**

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

#### **Course Outcomes (COs)**

- 1. Summarize the origin and advance of nanomaterials and its classification
- 2. Compare the different types of methods adopted for synthesizing nanomaterials
- 3. Analyze the characterization techniques for analyzing nanomaterials
- 4. Explain the physical properties exhibited by nanomaterials
- 5. Organize the nanomaterials developed for advanced technological applications

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1													
2	2	2													
3	3	1													
4	1	1													
5	2	3													

#### UNIT I

#### NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

#### UNIT II

#### NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

#### UNIT III

#### **CHARACTERIZATION TECHNIQUES**

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

#### 9 Hours

9 Hours

#### UNIT IV

#### SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes- structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials

#### UNIT V

#### NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

#### **Reference**(s)

- 1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
- 2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
- 3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
- 4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw Hill Education (India) Ltd, 2012
- 5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
- 6. Viswanathan B, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

#### 9 Hours

### 9 Hours

Total: 45 Hours

#### 18GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES

#### **Course Objectives**

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

#### **Course Outcomes (COs)**

- 1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
- 2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
- 3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
- 4. Illustrate the operation of metal oxide field effect transistor and their memory devices
- 5. Represent the working mechanism of opto-electronic devices

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1													
2	1	2													
3	1	1													
4	1	1													
5	2	1													

#### **Articulation Matrix**

#### UNIT I

#### **ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES**

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

#### UNIT II

#### **P-N JUNCTION**

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

#### UNIT III

#### **BIPOLAR JUNCTION TRANSISTOR**

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

#### 9 Hours

9 Hours

3003

#### UNIT IV

#### MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

#### UNIT V

#### **PHOTONIC DEVICES**

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency.

#### **Reference**(s)

# **Total: 45 Hours**

- 1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
- 2. S. M. Sze and M. K. Lee, Semiconductor Devices, Physics and Technology, John-Wiley & Sons, 2015
- 3. Ben. G. Streetman and S. K. Banerjee , Solid State Electronic Devices, Pearson Education Ltd, 2015
- 4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
- 5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
- 6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006.

#### 9 Hours

#### 18GE0P3 APPLIED LASER SCIENCE 3003

#### **Course Objectives**

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

#### **Course Outcomes (COs)**

- 1. Illustrate the transition mechanisms and the components of a laser system
- 2. Compare the different types of lasers based on pumping method, active medium and energy levels
- 3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
- 4. Analyze the role of lasers in surgical and endoscopy applications
- 5. Apply the laser techniques in industrial applications

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1													
2	1	2													
3	2	1													
4	1	1													
5	1	2													

#### UNIT I

#### LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein''s prediction - Einstein''s relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

#### UNIT II

#### LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

#### UNIT III

#### LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance -Light detection And Ranging (LIDER) - velocity measurement - holography

#### 9 Hours

#### 9 Hours

9 Hours

#### 164

#### UNIT IV

#### LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

#### UNIT V

#### LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting- Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

#### **Reference**(s)

- 1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
- 2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
- 3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
- 4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
- 5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
- 6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006.

#### 9 Hours

#### 9 Hours

Total: 45 Hours

#### 18GE0C1 CORROSION SCIENCE AND ENGINEERING 3003

#### **Course Objectives**

- Understand the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

#### **Course Outcomes (COs)**

- 1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
- 2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
- 3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
- 4. Calculate the rate of corrosion on metals using electrochemical methods of testing
- 5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1													
2	2						1								
3	1	3													
4	2	2													
5	3	3					1								

#### **Articulation Matrix**

#### UNIT I

#### CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

#### UNIT II

#### **TYPES OF CORROSION**

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

#### 9 Hours

#### 167

#### UNIT III MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

#### UNIT IV

#### **CORROSION RATE AND ITS ESTIMATION**

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing and eddy current testing

#### UNIT V

#### **CORROSION CONTROL METHODS**

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

#### FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems

#### **Reference**(s)

- 1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", Create Space Independent Publishing Platform, 2016.
- 2. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010.
- 3. R. Winstone Revie and Herbert H. Uhlig, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, 4th Edition, John Wiley & Science, 2008.
- 4. Mars G. Fontana, Corrosion Engineering, Tata McGraw Hill, Singapore, 2008
- 5. David E.J. Talbot (Author), James D.R. Talbot, Corrosion Science and Technology, Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
- 6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

#### 9 Hours

**10 Hours** 

#### 10 Hours

### Total: 45 Hours

#### 18GE0C2 ENERGY STORING DEVICES 3003

#### **Course Objectives**

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles
- Identify the types of fuel cells and to relate the factors of energy and environment
- Analyze various energy storage devices and fuel cells

#### **Course Outcomes (COs)**

- 1. Explain the parameters required for operation of a cell to evaluate the capacity of energy storage devices
- 2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
- 3. Differentiate fuel cells based on its construction, production of current and applications
- 4. Compare different methods of storing hydrogen fuel and its environmental applications
- 5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1													
2	2	3													
3	3	1													
4	2	2													
5	3	3													

#### **Articulation Matrix**

#### UNIT I

#### **BASICS OF CELLS AND BATTERIES**

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge- over discharge

#### UNIT II

#### BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries - zinc-carbon, magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles

#### 10 Hours

#### UNIT III

#### **TYPES OF FUEL CELLS**

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells

#### UNIT IV

#### **HYDROGEN AS A FUEL**

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations

#### UNIT V

#### **ENERGY AND ENVIRONMENT**

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell

#### **Reference**(s)

- 1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009
- 2. F. Barbir, PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013
- 3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001
- 4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012
- 5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016
- 6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010.

#### 169

## 10 Hours

**10 Hours** 

# 9 Hours

Total: 45 Hours

#### **18GE0C3 POLYMER SCIENCE** 3003

#### **Course Objectives**

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers and its • processing
- Identify suitable polymers for various industrial applications •

#### **Course Outcomes (COs)**

- 1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
- 2. Identify the suitable polymerization techniques to synthesize the high quality polymers
- 3. Characterize the polymers to identify the structural, thermal, mechanical and electrical features for specific applications
- 4. Apply the polymer processing methods to design polymer products
- 5. Identify and analyze the polymers used in electronic and biomedical applications

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1													
2	1	2													
3	2	2													
4	1	1	2												
5	1	3	2												

#### UNIT I

#### POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

#### UNIT II

#### **POLYMERIZATION TECHNIQUES**

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

#### 170

## **10 Hours**

#### UNIT III

#### CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption

#### UNIT IV

#### POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

#### UNIT V

#### **SPECIALITY POLYMERS**

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration

#### FOR FURTHER READING

Biodegradable polymers

#### **Reference**(s)

- 1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2015
- 2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
- 3. F. W. Billmeyer, "Text Book of Polymer Science", John Wiley & Sons, New York, 2007
- 4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
- 5. George Odian, "Principles of Polymerization", John Wiley & Sons, New York, 2004
- 6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011

#### **8 Hours**

**10 Hours** 

9 Hours

#### Total: 45 Hours

#### 18GE0M1 GRAPH THEORY AND COMBINATORICS 3003

#### **Course Objectives**

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer Science.

#### **Course Outcomes (COs)**

- 1. Recognize the basic ideas of Graph and its characteristics.
- 2. Assess the characteristics of trees and its properties.
- 3. Predict the coloring of graphs and its applications in the respective areas of engineering.
- 4. Compute the permutations and combinations in the engineering field.
- 5. Demonstrate the types of generating functions and their applications in engineering.

#### **Articulation Matrix**

CO No	<b>PO1</b>	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2													
2	2	2													
3	2	2													
4	2	2													
5	2	2													

### UNIT I

#### 9 Hours

9 Hours

#### INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

#### UNIT II

#### **TREES, CONNECTIVITY**

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

#### UNIT III MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

#### UNIT IV

#### PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

#### UNIT V

#### **GENERATING FUNCTIONS**

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

#### **Total: 45 Hours**

#### **Reference**(s)

- 1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
- 2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
- 3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
- 4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
- 5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
- 6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

#### 9 Hours

#### 9 Hours

#### 18GE0M2 ALGEBRA AND NUMBER THEORY 3003

#### **Course Objectives**

- Understand the basic notions of groups, rings, fields which will then be used to solve related problems.
- Examine the key questions in the Theory of Numbers.
- Implement the integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

#### **Course Outcomes (COs)**

- 1. Exemplify the concepts of groups and fields in the areas of Engineering.
- 2. Classify the different types of fields.
- 3. Organize the divisibility in number theory in various areas of Engineering.
- 4. Identify the solution of some kinds of equations.
- 5. Demonstrate the theorems in number theory.

#### **Articulation Matrix**

	1		1	1	1										
CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2													
2	2	2													
3	2	2													
4	2	2													
5	2	2													

#### UNIT I

FIELDS

Group Theory - Rings and Polynomials - Fields.

#### UNIT II

#### FINITE FIELDS AND POLYNOMIALS

Finite Fields - Irreducible Polynomials over Finite fields - Factorization of Polynomials over Finite Fields.

#### UNIT III

#### DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS

Division algorithm- Base-b representations - number patterns - Prime and composite numbers - Fibonacci and Lucas numbers - Fermat numbers - GCD - Euclidean Algorithm - Fundamental theorem of Arithmetic - LCM.

#### 9 Hours

## 9 Hours

#### UNIT IV

#### DIOPHANTINE EQUATIONS AND CONGRUENCES

Linear Diophantine equations - Congruences - Linear Congruences - Applications: Divisibility tests - Modular Designs - Chinese remainder theorem - 2x2 linear systems.

#### UNIT V

#### CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS

Wilson's theorem - Fermat's Little theorem - Euler's theorem - Euler's Phi functions - Tau and Sigma functions - Perfect numbers - Mersenne Primes - Mobius Function.

#### **Total: 45 Hours**

#### **Reference**(s)

- 1. Lidl. R., and Pilz. G., Applied Abstract Algebra, Springer-Verlag, New Delhi, 2nd Edition, 2006.
- 2. Thomas Koshy, Elementary Number Theory with Applications, Elsevier Publications, New Delhi, 2002.
- 3. San Ling and Chaoping Xing, Coding Theory: A first Course, Cambridge Publications, Cambridge, 2004.
- 4. Niven.I, Zuckerman. H.S., and Montgomery, H.L., An Introduction to Theory of Numbers, John Wiley and Sons, Singapore, 2004.

175

# 8 Hours

#### 18GE0M3 MATHEMATICAL FINANCE AND QUEUEING THEORY 3003

#### **Course Objectives**

- To provide the required fundamental concepts in probability and queuing models and apply these techniques in networks, image processing etc.
- Acquire skills in analyzing queuing models.

#### **Course Outcomes (COs)**

- 1. Identify the properties of stochastic process in finance
- 2. Interpret the concept and applications of Statistics in finance.
- 3. Demonstrate the basics of finance using the notions of statistics.
- 4. Assess the classifications and the properties of queues.
- 5. Implement the concepts of queue in open and closed networks.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2													
2	2	2													
3	2	2													
4	2	2													
5	2	2													

#### UNIT I

#### **APPLIED STOCHASTIC CALCULUS**

Brownian motion - Constructions - Non differentiability - Quadratic variation - Stochastic integration - Construction of Ito integral and properties, The Ito formula - Feynman-Kac formula

#### UNIT II

#### **STATISTICS**

Basic parameter estimation - Maximum likelihood estimation - Distributions - Regression techniques - Tests for normality - QQ plots - Hypothesis testing - Numerical examples in R.

#### 176

#### 9 Hours

#### UNIT III CONTINUOUS-TIME FINANCE

Black-Scholes-Merton model of stock prices as geometric Brownian motion, derivation of the Black-Scholes-Merton partial differential equation, the Black-Scholes formula and simple extensions of the model, self-financing strategies and model completeness, risk neutral measures, the fundamental theorems of asset pricing, continuous time optimal stopping and pricing of American options, forwards and futures in Black-Scholes-Merton model.

# UNIT IV

QUEUEING THEORY

Markovian queues - Birth and Death processes - Single and multiple server queueing models - Little s formula - Queues with finite waiting rooms - Finite source models.

#### UNIT V

#### NON-MARKOVIAN QUEUES AND QUEUEING NETWORKS

M/G/1 queue - Pollaczek Khinchin formula - M/D/1 and M/EK/1 as special cases - Series queues - Open and closed Jackson networks.

#### Total: 45 Hours

#### **Reference**(s)

- 1. M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer, 2005.
- 2. S. Shreve, Stochastic Calculus for Finance, Vol. 1 and Vol. 2, Springer, 2004.
- 3. G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, 3rd Edition, Oxford University Press, 2001.
- 4. Taha, H.A., Operations Research, Pearson Education, Asia, 8th Edition, 2003.

### 9 Hours

9 Hours

9 Hours

# 177

#### 18ME001 COMPUTER AIDED DESIGN 3003

#### **Course Objectives**

- To provide knowledge of fundamentals of CAD and geometric transformations.
- To understand the various geometric modeling concepts
- To identify the common visual realism algorithms.
- To impart the knowledge on parts assembly logics and consideration factors.
- To study the available data exchange formats for CAD model transportation.

#### **Course Outcomes (COs)**

- 1. Explain the fundamentals of CAD and geometric transformation concepts.
- 2. Describe the various representations of geometric curves, surfaces and solids.
- 3. Identify the importance of visual realism algorithms.
- 4. Identify the significant factors in computer aided assembly.
- 5. Explain the geometrical model data exchange and transfer CAD Models between various platforms.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2												2		
2	2	1											2		
3	2	1											2		
4	3	2											3		
5	2	1											3		

#### UNIT I

#### FUNDAMENTALS

Product cycle, Sequential and Concurrent Engineering, CAD - Architecture, Tools, applications - Coordinate systems - Two and Three-dimensional Transformations - Translation - Scaling - Reflection - Rotation, Windowing - clipping and Viewing.

#### UNIT II

#### **GEOMETRIC MODELING**

Representation of curves - Hermite, Bezier, B-Spline and rational curves - Surface Modeling - surface patch - Bezier and B spline surface. Solid Modelling - Boundary representation and Constructive Solid Geometry

#### UNIT III

#### VISUAL REALISM

Coherence - types. Hidden line removal algorithm - Priority and Area oriented algorithms. Hidden Surface removal algorithm - Depth buffer and Warnock's algorithms. Hidden solid removal algorithm, Ray Tracing algorithm, Shading and Coloring - types. Computer Animation.

#### 10 Hours

9 Hours
#### **ASSEMBLY OF PARTS**

Assembly modeling - Interference of Positions and orientations - CAD Tolerance Analysis - geometrical Mass Properties - degree of freedom - Constraints and Simulation concepts.

#### UNIT V

#### DATA EXCHANGE FORMATS

Database Management System - CAD Standards- File types - IGES, PDES, PARASOLID, ACIS, Data - Database - Structures - Types, DXF, STL and STEP Files. Communication Standards - File Transfer between CAD and CAM package.

#### FOR FURTHER READING

Graphics manipulation and Editing - Parametric Representation of Synthetic Curves - Applications of CAD in FEM

#### **Total: 45 Hours**

#### **Reference**(s)

- 1. Ibrahim Zied, CAD/CAM-Theory and Practice, Tata McGraw Hall Publishing Company Pvt. Ltd., New Delhi, 2009.
- 2. Donald Hearn, M. Pauline Baker, Computer Graphics, Prentice Hall of India, New Delhi, 2014.
- 3. Richard M. Lueptow, Graphics Concepts for Computer-Aided Design, Pearson Education India, 2006.
- 4. William M. Neumann, Robert F. Sproul, Principles of Computer Graphics, Tata McGraw Hall Publishing Company Pvt Ltd., New Delhi, 2005.
- 5. Mikell P. Groover, Emory W. Zimmers, CAD/CAM Computer-Aided Design and Manufacturing, Prentice Hall of India, New Delhi, 2007.

#### 8 Hours

#### 18ME002 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

## 3003

### **Course Objectives**

- To provide knowledge on design principles for designing the jigs and fixtures.
- To impart knowledge on locating and clamping principles for designing jigs and fixtures.
- To introduce the different types of jigs for producing the part.
- To study different types of fixtures for the producing the part.
- To introduce about press working terminologies and press accessories.

#### **Course Outcomes (COs)**

- 1. Explain the design aspects of jigs and fixtures.
- 2. Identify the suitable locators and clamps for jigs, fixtures and press tools.
- 3. Design a suitable jig for producing a part of the given component.
- 4. Design a suitable fixture for producing the given component
- 5. Design a suitable press tool dies and Press tools for the given simple components.

### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2											2		
2	1	2											2		
3	1	2											2		
4	1	2											2		
5	1												2		

#### UNIT I

#### **TOOL DESIGN**

Objectives, Challenges and Requirements, Production and Inspection Devices. Jigs and Fixtures - Differences, Design principles, Advantages, Essential Features, Materials used. Introduction to Limits, Fits and Tolerances, International Tolerance Grades, Geometric Dimensioning and Tolerancing.

#### UNIT II

#### LOCATION AND CLAMPING

Location - Principles, Basic rules, Degrees of Freedom, 3-2-1 Principle, Locating Methods, Types of Locators, Standard Parts. Clamping - Principles, Types of Mechanical Actuation Clamps, Pneumatic, Hydraulic, Magnetic, Vacuum, Electrostatic clamping, Epoxy Resin Clamping. Factors considered for Design of Jigs and Fixtures.

#### UNIT III

### DESIGN OF JIGS

Jigs - Elements, Construction, Types and Materials for Jig Elements. Drill bushes - Types, Special Bushes, Bush Clearance. Automatic drill jig, Rack and pinion operated, Indexing, Air operated Jig components - Design of Jigs for given components.

#### 7 Hours

8 Hours

#### **10 Hours**

**10 Hours** 

#### UNIT IV

#### FIXTURES

General Design Principles of Fixture. Types of Boring, Lathe, Milling and Broaching fixtures -Setting Block. Grinding, Planing and Shaping fixtures. Inspection - Gauging, Measuring and Supplement fixtures. Welding, Assembly and Modular fixtures. Design of fixtures for given component.

#### UNIT V

#### PRESS TOOLS

Mechanical Presses - Working terminology, Elements, Types and Press Accessories. Types of Dies, Punches and Strippers. Pressure pad, Knockouts, Stops and Pilots. Bending, Forming, Drawing and Deep Drawing - Dies and its Types. Spring-back phenomenon and Draw Ratio. Progressive, Combination and Compound Dies. Design and Development of Dies - Blank Development, Strip Layout, Computation of capacities and tonnage requirements.

#### **Total: 45 Hours**

#### **Reference**(s)

- 1. Edward G. Hoffman, Jig and Fixture Design, Cengage Learning, New Delhi, 2004
- 2. C. Elanchezhian, Design of Jigs, Fixtures and Press Tools, Eswar Press, Chennai, 2010
- 3. P. H. Joshi, Jigs & Fixtures, Tata McGraw Hill Education Private Limited, New Delhi 2012
- 4. Hiram E Grant, Jigs and Fixtures, Tata McGraw Hill Education Private Limited, New Delhi, 2011
- 5. C. Donaldson, G. H. Lecain and V. C. Goold, Tool Design, Tata McGraw Hill Education Private Limited, New Delhi, 2011
- 6. Fred Herbert Colvin, Lucian Levant Hass, Jigs and Fixtures: A Reference Book Showing Many Types of Jigs and Fixtures in Actual Use, and Suggestions for Various Cases, Nabu Press, 2011

#### 18ME003 NON - TRADITIONAL MACHINING PROCESSES

3003

#### **Course Objectives**

- To introduce basics of non-traditional machining processes.
- To study the mechanical energy based non-traditional machining processes.
- To provide knowledge on electrical energy based non-traditional machining process
- To impart knowledge on chemical and electro-chemical energy based processes.
- To impart knowledge on thermal energy based machining processes.

#### **Course Outcomes (COs)**

- 1. Explain the basics of non-traditional machining processes.
- 2. Select the suitable mechanical energy based non-traditional machining processes for the given industrial applications.
- 3. Find the suitable machining processes for machining electrically conductive materials.
- 4. Choose appropriate chemical and electro-chemical energy based processes for precision machining
- 5. Select the suitable thermal energy based process for cutting and machining of the hard materials.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2			2									2	
2	2	2			2									2	
3	2	2			2									2	
4	2	2			2									2	
5	2	2			2									2	

#### **Articulation Matrix**

#### UNIT I

#### NON TRADITIONAL MACHINING PROCESS

Introduction - Need - Classification - Energies employed in the processes - Brief overview of Abrasive jet machining(AJM), Water jet machining(WJM), Ultrasonic machining(USM), Electric discharge machining(EBM), Electro-chemical machining(ECM), Electron beam machining(EBM), Laser beam machining(LBM), Plasma arc machining(PAM).

#### UNIT II

#### **MECHANICAL ENERGY BASED PROCESSES**

Abrasive Jet Machining, Water Jet Machining and Ultrasonic Machining - Working Principles, Equipment, Process parameters, Material removal rate, Applications.

#### UNIT III

#### **ELECTRICAL ENERGY BASED PROCESSES**

Electric Discharge Machining - Working Principles, Equipment, Process Parameters, Material removal rate, Electrode / Tool, Power Circuits, Tool Wear, Dielectric, Flushing, Wire cut EDM Applications.

#### 7 Hours

#### 10 Hours

#### CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES

Chemical machining - Etchants, Maskants - techniques. Electro-chemical machining - Working principle, Equipment, Process Parameters, Material removal rate, Electrical circuit.Electro-chemical grinding - Electro-chemical honing - Applications.

#### UNIT V

#### THERMAL ENERGY BASED PROCESSES

Laser Beam machining, Plasma Arc Machining - Principles, Equipment. Electron Beam Machining - Principles, Equipment, Types, Beam control techniques, Material removal rate-Applications.

#### **Reference**(s)

- 1. P. K. Mishra, Non Conventional Machining, Narosa Publishing House, New Delhi, 2007
- 2. P. C. Pandey and H.S.Shan, Modern Machining Processes, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2008.
- 3. Joao Paulo Davim, Nontraditional Machining Processes: Research Advances, Springer, NewYork, 2013.
- 4. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, Material and Processes in Manufacturing, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
- 5. Vijaya Kumar Jain, Advanced Machining Processes, Allied Publishers Pvt. Ltd., New Delhi, 2005.
- 6. Hassan El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Professional, New Delhi, 2005.

#### **10 Hours**

#### 8 Hours

**Total: 45 Hours** 

#### **18ME004 WELDING TECHNOLOGY** 3003

#### **Course Objectives**

- To study the principles of welding process, gas welding, arc welding and their applications. •
- To provide knowledge on resistance welding process, parameters and its applications. •
- To study the solid state welding process, parameters and its applications. •
- To know about special welding process and the welding automation for mass production. •
- To learn the welding metallurgy, design and testing of weldments. •

#### **Course Outcomes (COs)**

- 1. Explain the working principle of welding process and selecting parameters for the given applications.
- 2. Select the suitable Resistance welding techniques for industrial requirements.
- 3. Identify the suitable technique to suit the welding requirement of the components.
- 4. Understand the need for the special techniques suitable automation for the special materials.
- 5. Understand the welding symbol, welding metallurgy and weldability of special metals to design and test to have sound weld.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1			1	1							2		
2	2	1	1		1	1							2		
3	2	1	1	1	1	1	1						2	1	
4	2	1	1	1	1	1	1						2	1	
5	2	1	1	1	1	1	1						2	1	

#### UNIT I

#### WELDING PRINCIPLES, GAS AND ARC WELDING PROCESSES

Classifications of Welding Processes - Power sources, Arc characteristics, V-I characteristics, Metal transfer modes, electrodes and fluxes. Types of Weld joints. Weld position. Gas welding: Oxyacetylene welding (OAW), Oxyhydrogen welding (OHW). Arc welding: Shielded Metal Arc Welding (SMAW), Submerged Arc Welding (SAW), Gas Tungsten Arc Welding (GTAW/TIG), Gas Metal Arc Welding (GMAW/MIG), Plasma Arc Welding (PAW) and Electroslag welding (ESW), Electrogas Welding process (EGW) - Advantages, limitations and its applications.

#### UNIT II

#### **RESISTANCE WELDING PROCESSES**

Spot welding (RSW), Seam welding (RSEW), Projection welding (PW), Resistance Butt welding, Flash Butt welding (FW), Percussion welding, High frequency resistance welding process and High frequency induction welding process - Advantages, limitations and its applications.

#### 9 Hours

#### UNIT III

#### SOLID STATE WELDING PROCESSES

Forge welding (FOW), Friction welding (FRW), Explosive welding (EXW), Ultrasonic welding (USW), Cold welding (CW), Diffusion bonding (DFW), Roll welding (ROW) and Hot pressure welding (HPW) processes - Advantages, limitations and its applications.

#### UNIT IV

#### SPECIAL WELDING PROCESSES AND WELDING AUTOMATION

Thermit welding (TW), Atomic Hydrogen welding (AHW), Electron beam welding (EBW), Laser Beam welding (LBW), Friction stir welding (FSW), Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

#### UNIT V

#### DESIGN OF WELD JOINTS, TESTING OF WELDMENTS, CODES AND STANDARDS

Welding symbols, welding dimension, design of various welded joints weldability of Aluminium, Copper, Cast Iron and Stainless steels. Destructive tests: Tensile Testing, Ductility Testing, Toughness Testing, Fatigue Testing. Non-destructive testing: Visual Inspection, Liquid Penetrant Testing, Magnetic Particle Testing, Radiographic Testing and Ultrasonic Testing of weldments. Codes and Standards: Introduction to codes and standards, Welding and Welder Qualification, Procedure Qualification Record (PQR), Welding Procedure Specification (WPS), and Welder Performance Qualification (WPQ).

#### **Total: 45 Hours**

### **Reference**(s)

- 1. David H. Phillips, Welding Engineering: An Introduction, Wiley, 2016.
- 2. Parmer R.S., Welding Engineering and Technology, 3rd edition, Khanna Publishers, New Delhi. 2015
- 3. Parmer R.S., Welding Processes and Technology, Khanna Publishers, New Delhi, 2004.
- 4. Nadkarni S.V., Modern Arc Welding Technology, 1st edition, Oxford IBH Publishers, 2005.
- 5. AWS Welding Hand Book, Welding Process, 9th Edition, Vol-1&2, 2005.
- 6. https://nptel.ac.in/courses/112107089/

#### 9 Hours

9 Hours

#### 18ME005ADVANCED STRENGTH OF MATERIALS3003

#### **Course Objectives**

- To provide knowledge on deformation mechanisms in materials.
- To learn high temperature deformation phenomena.
- To impart knowledge on various fracture mechanism.
- To provide knowledge on the various strengthening mechanisms in materials.
- To impart knowledge on fatigue failure for different cyclic loading conditions.

#### **Course Outcomes (COs)**

- 1. Explain the deformation mechanisms of different materials.
- 2. Describe the phenomenon of high temperature deformation & failure
- 3. Explain the types of fracture modes and its mechanisms.
- 4. Express the concept of different strengthening mechanisms and its advantages
- 5. Describe about fatigue failure and its characteristics.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		1		1	2							2		
2			1		1	2							2		
3	2		1		1								2		
4	2		1		1								2		
5	2		1		1								2		

#### UNIT I

#### **BASIC CONCEPT OF MATERIAL BEHAVIOR**

Creep mechanism - Dislocation glide at low temperature, Differential flow creep mechanisms - Creep in two phase alloys - Independent and sequential process -Deformation mechanism maps - Engineering aspects of creep design -Introduction to Super plasticity, Hot working of metals, Dynamic Recovery and recrystallization.

#### UNIT II

#### HIGH TEMPERATURE DEFORMATION

Creep mechanism - Dislocation glide at low temperature, Differential flow creep mechanisms - Creep in two phase alloys - Independent and sequential process -Deformation mechanism maps - Engineering aspects of creep design -Introduction to Super plasticity, Hot working of metals, Dynamic Recovery and recrystallization.

#### UNIT III

#### TENSILE FRACTURE AT LOW TEMPERATURE AND EMBRITTLEMENT

Theoretical strength of a crystalline solid - Types of low temperature tensile fracture (Mode I, Mode II, Mode III Brittle fracture) - Ductile fracture, Introduction to Embrittlement fracture and types - Characteristics of Liquid Metal Embrittlement (LME), Solid Metal Embrittlement (SME), Hydrogen Embrittlement (HE) and Stress Corrosion Cracking (SCC).

#### 9 Hours

9 Hours

#### 9 Hours

#### 186

#### **STRENGTHENING MECHANISMS**

# Strengthening Mechanism-Types-Work hardening, Boundary strengthening, solid solution strengthening, Particle hardening- Deformation of two phase aggregates- Precipitation hardening in aluminum alloys, Patented steel wire, Martensite, Ausforming, TRIP (Transformation induced plasticity) steel, Maraging steel.

#### UNIT V

#### FRACTURE MECHANICS AND FATIGUE

Importance of Fracture Mechanics, Griffith Fracture Theory-Crack Driving Force & Energy Release Rate-Stress intensity factors - Fracture Toughness - Crack initiation and propagation- Material design for fracture toughness- Characteristics of fatigue fracture - Fatigue crack growth rates - Pari's Law - Cyclic stress-strain behavior - Design and evaluation of materials against fatigue.

#### Total: 45 Hours

#### **Reference**(s)

- 1. Thomas H Courtney, Mechanical Behavior Materials, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2000
- 2. R. W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley & Sons, New Delhi, 2000.
- 3. M. A. Meyers and K. Chawla, Mechanical Behavior of Materials, Prentice Hall of India, New Delhi, 2001.
- 4. George E. Dieter, Mechanical Metallurgy, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2007.
- 5. F. A. Mcclintock, and A. S. Argon, Mechanical Behavior of Materials, Addison Wesley Reading, Mass, New Delhi, 1966.

#### 9 Hours

#### 18ME006 PROCESS PLANNING AND COST ESTIMATION

3003

#### **Course Objectives**

- To introduce the process planning concepts.
- To impart the importance of cost estimation process and procedures.
- To study the procedure to calculate direct, indirect and overhead expenses.
- To learn the procedure to estimate the various machine costs.
- To learn procedure to estimate the machining time for Lathe, drilling, boring, shaping, milling and grinding operations.

#### **Course Outcomes (COs)**

- 1. Explain the concepts of process planning and cost estimation.
- 2. Assess the importance of cost estimation process and its procedures.
- 3. Compute direct, indirect and over head expenses.
- 4. Determine the production cost of forging, welding, and foundry.
- 5. Find the machining time for Lathe, drilling, boring, shaping, milling and grinding operations

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CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2							1		1	1	1	1	
2	3	2						1	1		1	1	1	1	
3	2	2	2					1	2		1	1	1	2	
4	3	2	2					2	1		2	1	1	2	
5	3	2	2						1			1	1	2	

#### **Articulation Matrix**

#### UNIT I

#### **PROCESS PLANNING**

Definition - Objective - Scope - Process planning activities - Approaches - Manual, Computer Aided Process planning - Retrieval, Generative and Semi- generative - Selection processes - Machine selection - Material selection parameters - Set of documents for process planning. Production time calculation - Selection of cost optimal processes.

#### UNIT II

#### INTRODUCTION TO COST ESTIMATION

Objectives and functions of Estimating - Costing - Importance and aims of Costing - Difference between Costing and Estimation - Methods of Costing - Types of estimates - Methods of estimates - Importance of Realistic Estimates - Estimating procedure.

#### UNIT III

#### **ELEMENTS OF COST**

Introduction - Material Cost - Direct and Indirect - Labour cost - Direct, Indirect and Determination of Direct Labour Cost - Expenses - Direct and Indirect - Analysis of overhead expenses - Administrative expenses - Selling and Distributing expenses - Allocation of overhead expenses- Depreciation - Causes and methods of depreciation.

#### 9 Hours

#### 8 Hours

189

#### UNIT IV

#### **PRODUCTION COST ESTIMATION**

Estimation in forging shop - Losses in forging and forging cost - Problems - Estimation in Gas cutting and welding shop - Material cost, Labour cost and Finish on cost -Problems - Estimation in foundry shop - Pattern cost, Foundry cost and casting cost - Problems

#### UNIT V

#### **ESTIMATION OF MACHINING TIME**

Importance of machine time calculations - Estimation of machining time for Lathe, drilling, boring, shaping, milling and grinding operations - Problems

#### FOR FURTHER READING

Case studies in Plant Layout design, Equipment selection, and process planning, Cost Evaluation of Layout - Implementation process.

#### **Reference**(s)

- 1. R. Kesavan, E. Elanchezhian, B. Vijaya Ramnath, Process planning and cost estimation, New Age International Publications, 2008
- 2. S. K. Mukhopadhyay, Production Planning and Control-Text and cases, Prentice Hall of India Private Limited, 2015.
- 3. Chitale. A.C., Gupta. R.C., Product Design and Manufacturing, Prentice Hall of India Private Limited, 2011
- 4. Peter scallan, Process planning, Design/Manufacture Interface, Elsevier science technology Books, 2003.
- 5. https://nptel.ac.in/courses/112107238/27

#### **10 Hours**

# 10 Hours

**Total: 45 Hours** 

#### 18ME007 INTERNAL COMBUSTION ENGINES 3003

#### **Course Objectives**

- To learn about the combustion phenomenon in spark ignition engines.
- To learn about the combustion phenomenon in compression ignition engines.
- To study the causes, effects and control of pollutants from an Internal Combustion engine.
- To provide the knowledge of alternate fuels in Internal Combustion engines.
- To impart the knowledge on recent developments in Internal Combustion engines.

#### **Course Outcomes (COs)**

- 1. Interpret the combustion phenomenon in spark ignition engines.
- 2. Explain the combustion phenomenon in compression ignition engines.
- 3. Exemplify the causes, effects and control of pollutants from an IC engine.
- 4. Identify the uses of alternate fuels in Internal Combustion engines.
- 5. Illustrate the recent developments in Internal Combustion engines.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3														2
2	3														2
3	3					2	2								2
4	3					2	2					2			2
5	3											2			2

#### UNIT I

#### **SPARK IGNITION ENGINES**

Spark ignition engine- Mixture requirements, carburetors, fuel injection systems, mono point and multipoint injection, stages of combustion, normal and abnormal combustion, factors affecting knocking-combustion chambers.

#### UNIT II

#### **COMPRESSION IGNITION ENGINES**

States of combustion in Compression Ignition Engine - combustion knock in compression ignition engines, methods of controlling knock. Direct and indirect injection systems. Combustion chambers. Fuel spray behaviour-spray structure, spray penetration and evaporation. Air motion-turbocharging.

#### UNIT III

#### POLLUTANT FORMATION AND CONTROL

Pollutant -formation of Oxides of Nitrogen in spark ignition and compression ignition engines, hydrocarbon emission - carbon monoxide formation - particulate emissions. Measurement of exhaust emissions- Non dispersive infrared gas analyzer, gas chromatography, chemiluminescent analyser and flame ionization detector, smoke meters. Methods of controlling emissions- Catalytic converters and particulate traps. Exhaust gas recirculation and Selective catalytic Reduction

# 9 Hours

10 Hours

#### **ALTERNATIVE FUELS**

Bio-fuels, alcohol, hydrogen, natural gas and liquefied petroleum gas, bio gas, properties, suitability, engine modifications, merits and demerits as fuels

#### UNIT V

#### **RECENT TRENDS IN I.C ENGINES**

Lean Burn Engines - stratified charge engines, homogeneous charge compression ignition, plasma Ignition. Variable valve timing, multi-valving, tuned manifolding, camless valve gearing, Variable compression ratio engines

#### **Reference**(s)

#### **Total: 45 Hours**

- 1. John B. Heywood, Internal Combustion Engine Fundamentals, Tata McGraw Hill Publishing Company Private limited., New Delhi, 2015
- 2. R. B. Mathur and R. P. Sharmal Internal Combustion Engines, Dhanpat Rai Publications, 2010
- 3. B.P. Pundir, Internal combustion Engines Combustion and Emissions, Narosa Publishing House Private limited, New Delhi, 2017
- 4. V. Ganesan, Internal Combustion Engines, Tata McGraw Hill Publishing Company Private limited., New Delhi, 2013
- 5. W.W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine, Prentice Hall, 2006.
- 6. https://onlinecourses.nptel.ac.in/noc19\_me10

#### 18ME008 REFRIGERATION AND AIR-CONDITIONING

3003

#### **Course Objectives**

- To provide the knowledge on air refrigeration systems
- To study the working of single and multistage vapour compression refrigeration systems
- To learn the operation of vapour absorption and other refrigeration systems
- To impart the knowledge about Psychometrics and its applications
- To learn the parameters involved in design of air conditioning systems

#### **Course Outcomes (COs)**

- 1. Illustrate the principle of operation of air refrigeration systems
- 2. Explain the components and working of vapor compression refrigeration systems
- 3. Demonstrate the working of other refrigeration systems
- 4. Resolve the psychometric problems in various applications
- 5. Determine the parameters involved in design of air conditioning systems

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2				2	2								3
2	3	2				2	2					2			3
3	3	2				2	2					2			3
4	3	3			2	2	2					2			3
5	3	3			2	2	2					2			3

#### UNIT I

#### AIR REFRIGERATION SYSTEMS AND REFRIGERANTS

First and Second law of thermodynamics applied to refrigerating machines - Reversed Carnot cycle, unit of refrigeration, co-efficient of performance. Air refrigeration: Bell-Coleman cycle, Types of air refrigeration systems. Refrigerants- Desirable properties of refrigerants, Recent substitute for refrigerants.

#### UNIT II

#### VAPOR COMPRESSION SYSTEM

Need for modification of Carnot cycle, Ideal and actual vapour compression cycle, Improvements in simple vapour compression system using flash chamber and flash inter cooler. Compound vapor compression system- Need for compound compression, two stage compression and various arrangements for improvement in coefficient of performance.

#### UNIT III

#### **OTHER REFRIGERATION SYSTEMS**

Principle, Components, working, limitations and applications of Steam jet refrigeration system, Thermo-electric refrigeration system, Electrolux refrigeration system, Vortex refrigeration system and Cascade refrigeration system.

### 9 Hours

9 Hours

9 Hours

#### 192

#### **APPLIED PSYCHROMETRY**

#### 9 Hours

9 Hours

#### AIR CONDITIONING SYSTEMS

Comfort Air Conditioning - parameters, requirements, concept of effective temperature, infiltration, internal heat gains, comfort charts. Industrial Air conditioning. Air conditioning systems and their types, selection of system, Components and controls of air distribution, Window air conditioner, split air conditioner, Central air conditioner, load estimation.

Principle and properties of psychometric of air, Representation of various psychometric processes on psychometric chart and their analysis, by-pass factor, sensible heat factor, room sensible heat factor, equipment sensible heat factor, grand sensible heat factor, apparatus dew point, ventilation and infiltration, energy efficiency ratio. Use of psychometric charts. Cooling and heating load

#### **Total: 45 Hours**

#### **Reference**(s)

calculations.

UNIT V

- 1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2017.
- 2. Langley and C. Billy, Refrigeration and Air conditioning, Ed. 3, Engle wood Cliffs (NJ), Prentice Hall of India, New Delhi, 2009.
- 3. Roy J. Dossat, Principles of Refrigeration, Pearson Education, New Delhi, 2007.
- 4. N. F Stoecker and Jones, Refrigeration and Air Conditioning, Tata McGraw Hill Publishing Company, New Delhi, 2008.
- 5. Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Limited, 2007.
- 6. https://nptel.ac.in/courses/112105129/

#### **18ME009 COMPOSITE MATERIALS** 3003

#### **Course Objectives**

- To provide fundamental knowledge in reinforcement and matrix materials.
- To impart knowledge on polymer matrix composites. ٠
- To impart knowledge on polymer matrix composites. To expose the characteristics and different fabrication techniques of metal matrix composites.
- To impart knowledge on ceramic matrix composites. •
- To provide knowledge on advanced composites.

#### **Course Outcomes (COs)**

- 1. Identify suitable reinforcement and matrix materials for different applications
- 2. Select appropriate fabrication technique for specific application of polymer matrix composite.
- 3. Select suitable processing method for the fabrication of metal matrix composites
- 4. Select suitable fabrication method for specific application of ceramic matrix composite.
- 5. Identify the advanced composites for appropriate applications.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2												2	
2	2	2												2	
3	2	2												2	
4	2	2												2	
5	2	2												2	

#### UNIT I

#### **INTRODUCTION TO COMPOSITES**

Fundamentals of composites, characteristics, need for composites, Enhancement of properties, Reinforcements - glass fibers, boron fibers, carbon fibers, organic fibers, aramid fibers, ceramic fibers, oxide and nonoxide fibers, Forms of reinforcements - Roving, Woven fabrics, Non woven, random mats, whiskers, Matrix materials - Polymers - Thermosetting resins, thermoplastic resins , Metals, Ceramic materials

#### UNIT II

#### **POLYMER MATRIX COMPOSITES**

Processing of polymer matrix composites- hand lay-up, Spray lay-up processes, Compression molding- SMC Reinforced reaction injection molding, Resin transfer molding, Pultrusion, Filament winding, Applications of polymer matrix composites

#### UNIT III

#### METAL MATRIX COMPOSITES

Characteristics of MMCs, Various types of Metal matrix composites, Advantages and limitations of MMCs, Effect of reinforcements on properties-Volume fraction - Rule of mixtures, Processing of MMCs - Liquid state processing- stir casting, squeeze casting, infiltration, solid state processing -Powder metallurgy, Diffusion bonding, In-situ processes, applications of MMCs.

#### 9 Hours

#### 194

9 Hours

#### **CERAMIC MATRIX COMPOSITES**

Need for CMCs, Processing of CMCs- cold pressing and sintering, hot pressing, infiltration, chemical vapor deposition and chemical vapor impregnation, sol-gel and polymer pyrolysis, high temperature synthesis properties and applications in aerospace and space fields.

#### UNIT V

#### **ADVANCES IN COMPOSITES**

Carbon fiber composites - properties, chemical vapor deposition - oxidative etching, liquid phase oxidation carbon/carbon composites - properties and applications of C/C Composites, future scope of c-c composites, multi-filament superconducting composites.

#### **Total: 45 Hours**

#### **Reference**(s)

- 1. P.K. Mallick, Fiber Reinforced Composites Materials, Manufacturing and Design, MarceDekker Inc, 2003.
- 2. K. Autar Kaw, Mechanics of Composite Materials, CRC Press, 2006.
- 3. B.D. Agarwal and L.J. Broutman, Analysis and Performance of Fiber Composites, JohWiley and Sons, New York, 2000.
- 4. Ronald Gibson, Principles of Composite Material Mechanics, Tata McGraw Hill, 2004.
- 5. K.K. Chawla, Composite materials, Springer Verlag, 2007.

#### 9 Hours

#### 18ME010 STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING

3003

### **Course Objectives**

- To familiarize with various statistical process control methods.
- To study the methods and characteristics of sampling.
- To introduce Taguchi method of experimental design.
- To describe the concept of reliability and its models.
- To impart knowledge on design of reliability process.

### **Course Outcomes (COs)**

- 1. Select suitable statistical process control charts for production process.
- 2. Explain the importance of sampling methods and its characteristics.
- 3. Implement the Taguchi method for experimental design.
- 4. Evaluate the reliability concept with their models.
- 5. Determine and analyze the reliability process.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	1	2									2	
2	2	2	3	1	2									2	
3	3	2	3	3	2								2		
4	2	3	2		2								1		
5	2	3	2		1								1		

#### UNIT I

### QUALITY AND STATISTICAL PROCESS CONTROL

Quality-Definition, Quality Assurance-Variation in process-Factors, Process capability. Control charts variables X, R and X, Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts-Charts for variables. Quality rating-Short run.

#### UNIT II

#### ACCEPTANCE SAMPLING

Lot by lot sampling-Types, Probability of acceptance in single, double, multiple sampling plans-Operating Characteristic curves-Producer's risk and consumer's risk-Acceptable Quality Limit, Lot Tolerance Percent Defective, Average Outgoing Quality, Concepts-Standard sampling plans for average outgoing quality and Lot Tolerance Percent Defective, Use of standard sampling plans.

#### UNIT III

#### EXPERIMENTAL DESIGN AND TAGUCHI METHOD

Fundamentals-Factorial experiments, Random design, Latin square design, Taguchi method-Loss function-Experiments, Signal/Noise ratio and performance measure, Orthogonal array.

#### **10 Hours**

8 Hours

#### CONCEPT OF RELIABILITY

Definition, reliability vs quality, reliability function-Mean Time Between Failures(MTBF),Mean Time To Repair(MTTR), availability, bathtub curve-time dependent failure models-Distributions-Normal, weibull, log normal-Reliability of system and models-serial, parallel and combined configuration - Markove analysis, load sharing systems, standby systems, co-variant models, static models, dynamic models.

#### UNIT V

#### **DESIGN FOR RELIABILITY**

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, System safety-analysis of down-time-Repair time distribution.

#### **Reference**(s)

- 1. Amitava Mitra, Fundamentals of Quality Control and improvement, Wiley, 2013.
- 2. Patrick D Connor, Practical Reliability Engineering, Wiley, 2012.
- 3. Charles E Ebling, An Introduction to Reliability and Maintainability Engineering, Overseas Press, 2011
- 4. David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth-Heinemann, 2011
- 5. Dhillon, Engineering Maintainability, How to design for reliability and easy maintenance, PH India publications, 2008.
- 6. https://nptel.ac.in/courses/112107238/49

#### **11 Hours**

**Total: 45 Hours** 

#### **18ME011 MECHANICAL VIBRATIONS** 3003

#### **Course Objectives**

- To learn the fundamental concept of vibration of single degree of freedom (DOF) system.
- To expose knowledge on vibration of Two DOF system. •
- To expose knowledge on vibration of Multi-DOF system. •
- To learn the governing equation of vibration of continuous systems. •
- To describe various instruments and control methods used in vibration analysis. •

#### **Course Outcomes (COs)**

- 1. Explain basic elements of vibration of Single Degree of Freedom (SDF) systems.
- 2. Calculate the natural frequency of vibration of Two Degree of Freedom (TDF) systems.
- 3. Estimate the natural frequency of vibration of Multi Degree of Freedom (MDF) systems
- 4. Perform vibration analysis for vibration of continuous systems
- 5. Select suitable instruments and control method for measurement and control of vibration.

Art	iculati	on Ma	atrix												
CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1										2		
2	3	2	1										2		
3	3	2	1	2						1			2		
4	3	2	1										1		
5	1		2		2					1		1		2	

#### ... wlation Matri

#### UNIT I

#### SINGLE DEGREE OF FREEDOM (SDF)

Fundamentals of vibration. Single Degree of Freedom - Responses of undamped free vibration -Viscous damping - Damped free vibration - Reponses of undamped forced vibration and damped forced vibration - Response of damped system under base excitation - Rotating unbalance. Introduction to Energy methods.

#### UNIT II

#### **TWO DEGREE FREEDOM SYSTEM (TDF)**

General equation of motion - Principal mode of vibration - Coordinate coupling - Orthogonolity principle - Rectilinear and torsional systems - Natural frequencies of undamped free vibration systems - Equations of motion for forced vibrations and damped free vibration - Dynamic vibration absorber -Lagrange's equation.

#### 9 Hours

#### UNIT III

#### MULTI-DEGREE FREEDOM SYSTEM (MDF)

Exact Analysis of MDF Modelling of MDF systems by equations of motion from Newton's law -Influence coefficients - Stiffness coefficients and Generalised coordinate - Eigenvalue problems and solution to Eigen value problems. Approximate method sin MDF Determination of natural frequencies by Dunkerley's method, matrix iteration method. Rayleigh's and Holzer's method.

#### UNIT IV

#### **VIBRATION OF CONTINUOUS SYSTEMS**

Introduction - Transverse vibration of string - Longitudinal vibration of shaft - Torsional vibration of shaft - Lateral vibration of beam - Rayleigh's Method and Rayleigh-Ritz method

#### UNIT V

#### **VIBRATION MEASUREMENT AND CONTROL**

Transducers - Vibration Pickups - Frequency Measuring Instruments - Vibration exciters. Control of vibration- Control of Natural frequencies - Introduction to damping. Vibration Isolation - Vibration Absorbers.

#### **Reference**(s)

- 1. Rao, S. S. Mechanical Vibrations, Pearson Education, 2011.
- 2. Thomson W.T. Theory of Vibration with Applications, CBS Publishers and Distributors, New Delhi, 2006.
- 3. Mallik, A, K, Principles of Vibration Control, Affiliated East-West Press Pvt. Ltd, 2004.
- 4. Rao V. Dukkipati J. Srinivas. Text book of Mechanical Vibrations, PHI Learning Pvt Ltd, New Delhi, 2016.
- 5. Graham Kelly G and Shashidar K. Kudari, Mechanical Vibrations, Tata McGraw-Hill Publishing Company Ltd New Delhi, 2007.
- 6. http://nptel.ac.in/courses/112103111/

#### 9 Hours

# 9 Hours

9 Hours

#### **Total: 45 Hours**

#### 18ME012SUPPLY CHAIN MANAGEMENT3003

#### **Course Objectives**

- To understand the individual processes of supply chain management and their interrelationships within individual companies and across the supply chain
- To understand the components of supply chain management
- To understand the tools and techniques useful in implementing supply chain management
- To understand the concept of retail logistics and contemporary issues.
- To understand the concept of ware house management.

#### **Course Outcomes (COs)**

- 1. Demonstrate knowledge on logistics and supply chain management tools and techniques
- 2. Plan and organize retail distribution logistic systems.
- 3. Carry out order management and reverse logistics.
- 4. Evaluate the role of logistics drivers and contemporary practices.
- 5. Organize the functions of warehouse management.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1					1							1	
2	1	2					1							1	
3	1	2					1							1	
4	1	2					1							1	
5	1	2					1							1	

#### UNIT I

#### INTRODUCTION

Concepts of Supply Chain and Logistics - Elements of Supply Chain - Elements of Logistics - Manufacturing Supply Chain - Functions of Manufacturing Supply Chain - Retail Supply Chain - Functions of Retail Supply Chain -Scope of Retail Logistics - Retail Supply Chain Management as a subset of Retail Management -Retail supply chain elements.

#### UNIT II

#### MANAGING RETAIL LOGISTICS

Retail Distribution - Retail Replenishment - Direct Store Delivery - Managing Retail Home Delivery - IT for Retail distribution and replenishment -Measures for Retail Distribution and replenishment - Retail logistics -Retail Transport -Transportation Cycle of a retailer - Using IT in Transport Management -Green Transport

#### UNIT III

#### ORDER MANAGEMENT AND REVERSE LOGISTICS

Order Management -Order Management Process - Concept of perfect order- Perfect order measures -Multi channel logistics -Retail Return and reverse logistics -Return Policy - Return Process -Reverse Logistics-Reverse logistics process -Designing reverse supply chain Network - Reverse Logistics Challenges -Application for Reverse Management

#### 9 Hours

9 Hours

9 Hours

#### 200

#### **RETAIL LOGISTICS AND CONTEMPORARY ISSUES**

Managing retail shrinkage -Elements and causes of shrinkage - Approach for shrinkage reduction -Green retailing - Green Logistics -Green Infrastructure - Green IT - Managing Logistics Service Provider -3PLs/LSPs -Services outsourced to LSP/3PL -Major drivers of logistics outsourcing -Benefits of using 3PL/LSP -Evolution of 4 PL - Retail Logistic Service Provider - An Indian perspective

#### UNIT V

#### WAREHOUSE MANAGEMENT

Cross Docking -Advantages of cross docking - How cross docking works -Cross Docking Functions -Necessary ingredients for Cross Docking - How cross docking saves time -Warehouse Process Maturity Model -IT in warehouse Management - Measures of warehouse Management - Retail Warehousing -Basic Functions of retail warehouse-Value added services of a Retail Warehouse.

#### **Reference**(s)

- 1. Rajesh Ray, Supply Chain Management for Retailing, Tata McGraw Hill Education Private Ltd
- 2. Janat Shah, Supply Chain Management, Text and Cases, Pearson Education, 2009
- 3. Sunil Chopra and Peter Meindl, Supply Chain Management-Strategy Planning and Operation, PHI Learning / Pearson Education, 2007.
- 4. Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, 5th Edition, 2007.
- 5. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Designing and Managing the Supply Chain: Concepts, Strategies, and Cases, Tata McGraw-Hill, 2005.
- 6. Altekar Rahul V, Supply Chain Management-Concept and Cases, PHI, 2005.

#### 9 Hours

9 Hours

**Total: 45 Hours** 

#### **18ME013 COMPUTER INTEGRATED** MANUFACTURING

3003

#### **Course Objectives**

- To introduce the basic concepts of Computer Integrated Manufacturing (CIM). •
- To provide knowledge on Group Technology and Computer Aided Process Planning •
- To impart knowledge on Shop Floor Control and Flexible Manufacturing Systems. •
- To learn the various CIM implementation and data communication techniques. •
- To provide knowledge on the concept of Manufacturing automation protocol, Technical • office protocol and database terminology.

#### **Course Outcomes (COs)**

- 1. Assess CAD/CAM integration for changing manufacturing and management scene.
- 2. Construct a machine cell using the concepts of Group Technology and Computer Aided **Process Planning**
- 3. Select the suitable material handling and storage system for Flexible Manufacturing Systems.
- 4. Choose the suitable CIM implementation and data communication techniques.
- 5. Use various protocols and database terminology in CIM.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2			1									2	
2	2	2			1									2	
3	2	2			1									2	
4	2	2			1									2	
5	2	2			1									2	

#### Articulation Matrix

#### UNIT I

#### **INTRODUCTION**

The changing manufacturing and management scene, External communication, Islands of automation and software, dedicated and open systems, manufacturing automation protocol, introduction to CAD/CAM integration.

#### UNIT II

#### **GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING**

Classification and coding - DCLASS, MICLASS and OPITZ coding systems. Facility design using G.T. - Benefits of G.T - cellular manufacturing. Process planning, role of process planning in CAD/CAM integration- approaches to computer aided process planning- variant approach and generative approaches.

#### 202

**10 Hours** 

#### UNIT III

#### SHOP FLOOR CONTROL AND FMS

Shop floor control phases -factory data collection system -automatic identification methods- Bar code technology - automated data collection system. FMS- components of FMS- types -FMS workstation-material handling and storage systems- FMS layout-computer control systems-application and benefits

#### UNIT IV

#### CIM IMPLEMENTATION AND DATA COMMUNICATION

System modelling tools- ICAM definition (IDEF) models, activity cycle diagram, CIM open system architecture (CIMOSA) - manufacturing enterprise wheel- CIM architecture- Product data management, implementation-software. Communication fundamentals- local area networks (LAN) - topology -LAN implementations - network management and installations.

#### UNIT V

#### **OPEN SYSTEM AND DATABASE FOR CIM**

Open systems-open system inter-connection - manufacturing automation protocol and technical office protocol-(MAP/TOP).Development of databases -database terminology-architecture of database systems- data modeling and data associations -relational data bases - database operators - advantages of data base and relational database

#### **Reference**(s)

- 1. Mikell P Groover, Automation of production systems and computer integrated manufacturing, Pearson Education, United States of America, 2008.
- 2. Lee Kunwoo, CAD, CAM, CAE systems, Addison Wesley, United States of America, 1999
- 3. Kant Vajpayee S, Principles of Computer Integrated Manufacturing, Prentice Hall, New Delhi, 2003
- 4. Radhakrishnan P, Subramanyan S and Raju V, CAD,CAM,CIM, Second Edition New Age International Pvt. Ltd, New Delhi, 2000.

#### 9 Hours

# 9 Hours

# 9 Hours

#### **Total: 45 Hours**

#### 18ME014 ADVANCED CASTING AND FORMING PROCESSES 3003

#### **Course Objectives**

- To understand the concept design of gating in casting process.
- To impart knowledge on special casting processes like investment, centrifugal, die casting, and continuous casting.
- To understand the concept of theory of metal forming processes.
- To understand the working principle of bulk deformation processes.
- To expose the methods of sheet metal forming operations and powder metallurgy.

#### **Course Outcomes (COs)**

- 1. Design the sand moulding process gating system
- 2. choose the suitable casting process for the given component and explain the advanced casting process
- 3. Explain the centrifugal casting and die casting process
- 4. Select the suitable bulk deformation process based on application.
- 5. Explain the sheet metal forming processes and make simple sheet metal components.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1									2		2	
2	2	2										2		2	
3	2	2										2		2	
4	2	2	1									2		2	
5	2	2										2		2	

#### **Articulation Matrix**

#### UNIT I

#### **CASTING DESIGN**

Introduction - Principles and Design considerations in casting, Elements of a gating system, design of gating and risering, Designing for directional solidification - casting defects, causes and its inspection - hot coating, cold coating and warm coating.

#### UNIT II

#### **ADVANCED CASTING PROCESSES**

Investment casting, Shell mould casting, Continuous casting process-Reciprocating moulding process, direct chill process, materials, defects and its applications. Centrifugal casting- Types of centrifugal casting, calculation of rotation speed of the mould equipment. Die casting - types, dies for permanent mould castings, machines, design consideration for die casting and low pressure die casting.

# 10 Hours

#### UNIT III

#### THEORY OF METAL FORMING

Metallurgical aspects of metal forming - slip twining - mechanics of plastic deformation - effects of temperature - strain rate - microstructure and friction in metal forming - spring back effect - yield criteria and their significance - classification of metal forming processes.

#### UNIT IV

#### **BULK DEFORMATION PROCESSES**

Forging and Rolling - Introduction, classification, equipment types, die design and its types, press tools, processes, parameters and force calculation. Classification of extrusion processes tool, equipment and principle of these processes - influences of friction - Extrusion force calculation - Defects and analysis - Rod/wire drawing tool equipment and principle of processes - defects - Tube drawing and sinking processes - Mannesmann processes of seamless pipe manufacturing.

#### UNIT V

#### SHEET METAL FORMING AND POWDER METALLURGY PROCESSES

Classification - conventional and HERF processes - Presses - types and selection of presses formability - diagram formability of sheet metals - Principle, process parameters equipment and application of the following processes - Deep drawing, spinning - stretch forming, plate bending, press brake forming Explosive forming - electro hydraulic forming - magnetic pulse forming - Powder Metallurgy Technique - Advantages - applications - Powder preform forging - powder rolling Tooling, process parameters and applications.

#### **Total: 45 Hours**

#### **Reference**(s)

- 1. Jain P.L, Principles of Foundry Technology, Tata McGraw Hill Publications, New Delhi, 2014.
- 2. Heine R.W, Carl Loper and Rosenthal P.C, Principles of Metal Casting, Tata McGraw Hill Publications, New Delhi, 2012.
- 3. J. P Kaushish, Manufacturing process., Prentice Hall of India Learning Private Limited, second edition, New Delhi, 2015
- 4. Dieter G.E, Mechanical Metallurgy, Tata McGraw Hill Company, New Delhi, 2015
- 5. Mikell P. Groover, Automation, Production System and Computer Integrated Manufacturing, Prentice Hall of learning, New Delhi, 2015
- 6. B.L. Juneja, Fundamentals of metal forming processes, New Age International private Limited, New Delhi, 2012.

#### **6 Hours**

# 10 Hours

#### 18ME015INDUSTRIAL SAFETY ENGINEERING3003

#### **Course Objectives**

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

#### **Course Outcomes (COs)**

- 1. Explain safety management system of an industry.
- 2. Implement the provisions of acts and rules in industries.
- 3. Implement and review the safety performance followed in various industries
- 4. Evaluate safety appraisal in chemical industries.
- 5. Generate safety reports on construction industries.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1					2	1		1						2	2
2					1			3					2	1	
3	2											3	1		2
4	2	3							2				2		1
5					2					3				3	

#### UNIT I

#### SAFETY MANAGEMENT

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Reporting and Investigation - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

#### UNIT II

#### SAFETY AND LAW

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, Building and other construction works act 1996, Electricity Rules.

#### UNIT III

#### SAFETY IN ENGINEERING INDUSTRIES

Safety in machine shop,- Principles of machine guarding - Personal protective equipment- Safety in handling industrial gases - Safety in cold forming and hot working of metals- Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

# 10 Hours

#### SAFETY IN CHEMICAL INDUSTRIES

# Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, Plant maintenance and emergency planning, management of maintenance-HAZOP study.

#### UNIT V

#### SAFETY IN CONSTRUCTION INDUSTRY

Construction regulations, contractual clauses, permit to work, - Education and training-Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights,-Working on fragile roofs, work permit systems-Construction machinery, cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, - Safety in confined spaces

#### FOR FURTHER READING

Case Studies- Major accidents at Flixborough, UK, Seveso, Italy, Victoria Dock, India, Bhopal, India. Total: 45 Hours

#### **Reference**(s)

- 1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey, 1973.
- 2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988
- 3. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules , 1950, Madras
- 4. Environmental Pollution Control Act, 1986
- 5. BOCW Act,1996, Madras Book agency, Chennai-1
- 6. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.

#### 9 Hours

#### 18ME016 ADDITIVE MANUFACTURING 3003

#### **Course Objectives**

- To provide knowledge on generic steps of Additive Manufacturing (AM) technique.
- To learn the concept and applications of liquid and solid based AM processes
- To impart knowledge on powder based AM processes.
- To introduce the concept of open source 3D printers and rapid tooling
- To expose the emerging trends and applications of Additive Manufacturing technology

#### **Course Outcomes (COs)**

- 1. Explain the generic steps and classification of Additive Manufacturing processes.
- 2. Select the suitable material and AM process based on applications.
- 3. Identify the suitable AM process to fabricate metallic components.
- 4. Design their own open source 3D printer based on application.
- 5. Implement the reverse engineering techniques for developing prototype

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2		2									2	
2	2	2	1		2									2	
3	2	2	1		2									2	
4	2	2	1		2									2	
5	2	2	2		2									2	

#### UNIT I

#### INTRODUCTION

Needs - Impact of AM and Rapid Tooling on Product Development - Distinction between AM and CNC Machining- The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - RP Benefits - Classification of RP systems

#### UNIT II

#### LIQUID POLYMER AND SOLID BASED SYSTEMS

Stereolithography Apparatus (SLA), Digital Light Projection (DLP), Continuous Liquid Interface Production (CLIP), Photo polymerization process, Fused Deposition Modeling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Materials and Applications.

#### UNIT III

#### **POWDER BASED SYSTEMS**

Selective Laser Sintering (SLS), Color Jet Printing, Direct Metal Deposition (DMD), Ballistic Particle Manufacturing (BPM), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS)-Working Principle, Construction, Process Variables, Materials and Applications

# 7 Hours

# 7 Hours

#### **OPEN SOURCE PRINTER AND RAPID TOOLING**

Concept of open source 3D printer - Structural details, Control mechanism - Materials and Applications. Introduction to rapid tooling (RT) - Direct and Indirect tooling - Silicone rubber moulding, Epoxy tooling, Spray Metal Coating, 3D printing direct, Electro Optical Sintering (EOS) - Working Principle, Materials and Applications

#### UNIT V

#### **REVERSE ENGINEERING AND APPLICATIONS OF ADDITIVE MANUFACTURING**

Reverse Engineering - Application of CMM, Laser scanner, CT and MRI scan in acquiring point data - Software for STL file processing. Application of Rapid prototyping in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries. Leading manufacturer of RP systems

#### Total: 45 Hours

#### **Reference**(s)

- 1. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
- 2. D. T. Pham and S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
- I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015 http://www.springer.com/978-1-4939-2112-6
- 4. L.W. Liou, and F.W. Liou, Rapid Prototyping and Engineering applications: A toolbox for prototype development, CRC Press, 2013.
- Yang, L., Hsu, K., Baughman, B., Godfrey, D., Medina, F., Menon, M., and Wiener, S., Additive Manufacturing of Metals: The Technology, Materials, Design and Production, Springer, 2017 https://doi.org/10.1007/978-3-319-55128-9
- 6. www.all3dp.com, www.3dprintingindustry.com, www.reprap.org, www.thingiverse.com

#### **11 Hours**

#### 18ME017 NON - DESTRUCTIVE TESTING 3003

#### **Course Objectives**

- To learn different surface inspection techniques.
- To provide knowledge on sub surface testing methods.
- To impart knowledge on ultrasonic testing method.
- To provide knowledge on radiography testing method.
- To study various special non-destructive testing methods.

#### **Course Outcomes (COs)**

- 1. Select appropriate surface inspection techniques for the components to be inspected.
- 2. Explain the non destructive testing method to identify the sub surface defects in materials.
- 3. Select and explain the suitable testing method for testing internal defects.
- 4. Apply radiography testing methods for different suitable applications.
- 5. Choose the suitable special non-destructive technique for various applications.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	2			1							2	
2	1	2	2	2			1							2	
3	1	2	2	2			1							2	
4	1	2	2	2			1							2	
5	1	3	3	2			1							2	

#### UNIT I

#### SURFACE TECHNIQUES

Introduction and Scope of NDT, Discontinuities and Defects in various manufactured Components, Various physical characteristics of materials and their applications in NDT, Relative merits and limitations of NDT, Types of NDT techniques, Visual or Optical Testing - Direct and remote visual inspection and Aides. Liquid Penetrant Testing (LPT) Principles - Types and properties of liquid penetrants and developers - Preparation of test materials - Advantages and limitations - Application of penetrants to parts - Fluorescent penetrant test

#### UNIT II

#### SUB SURFACE TECHNIQUES TESTING

Magnetic Particle Testing (MPT) - Principles, applications, magnetization methods, magnetic particles - Dry particle technique and Wet fluorescent particle technique - Advantages and Limitations. Eddy Current Inspection - Principle, Methods, Equipment for ECT, Techniques, Sensitivity, Application, scope and limitations

#### 9 Hours

#### 9 Hours

9 Hours

9 Hours

Total: 45 Hours

Ultrasonic Testing (UT) - Principle, Types and characteristics of Ultrasonic waves - Attenuation, Couplants, Probes - Inspection methods - Pulse echo, Transmission and Phased Array techniques (PAUT), Types of scanning and displays - Angle beam inspection of welds - Calibration of ASTM Test blocks, International Institute of Welding IIW) reference blocks - Applications

#### UNIT IV

UNIT III

#### **RADIOGRAPHY TESTING**

ULTRASONIC TESTING

Radiographic testing (RT) -Principle, Sources of X-rays and Gamma rays and their characteristics -Absorption, scattering, Filters and screens, imaging modalities - Film radiography and Digital Radiography - Problems in shadow formation, Exposure factors, film handling and storage- Inverse square law, Exposure charts, and Radiographic equivalence, Penetrometers - Safety in radiography-Applications

#### UNIT V

#### **SPECIAL NDT TECHNIQUES**

Acoustic Emission Testing (AET) Principle - Instrumentation and applications, advantages and limitations. Infra-Red Thermography (IRT) - Principle, Techniques and applications. Leak Testing - Principle, Testing Procedure and applications. LASER Stereography- Typical applications-Requirements - advantages and disadvantages.

#### **Reference**(s)

- 1. Charles J. Hellier, Handbook Of Nondestructive Evaluation, McGraw-Hill Education; 2 edition 2012.
- 2. Baldev Raj, Jayakumar T, Thavasimuthu M, Practical Non-Destructive Testing, Narosa Publishing, 2009.
- 3. ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 2001.
- 4. Mc Gonnagle W T, Non-Destructive Testing, McGraw Hill Book Co., 1988.
- 5. Louis Cartz, Non-Destructive Testing, ASM International, Metals Park Ohio, US, 1995.
- 6. https://onlinecourses.nptel.ac.in/noc19\_mm07/course

#### 18ME018 RENEWABLE ENERGY SOURCES 3003

#### **Course Objectives**

- To learn about solar radiation and solar thermal system application.
- To provide knowledge on fundamentals and sizing of solar photovoltaics.
- To study about the potential and energy conversion process of Wind Energy and Bio Energy.
- To impart fundamental knowledge about Ocean Thermal Energy and Geothermal Energy.
- To provide knowledge about the recent trends in Hydrogen and Fuel Cells.

#### **Course Outcomes (COs)**

- 1. Understand the solar radiation, and its conversion into heat using solar collectors.
- 2. Explain the working concept of solar photovoltaic system for any isolated applications
- 3. Expose the energy conversion process of wind energy and bio energy.
- 4. Illustrate the fundamentals concepts of ocean thermal energy systems and geothermal thermal energy systems
- 5. Update their knowledge in the field of hydrogen and fuel cells.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		2	2		2	3						2		2
2	2		2	2		2	3						2		2
3	2		2	2		2	3						2		2
4	2		2	2		2	3						2		2
5	2		2	2			3					2	2		2

#### UNIT I

#### SOLAR THERMAL SYSTEMS

Solar radiation spectrum, Radiation measurement, Estimation of average solar radiation, Introduction to solar collectors (liquid flat- Plate collector - Air heater and concentrating collector) Solar distillation, Solar drying, Solar thermal system for power generation.

#### UNIT II

#### SOLAR PHOTOVOLTAIC SYSTEMS

Operating principle, Photovoltaic cell concepts, Cell, module, array, Voltage current characteristics of a solar cell, Series and parallel connections, Maximum power point tracking, Applications - Battery charging, Pumping, Lighting

#### UNIT III

#### WIND ENERGY AND BIO ENERGY

Basic principles of wind energy conversion - classification of wind turbines, wind power generation curves, wind data and energy estimation. Site selection considerations - Merits and demerits of wind energy systems. Biofuels classification, Biomass gasification- Technologies for utilisation of biomass, Biogas - Production, factors affecting biogas production, biogas plants.

# 9 Hours

9 Hours

#### OCEAN THERMAL ENERGY AND GEOTHERMAL ENERGY

Wave energy - Energy from waves, energy potential. Conversion devices. Tidal energy - energy potential, conversion systems. Ocean thermal energy conversion -Methodology, Applications. Geothermal energy - classification of geothermal resources, schematic of geothermal power plants, operational and environmental problems

#### UNIT V

#### HYDROGEN AND FUEL CELLS

Basic properties of hydrogen. Technologies of hydrogen production. Transformation of hydrogen energy - hydrogen economy. Fuel cells - operating principle, Alkaline Fuel cells (AFC), Phosphoric Acid Fuel cells (PAFC), Polymer Electrolyte Membrane Fuel cells (PEMFC), Specific characteristics, advantages and applications.

#### FOR FURTHER READING

Design of Solar Thermal Systems, PV Panel Sizing, Economic Analysis of Wind Energy, Need for Hybrid Systems, Fuel cell Hybrids

#### **Reference**(s)

- 1. Rai. G.D., Non Conventional Energy Sources, Khanna Publishers, New Delhi, 2011.
- 2. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 2006
- 3. Boyle, Godfrey. 2004. Renewable Energy (2nd edition). Oxford University Press, (ISBN: 0-19- 926178-4).
- 4. Schaeffer, John. 2007. Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living (30th anniversary edition). Gaiam.
- 5. Sukhatme, Suhas P., and J. K. Nayak. Solar energy. McGraw-Hill Education, 2017.
- 6. https://onlinecourses.nptel.ac.in/noc19\_ge11/course

#### 9 Hours

#### 9 Hours

Total: 45 Hours

#### 18ME019 CRYOGENIC ENGINEERING 3003

#### **Course Objectives**

- To learn about the cryogenic material properties and applications of cryogenics.
- To impart knowledge on Liquefaction cycles.
- To provide knowledge about gas separation and purification.
- To study the working of various cryo coolers.
- To learn about the construction of Dewar vessels and cryogenic instrumentation.

#### **Course Outcomes (COs)**

- 1. Explain the effect of material properties at cryogenic temperatures and applications of cryogens
- 2. Compute the figure of merit and yield of various liquefaction cycles
- 3. Assess the performance of rectification column for gas separation
- 4. Compare the Stirling, Gifford-McMahon and Pulse tube cry coolers based on power consumption, pressure ratio and Coefficient of Performance.
- 5. Explain the construction of Dewar vessels and cryogenic instrumentation

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2				2	2								2
2	2	2			2	2	2								2
3	2	2			2	2	2								2
4	2	2	2			2	2								2
5	2	2	2			2	2								2

#### UNIT I

#### **INTRODUCTION TO CRYOGENICS**

Insight on cryogenics - properties of cryogenic fluids - material properties at cryogenic temperatures - Applications of cryogenics in space programs, superconductivity, cryo metallurgy, biological and medical applications

#### UNIT II

#### LIQUEFACTION CYCLES

Basics of Refrigeration - Methods of production of low temperatures - Joule Thompson expansion - inversion curve. Gas Liquefaction cycles - Carnot liquefaction cycle, Simple Linde Hampson cycle, Precooled Linde-Hampson cycle, Simple Claude cycle, Dual pressure Claude cycle - Figure of merit and yield of liquefaction cycle.

#### UNIT III

#### SEPARATION AND PURIFICATION SYSTEMS

Basics of Gas separation - Ideal separation of gases, characteristics of mixtures and the governing laws - T-C and H-C diagrams. Principle of Rectification - Rectification column - Theoretical plate calculations using McCabe-Thiele method, Murphee efficiency. Gas purification.

#### 7 Hours

9 Hours
#### **CRYOGENIC REFRIGERATORS**

Cryocoolers - Fundamentals, classification, comparison and applications. Working of Stirling, Gifford-McMahon and Pulse tube cryocoolers

#### UNIT V

## STORAGE AND INSTRUMENTATION

Cryogenic Dewar vessels construction and design, cryogenic transfer Lines. Cryogenic insulation vacuum, powder, multi layer, micro-sphere and foam-fibrous insulation - concept of vapour coated shields. Cryogenic instrumentation - temperature, flow and level measurements.

#### **Reference(s)**

- 1. Mamata Mukhopadhyay, Fundamental of Cryogenic Engineering, PHI learning Private Limited, New Delhi, 2014.
- 2. Thomas M. Flynn, Cryogenics Engineering, Marcel Dekker, New york, 2005.
- 3. G.G. Haselden, Cryogenics Fundamentals, Academic Press Inc., London, 1999.
- 4. K.D. Timmerhaus and T.M. Flynn, Cryogenics Process Engineering, Plenum Press, New York, 1989.
- 5. Randall F. Barron, Cryogenic System, 2nd edition, Oxford University Press, New York, 1985.
- 6. https://nptel.ac.in/downloads/112101004/

9 Hours

9 Hours

## 18ME020 ENGINEERING TRIBOLOGY 3003

## **Course Objectives**

- To impart basic knowledge on friction and wear
- To provide knowledge on behavior of surface contacts
- To learn about frictional behavior of sliding and rolling contacts
- To learn the wear mechanisms and its consequences under different contact conditions
- To identify the appropriate lubrication method based on contact conditions

## **Course Outcomes (COs)**

- 1. Explain the fundamental concepts of friction and wear
- 2. Identify the appropriate surface contact characteristics for particular applications
- 3. Apply the characteristics of friction for tribological applications
- 4. Analyze the wear mechanism and measure wear rate
- 5. Select suitable lubrication type for particular application

## Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3						1						3		
2	2	1									1		2		
3	2	2					1						2		
4	3	2					1					1	3		
5	2	1					1					1	3		

## UNIT I

## INTRODUCTION

Introduction to Tribology, Factors influencing Tribological phenomena, Properties of materials relevant to friction and wear.

## UNIT II

## CONTACT BEHAVIOUR OF SURFACE

Engineering surfaces - Surface characterization, Contact of engineering surfaces: Hertzian and nonhertzian contact, Contact pressure and deformation in non-conformal contacts.

## UNIT III

#### FRICTION

Causes of friction, Stick-slip friction behavior and friction instability, sliding and rolling friction, frictional heating and temperature rise, Friction measurement techniques.

#### UNIT IV

## WEAR AND ITS MEASUREMENT

Wear and wear types, Mechanisms of wear, wear of metals and non-metals. wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage, wear measurement and controlling techniques.

#### 7 Hours

9 Hours

# 9 Hours

#### LUBRICATION

Lubricants- physical and chemical properties, types of additives. Selection of lubricants, Hydrodynamic lubrication-principle and application, Reynolds equation. Elastohydrodynamic Lubrication- Principle and application, pressure - viscosity term in Reynolds equation, Hertz theory, Ertel-Grubin Equation.

## **Reference**(s)

- 1. Prasanta Sahoo, Engineering Tribology, 3rd edition, Prentice-Hall India, New Delhi, 2011.
- 2. Bharat Bhushan, Introduction to Tribology, 2nd edition, Wiley Publication, 2013.
- 3. I.M. Hutchings, Friction and Wear of Engineering Material, Edward Arnold, London, 2002.
- 4. Neale, M.J., Bearings-Tribology Hand Book, Butterworth Heinemann, 2005.
- 5. T.A. Stolarski, Tribology in Machine Design, Industrial Press Inc., 2000.
- 6. http://www.nptel.iitm.ac.in/downloads/110105039/

## 11 Hours

#### 18ME021 POWER PLANT ENGINEERING 3003

## **Course Objectives**

- To impart the knowledge on boilers and steam power plant.
- To learn about the various components associated with steam power plant.
- To study the working of nuclear and hydel power plant.
- To learn about the working of diesel and gas turbine power plant.
- To provide the knowledge on power plants using renewable energy and economics of power plants.

#### **Course Outcomes (COs)**

- 1. Explain the working principle of steam power plant and boilers.
- 2. Represent the function of various systems in steam power plant.
- 3. Indicate the suitable components for nuclear power plants and hydel power plants.
- 4. Illustrate the working of diesel and gas turbine power plant.
- 5. Explain the different sources of renewable energy and calculate the economics of power plants

## **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3					2	2								2
2	3					2	2								2
3	3					2	2								2
4	3					2	2								2
5	3	2				2	2				2				2

#### UNIT I

#### **INTRODUCTION TO POWER PLANTS AND BOILERS**

Layout of Steam power plant - Components, Selection. Steam Boilers and Cycles - High Pressure and Super Critical Boilers, Fluidized Bed Boilers. Combined Power Cycles. Comparison and Selection.

#### UNIT II

#### **STEAM POWER PLANT**

Fuel and Ash Handling - Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, and Mechanical Collectors. Draught -different types. Surface Condenser types. Cooling Towers. Pollution controls.

## UNIT III

#### NUCLEAR AND HYDEL POWER PLANTS

Nuclear Energy - Fission, Fusion Reaction. Layout - Types of Reactors, Pressurized Water Reactor, Boiling Water Reactor, Waste Disposal and safety. Hydel Power Plant - Layout, Essential Elements, pumped storage. Selection of Turbines, Governing of Turbines.

#### 9 Hours

9 Hours

#### DIESEL AND GAS TURBINE POWER PLANTS

Layout of Diesel power Plant - Components, Selection of Engine Type, applications. Gas Turbine Power Plant - Layout, Fuels, Gas Turbine Material. Open and Closed Cycles -Reheating, Regeneration and Intercooling.

### UNIT V

#### **OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS**

Geo thermal power plant. Ocean thermal energy conversion (OTEC). Tidal power plant. Solar thermal power plant. Wind energy. Wind turbines. Magneto hydrodynamic generator (MHD). Cost of Electric Energy - Fixed and operating Costs, Economics of load sharing.

## Total: 45 Hours

### **Reference**(s)

- 1. S. C. Arora, S. Domkundwar, A course in Power Plant Engineering, Dhanpatrai & Sons, New Delhi, 2013.
- 2. K.K. Ramalingam, Power Plant Engineering, Scitech Publications (India) Private Limited, 2002.
- 3. P. K. Nag, Power plant Engineering, Tata McGraw Hill Company Private Limited, New Delhi, 2014.
- 4. G. R. Nagpal, Power Plant Engineering, Khanna Publishers, New Delhi, 2002.
- 5. G. D. Rai, Introduction to Power Plant Technology, Khanna Publishers, New Delhi, 2013.
- 6. R. K. Rajput, Power Plant Engineering, Laxmi Publications, New Delhi, 2016.

#### 9 Hours

#### **18ME022 OPTIMIZATION TECHNIQUES** 3003

## **Course Objectives**

- To impart knowledge on concept of optimization and problem formation. •
- To provide knowledge on optimization methods for single variable unconstrained problems •
- To educate about multi-objective unconstrained optimization problems solving algorithms. •
- To impart concepts of constrained non-linear optimization problems •
- To provide input on non-traditional optimization techniques to solve engineering problems •

### **Course Outcomes (COs)**

- 1. Summarize the concepts of design optimization and problem formation procedures.
- 2. Compute the solution for single variable unconstrained optimization problems
- 3. Determine the solution for multivariable unconstrained optimization problems
- 4. Find the solution for the constrained non-linear optimization problems
- 5. Apply non-traditional optimization techniques to solve engineering problems

Art	Iculati	on Ma	atrix												
CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1				1			-	1		1	2		
2	3	2	2	1	1	1	1			1		1	2		
3	3	2	2	2	1	1	1			1		1	2		
4	3	2	2	2	1	1	1			1		1	2		
5	3	2	2	2	1	1	1			1		1	2		

#### ... wlation Matri

## UNIT I

#### **INTRODUCTION**

Introduction to design optimization-Historical development, the design process, Conventional Vs Optimum design process - Statement of an optimization problem- Optimum design problem formulation - process steps, Problem formulation for engineering applications - Two-bar bracket, Design of coil springs-Classifications of optimization problems.

#### UNIT II

#### SINGLE VARIABLE NONLINEAR UNCONSTRAINED OPTIMIZATION ALGORITHMS

Optimality criteria - Unimodal function - Eliminating methods - Exhaustive search, Dichotomous search, Interval halving method, Fibonacci search method, Golden section search method. Point estimation method (Powell's algorithm) - Gradient-based methods - Newton-Raphson method (Taylor's series expansion), Bisection method, Secant method, Cubic search method.

#### UNIT III

#### MULTI VARIABLE NONLINEAR UNCONSTRAINED OPTIMIZATION ALGORITHMS

Optimality criteria - Unidirectional search - Direct search methods - Evolutionary optimization method, Random search methods, Simplex search method, Hooke-Jeeves pattern search method, Indirect search(gradient) methods- Cauchy's (steepest descent) method, Newton's method, Conjugate gradient method.

9 Hours

9 Hours

## CONSTRAINED NONLINEAR OPTIMIZATION ALGORITHMS AND SPECIALIZED PROGRAMMING

Introduction, Characteristics - Indirect search methods - Transformation methods, Penalty function method, Method of multipliers - Sensitivity analysis - Kuhn-Tucker conditions, Theorems. Test problems on three-bar truss, welded beam design. Direct search minimization methods- Variable elimination method, Complex search method and Random search methods - Feasible direction method. Integer programming - Penalty function method, Branch and Bound method.

#### UNIT V

#### NONTRADITIONAL OPTIMIZATION TECHNIQUES

Genetic Algorithms (GA)- principle, difference and similarities between GA and traditional methods, constrained optimization, GA operators, Real-coded and Advanced GAs - Simulated Annealing - Neural Network based Optimization.

### **Reference**(s)

- 1. Singiresu S. Rao, Engineering Optimization: Theory and Practice, Fourth Edition, Wiley India Pvt. Ltd, Delhi, 2009
- 2. Kalyanmoy Deb, Optimization for Engineering Design- Algorithms and Examples, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
- 3. Jasbir Singh Arora, Introduction to Optimum design, Third Edition, Elsevier India Pvt. Ltd., New Delhi, 2011.
- 4. R. Saravanan, Manufacturing optimization through intelligent techniques, First Edition, Taylor & Francis Publications, CRC Press, New Delhi, 2006.
- 5. Optimization Techniques and Applications with Examples, Xin-She Yang, Wiley India Pvt Ltd, Delhi, 2018.

#### 9 Hours

9 Hours

#### 18ME023 DESIGN FOR MANUFACTURE AND ASSEMBLY 3003

#### **Course Objectives**

- To learn the way of specifying geometric dimensioning and tolerancing in engineering drawing
- To familiarize the design considerations for designing components for the casting, welding and forming processes.
- To familiarize the design guidelines while designing components which are manufacturing by different machining processes.
- To learn the factors affecting easy assembly of parts into a final product
- To impart knowledge about the product life cycle assessments and environmental impact of materials, manufacturing methods and the way to minimize it

#### **Course Outcomes (COs)**

- 1. Apply geometric dimensioning and tolerancing techniques in engineering drawing
- 2. Select appropriate design considerations to minimize difficulty to produce components by casting, welding and forming processes
- 3. Use the design for manufacturing concept to reduce machining time and manufacturing cost
- 4. Analyze and design the parts for easy assembly using DFA guidelines
- 5. Design the components by considering the product life cycle and its environmental impact

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1		1							1		2	
2	2	2	1									1		2	
3	2	2	1									1		2	
4	2	2	1									1		2	
5	2	2	2				2					1		2	

## **Articulation Matrix**

#### UNIT I

#### GEOMETRIC DIMENSIONING AND TOLERANCING

Tolerance Chains and identification of functionally important dimensions. International Tolerance Grades, Surface finish, Attainable tolerance grades and different machining processes. Geometric Dimensioning and Tolerancing - Location, Form, profile, orientation, run out and Feature tolerance. Tolerance Limits for Assembly - Cumulative effect of Tolerances

#### UNIT II

#### DESIGN CONSIDERATIONS FOR CASTINGS, WELDING AND FORMING

Casting - Pattern, Mould, Casting hole - cast, Cored and Machined holes, Parting line - Redesign of castings based on parting line considerations, Minimizing core requirements. Welding - Stresses in welding - Measures to combat contraction stresses - Welding sequence - Joints in Welding - Weldability of steel - Design of welded structures. Form design aspects for Forging and sheet metal components

# 10 Hours

**10 Hours** 

#### 222

#### **UNIT III**

#### **DESIGN FOR MANUFACTURE - MACHINING CONSIDERATIONS**

Design for Assembly(DFA) Guidelines - Minimizing number of Parts - Insertion and Fastening - Design Guidelines for Part Handling - Effect of Part Symmetry, Part Thickness, Part Size, Weight on Handling Time - Types of Manual Assembly Methods - Effect of Assembly layout on Part Acquisition Time - Assembly Efficiency - DFA index.

#### UNIT IV

#### **DESIGN FOR ASSEMBLY**

Design for Assembly(DFA) Guidelines - Minimizing number of Parts - Insertion and Fastening - Design Guidelines for Part Handling - Effect of Part Symmetry, Part Thickness, Part Size, Weight on Handling Time - Types of Manual Assembly Methods - Effect of Assembly layout on Part Acquisition Time - Assembly Efficiency - DFA index.

#### UNIT V

#### **DESIGN FOR ENVIRONMENT**

Environmental objectives - Global issues, Regional and local issues - Basic Design for Environment (DFE) methods - Design guide lines - Lifecycle assessment - AT&T's (American Telephone and Telegraph Company) environmentally responsible product assessment, Weighted sum assessment method, Lifecycle assessment method - Techniques to reduce environmental impact - Design to minimize material usage - Design for disassembly, Recyclability, Remanufacture, Energy efficiency - Design to regulations and standards.

#### FOR FURTHER READING

Case studies - Design components for casting, welding, forging and machining processes. Design components for minimizing environmental impact.

#### **Reference**(s)

- 1. Gene R. Cogorno, Geometric Dimensioning and Tolerancing for Mechanical Design, McGraw-Hill Professional, New Delhi, 2011
- 2. Harry Peck, Designing for Manufacture, Pitman Publishing, London, 1973
- 3. Robert Matousek, Engineering Design A Systematic Approach, Blackie and Son Limited, London, 1974.
- 4. M. F. Spotts, Dimensioning and Tolerance for Quantity Production, Prentice Hall, New Jersey, 2007.
- 5. J. G. Bralla, Hand Book of Product Design for Manufacturing, McGraw-Hill Publications, New Delhi, 2000.
- 6. Kevin Otto, Kristin wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson education, 2003.

#### 8 Hours

#### 9 Hours

8 Hours

#### 18ME024 INDUSTRIAL ENGINEERING 3003

## **Course Objectives**

- To impart the knowledge on production system and layout design.
- To learn about production planning and its control methods.
- To provide the knowledge of work study, process charts and ergonomic condition.
- To impart the knowledge on inventory control and material handling equipments.
- To learn about system analysis and different types of maintenance.

### **Course Outcomes (COs)**

- 1. Select proper plant layout for the required production system.
- 2. Plan the resources required for the production and to perform the control methods.
- 3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
- 4. Analyze the inventory required based on production needs and material handling.
- 5. Explain the system and different types of maintenance process for smooth operations.

## **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1		1									2	
2	2	2	1		2									2	
3	1	2	3		2									2	
4	2	3	1		2									2	
5	2	3	1		2									2	

## UNIT I

#### INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM

Industrial engineering - Concept, History and Development, Applications, Roles of Industrial engineer. Production management, Industrial engineering versus Production management, Operations management. Production system Analysis, Input-output model, Productivity, Factors affecting productivity. Plant layout, Criteria for a good layout, Types of layout - Process layout, Product layout, Combination layout, and Fixed position layout. Material flow pattern, Workstation design.

#### UNIT II

#### PROCESS PLANNING AND PRODUCTION CONTROL

Introduction to Process planning- Definition, Procedure, Process selection, Machine capacity, Process sheet, Process analysis. Group technology - Definition, Classification and coding system, Formation of component family. Production planning - Introduction, Functions, Loading, Scheduling. Production control - Dispatching, Routing. Progress control - Bar, Curve, Gantt chart, Route and Schedule chart.

# 9 Hours

9 Hours

#### 224

#### UNIT III

#### WORK STUDY AND ERGONOMICS

Work study - Definition, Need, Advantages, Objectives of method study and work measurement, Method study procedure. Process chart - symbols, outline process chart, flow process chart. The flow diagram, String diagram, Multiple activity chart, Principles of motion economy, Therbligs, SIMO chart, Stopwatch procedure. Ergonomics- applications of ergonomic principles in the shop floor- work benches- seating arrangement.

#### UNIT IV

#### INVENTORY MANAGEMENT AND MATERIAL HANDLING

Inventory - Definition, Objectives, Classification, Functions, Economic order quantity, Economic batch quantity, Inventory models, ABC analysis. Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, Just in Time manufacturing system, KANBAN technique, Material handling - Definition, Functions, Principles, Equipment selection, and Equipment types.

#### UNIT V

#### SYSTEM ANALYSIS AND MAINTENANCE

System concept, System analysis, System engineering, Techniques, Applications. Value analysis/ Engineering - Definition, Types of values, Aim, Technique, Procedure, Advantages, Applications, Value engineering versus Value control. Plant maintenance department - Objectives, Importance, Duties, Functions, and Responsibilities. Types of maintenance - Breakdown, Scheduled, Preventive and Predictive. Plant maintenance schedule - Introduction, Procedure.

#### FOR FURTHER READING

Industrial Psychology, Industrial relations, Industrial legislation, Applied anthropometry, Biostatic mechanics, Estimation and costing concepts.

#### **Reference**(s)

- 1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications, 2010.
- 2. Panneerselvam R., Production and operations management, Heritage Publishers, 2006.
- 3. Martand T. Telsang, Industrial Engineering and Production Management, S Chand Publishers, 2006.
- 4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009.
- 5. Jan Dul, Bernard Weerdmeester, Ergonomics for Beginners: A Quick Reference Guide, CRC Press, Taylor and Francis group, 2008.
- 6. Lee J. Krajewski, Larry P. Ritaman, Operations Management, Addison Wesley, 2007.

#### 9 Hours

9 Hours

# 9 Hours

#### 18ME025 INDUSTRIAL MAINTENANCE ENGINEERING 3003

#### **Course Objectives**

- To Understand the principles, functions and practices adapted in industry for the effective maintenance management.
- To Learn the concept of Preventive and Total Productive Maintenance.
- To Study few methods and instruments for condition monitoring
- To Learn few repair methods for basic machine elements.
- To Learn few repair methods for material handling equipment

### **Course Outcomes (COs)**

- 1. Apply the principles, functions and practices for the effective maintenance management
- 2. Implement the preventive maintenance and total productive maintenance for improving productivity
- 3. Assess the process performance to take corrective measures.
- 4. Identify the suitable methods to repair the basic machine elements
- 5. Select the suitable methods to repair material handling equipment

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2												2	
2			-		2	2	1							2	
3	2	2	2											2	
4	3	2	2		2	2	2		-	-			-	2	
5	3	2				2	2		-	-	-			2	

#### **Articulation Matrix**

#### UNIT I

#### PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING

Basic Principles of maintenance planning-Objectives and principles of planned maintenance activity-Importance and benefits of sound maintenance systems-Reliability and machine availability-Mean Time Between Failures, Mean Time To Repair and Mean Waiting Time-Factors of availability-Maintenance organization-Maintenance economics.

#### UNIT II

#### MAINTENANCE POLICIES PREVENTIVE MAINTENANCE

Maintenance categories- Comparative merits of each category - Preventive maintenance, maintenance schedules, repair cycle -Principles and methods of lubrication-Total Productive Maintenance.

#### UNIT III

#### **CONDITION MONITORING**

Condition based maintenance-Cost comparison with and without Condition Monitoring-On-load testing and offload testing-Methods and instruments for Condition Monitoring - temperature sensitive tapes-pistol thermometers-wear-debris analysis

## 9 Hours

#### 9 Hours

#### **REPAIR METHODS FOR BASIC MACHINE ELEMENTS**

Failure analysis-Failures and their development-Logical fault location methods-Sequential fault location-Repair methods for beds, slide ways, spindles, gears, lead screws and bearings

#### UNIT V

## **REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT**

Repair methods for material handling equipment-Equipment records-Job order systems, Use of computers in maintenance

#### FOR FURTHER READING

Tribology in Maintenance, friction wear and lubrication, friction & wear mechanisms, prevention of wear, types of lubrication mechanisms, lubrication processes. Lubricants - types, general and special purpose, additives, testing of lubricants, degradation of lubricants, seal & packing Total: 45 Hours

#### **Reference**(s)

- 1. Srivastava S.K., Industrial Maintenance Management, S. Chand and Company, 2002
- 2. Venkataraman .K, Maintenance Engineering and Management, Prentice Hall of India Private Limited, 2007
- 3. Garg M. R., Industrial Maintenance, S. Chand & Co., 1986
- 4. Mishra R.C., Pathak.K, Maintenance engineering and Management, Prentice Hall of India Private Limited, 2012
- 5. Higgins R.L, R. Keith Mobley, Darrin Wikoff, Maintenance Engineering Handbook, The McGraw-Hill Companies Inc. 2008.

## 8 Hours

### 18ME026COMPUTATIONAL FLUID DYNAMICS3003

### **Course Objectives**

- To provide the knowledge on fundamental governing equations of fluid mechanics and heat transfer
- To acquire knowledge on formulation of governing Equations for fluid flow problems in finite difference method
- To study the steady and unsteady state diffusion type problems using finite volume method.
- To impart one dimensional and two dimensional elements in finite element techniques for fluid flow problems.
- To learn the structured and unstructured grids generation techniques.

### **Course Outcomes (COs)**

- 1. Formulate the fundamental governing equations of fluid mechanics and heat transfer.
- 2. Solve the fluid dynamics problems using finite difference method.
- 3. Construct finite volume equations for steady and unsteady state diffusion type problems.
- 4. Apply the finite element methods for fluid flow problems.
- 5. Generate the grids using grid generation techniques for simple and complex geometries.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3												3	
2	2	3		2	2										3
3	3	2			2										3
4	2	3			2										3
5	2		3	2											3

#### **Articulation Matrix**

#### UNIT I

#### INTRODUCTION

Introduction - Applications and impact of CFD in diverse fields - Navier Stroke equations in fluid dynamics-continuity - momentum and energy - generic integral form for governing equations -Initial and Boundary conditions. Classification of partial differential equations-Elliptic, Parabolic and Hyperbolic types.

#### UNIT II

#### FINITE DIFFERENCE METHOD

Basics and discretization of simple and complex governing equations. Applications. Incompressible in-viscid Flows - Illustrative and physical examples of Elliptic, Parabolic and Hyperbolic equations - Discretization of partial Differential Equations. Implicit, explicit and Crank Nicolson finite difference methods for viscous flows. Stability, convergence, accuracy.

#### 228

#### 9 Hours

#### 9 Hours

#### 9 Hours

### Over view of Finite Element Techniques in Computational Fluid Dynamics. Weighted residual and Variational formulations. Finite element interpolation. One and two dimensional elements. Steady state conduction and incompressible potential flow problems.

steady state diffusion type problems - 1-D convection-diffusion type problem - Unsteady flows implementation of boundary conditions in Finite Volume. Solution of discretized equations. Solution algorithm for Pressure Velocity coupling in steady flows - Pressure-velocity coupling - SIMPLE

#### UNIT V

#### NUMERICAL GRID GENERATION

Introduction. Algebraic grid generation. Differential Grid Generation. Structured and unstructured grids. Body fitted Coordinate Method.

#### **Reference(s)**

- 1. J. D. Anderson., Jr. Computational Fluid Dynamics- The Basic with Applications, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2004
- 2. S. C. Gupta, Applied Computational Fluid Dynamics, Wiley India Pvt. Ltd., New Delhi, 2019
- 3. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere, New York, 2004.
- 4. H. K. Versteeg and W. Malalasakera, An Introduction to Computational Fluid Dynamics The Finite Volume Method, Pearson Education Ltd., New Delhi, 2007.
- 5. K. A. Hoffman, Computational Fluid Dynamics for Engineering, Engineering Education System, Austin, Texas 2005.
- 6. Introduction to computational fluid dynamics http://nptel.ac.in/courses/112105045/.

#### UNIT III

#### **FINITE VOLUME METHOD**

## Basic rules for FV Discretization. Finite Volume (FV) Discretization of one and two dimensional

scheme.

# **FINITE ELEMENT METHOD IN FLUIDS**

UNIT IV

#### 9 Hours

#### 18ME027 FUELS AND COMBUSTION 3003

### **Course Objectives**

- To introduce the characteristics of fuels
- To provide knowledge on types and properties of solid and liquid fuels
- To impart knowledge on types and properties of gaseous fuels
- To learn about the stoichiometry and kinetics of combustion
- To expose the knowledge on combustion kinetics of fuels

### **Course Outcomes (COs)**

- 1. Determine the characteristics and calorific value of fuels
- 2. Compare the types and properties of solid and liquid fuels
- 3. Interpret the types and properties of gaseous fuels
- 4. Formulate the stoichiometry and thermodynamics of combustion
- 5. Analyze the kinetics of combustion processes of fuels

### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3													2
2	3					2	2								2
3	3					2	2								2
4	3	3				2	2								2
5	3	3													2

#### UNIT I

#### **FUEL CHARACTERISTICS**

Fuels- Types and Characteristics of Fuels-Determination of Properties of Fuels-Fuels Analysis-Proximate and Ultimate Analysis-Moisture Determination- Calorific Value-Gross and Net Calorific Values - Bomb Calorimetry- DuLong's Formula for CV Estimation- Flue gas Analysis- Orsat Apparatus

#### UNIT II

#### **SOLID AND LIQUID FUELS**

Solid Fuels: Wood and Wood charcoal - Origin of coal - Composition of coal-Analysis and properties of different grades of coal - preparation and storage of coal - coal washing -Briquetting. Liquid coals: Origin of petroleum fuels - Production - Composition - Petroleum refining. Properties of Liquid Fuels - Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, and Cetane Number-Gasification of liquid fuels -Synthetic fuels - Storage and handling of liquid fuels

#### 230

#### 10 Hours

#### 9 Hours

#### 9 Hours

9 Hours

**Total: 45 Hours** 

Stoichiometry - Mass Basis and Volume Basis - Fuel and Flue Gas Compositions - Calculations -Excess Air Calculation from flue gas analysis. Rapid Methods for solid, liquid and gaseous fuels. Thermodynamics - Heat of combustion- Equilibrium constants of combustion reactions - Enthalpy -Temperature diagrams - Flame Temperature - Theoretical -Adiabatic and Actual

and Lean Gas - Wobbe Index - Natural Gas - Dry and Wet Natural Gas - Stripped NG - Foul and Sweet NG - LPG - LNG - CNG - Methane - Producer Gas - Gasifiers - Water Gas - Town Gas - Coal-Gasification - Gasification Efficiency - Non - Thermal Route - Biogas - Digesters - Reactions -

#### UNIT V

#### **COMBUSTION: KINETICS**

Combustion Processes - Stationary Flame - Surface or Flameless Combustion -Submerged Combustion - Pulsating and Slow Combustion Explosive Combustion. Mechanism of Combustion -Chain reactions - Thermal mechanism - Ignition and Ignition Energy - Spontaneous Combustion -Flame Propagation- Ignition Limits - Limits of Inflammability

#### FOR FURTHER READING

**Reference**(s)

Coal Burning Equipments - Oil Burners - Vaporizing Burners, Atomizing Burners - Design of Burners. Gas Burners - Atmospheric Gas Burners - Air Aspiration Gas Burners

- 1. Samir Sarkar, Fuels & Combustion, 3rd Edition, University press, 2009
- 2. Bhatt, Vora Stoichiometry, 4th Edition, Tata McGraw Hill, 2004
- 3. Blokh AG, Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn,2003.
- 4. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1986
- 5. Sharma SP, Mohan Chander, Fuels & Combustion, Tata McGraw Hill, 1984
- 6. https://nptel.ac.in/courses/103105110/

## UNIT III

Viability

UNIT IV

#### **GASEOUS FUELS** Classification - Composition and Properties - Estimation of Calorific Value - Gas Calorimeter. Rich

**COMBUSTION: STOICHIOMETRY** 

#### **18ME028 PRODUCTION AND OPERATIONS** MANAGEMENT

3003

### **Course Objectives**

- To learn the concept of production and operations management •
- To familiarize in identifying the facility location •
- To introduce the concept of various forecasting methods •
- To emphasise the need of material management and inventory control •
- To educate on aggregate production planning •

## **Course Outcomes (COs)**

- 1. Explain the concept of production and operation management
- 2. Identify the suitable workplace by facility location attributes
- 3. Select appropriate forecasting methods
- 4. Use the principles of material management and inventory control
- 5. Practice the concept of aggregate production planning

## **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		1								3			2	
2	1	2	3								2			2	
3	1	2	2								2			2	
4	1	2	2								3			2	
5	1	2	2								2			2	

#### UNIT I

## **INTRODUCTION**

Integrated Production Management, System Productivity, Capital Productivity, Labour Productivity, Personnel Productivity, Training; Operations Management and Strategy, Tools for Implementation of **Operations**, Industry Best Practices.

#### UNIT II

#### **FACILITY LOCATION**

Factor influencing plant & warehouse location, impact of location on cost & revenue. Facility location procedure & models; qualitative models, Breakeven analysis, Single facility location model, Multi facility location model, Minimax location, Total & partial covering model

## UNIT III

#### FORECASTING

Need for forecasting, the forecasting process, Forecasting methods- qualitative methods, Quantitative models-Time series forecasting models, moving averages, exponential smoothing with trend and seasonal adjustment, multi-item forecasting, Simple and multiple linear regression models, monitoring and controlling forecasts

9 Hours

## 9 Hours

#### MATERIALS MANAGEMENT AND INVENTORY CONTROL

Material Management, Components of Integrated Material Management- Materials planning, Inventory Control, Purchase Management, Stores Management; Inventory control, Models of Inventory controls -Purchase model, Manufacturing model

#### UNIT V

#### AGGREGATE PRODUCTION PLANNING

Aggregate planning system, Requirement of Aggregate Plan, Steps in Developing an Aggregate Plan, Advantages of Aggregate Plan, Aggregate Planning Strategies, Planning Options. Selecting the Method in Aggregate Planning, Aggregate Planning in Services.

#### **Reference**(s)

- 1. Panneerselvam, R. Production and Operations Management, PHI, 2018.
- 2. R.B. Khanna, Production and operations management, PHI, 2015
- 3. Jay Heizer and Barry Render, Operations Management, Pearson College Division, 2013
- 4.N. Chary, Production and operations management, Tata McGraw-Hill Publishing Company Ltd, New Delhi. 2008.
- 5. https://onlinecourses.nptel.ac.in/noc18\_me26/preview

#### 9 Hours

# 9 Hours

#### 18ME029 GREEN MANUFACTURING 3003

#### **Course Objectives**

- Learn and understand the basic concept of green manufacturing and its significance
- Learn and understand the societal implications of green manufacturing
- Apply the concept of Green manufacturing in real time environment
- Learn the analytical methods and Techniques of green manufacturing
- Apply and analyze green manufacturing in design, implementation and its economics in industrial environment

#### **Course Outcomes (COs)**

- 1. Explain and experience the importance of carbon emission and identify strategies for green manufacturing.
- 2. Evaluate and demonstrating the nexus between green manufacturing and the society to reduce environmental effects
- 3. Analyze the benefits of green manufacturing and perform life cycle analysis in an industrial environment.
- 4. Apply various optimization techniques for resource conservation.
- 5. Identify energy efficient technologies and environmental impact.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2					1							2	
2	2	2					1							2	
3	2	2		2			1							2	
4	2	2		2			2							2	
5	2	2	2				2						2	2	

#### **Articulation Matrix**

#### UNIT I

#### INTRODUCTION

Why GM-Definition-Motivation and Barrier to GM-regulatory pressure-economic incentivecompetitive advantage-Pillars of GM-environmental impact-carbon emission- waste generationenergy consumption-strategies for GM

#### UNIT II

#### **METRICS FOR GREEN MANUFACTURING(GM)**

Overview of metrics-Financial metrics- Metrics for ecology- metrics for society-Multiple metrics-Material and energy flow analysis-Green supply chain-definition-motivation-techniques of green supply chain-future of green supply chain

## UNIT III

#### **PRINCIPLES OF GM**

Technology wedges for GM-Five principles of GM-Mapping of principles- Closed loop production system-Life cycle of production system-benefits- machine tools and energy consumption

#### 8 Hours

9 Hours

#### GM THROUGH GREEN ENERGY SUPPLY

Green energy technologies-solar photovoltaics-wind energy-fuel cell- applications-technology performance-cost benefit of emission mitigation-examples of green house gas emission mitigation.

#### UNIT V

### TECHNOLOGY FOR GREEN MANUFACTURING

Process monitoring system-electrical flow-fluid flow-cutting fluid-compressed air-water-case studyenergy consumption and spindle rpm profile

#### **FURTHER READING**

Future of green manufacturing, Case Study : semi conductor manufacturing, Green supply chain

#### **Reference**(s)

- 1. David Dornfeld, Chris Yuan, Nancy Diaz, Teresa Zhang, and Athulan Vijayaraghavan, Introduction to Green manufacturing, First Edition, Springer, 2013
- 2. David R. Hillis, J. Barry Duvall, Improving Profitability Through Green Manufacturing, First Edition, John Wiley & Sons, Inc, 2012
- 3. Jiri Klemes, Ferenc Friedler, Igor Bulatov, Petar Varbanov, Sustainability in the Process Industry, First Edition, Mc Graw Hill, 2011
- 4. M. Thirugnanasambandam, CO<sub>2</sub> Emission Mitigation Through Energy Conservation- A practical Guide, First Edition, Shanlax Publishers, India, 2018.

**8 Hours** 

#### **10 Hours**

## 18ME030 PRODUCT DEVELOPMENT AND REVERSE ENGINEERING

## 3003

## **Course Objectives**

- To develop a new product by practicing a typical NPD Process followed in Industry
- To learn value engineering and product design tools to design a product
- To perform the Engineering Change Management process for a product
- To familiarize with the concept and design guidelines for manufacturing parts by different machining processes
- To educate the emerging trends and applications of reverse engineering and Additive manufacturing technology

## **Course Outcomes (COs)**

- 1. Analyse a new product based on the various roles in a typical NPD Process followed in Industry
- 2. Evaluate the value of a product and to select the appropriate product design tool for the specific product
- 3. Apply and demonstrate the Engineering Change Management process for a product
- 4. Design metallic and non-metallic products under DFMA concepts to reduce machining time and manufacturing cost also considering the environmental impact
- 5. Create prototype by performing the reverse engineering techniques

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	2								2	1	
2	2	1	2	3	2								2	1	
3	1	1	2	2	2					3			2	1	
4	2	2	2	1	2	2							2	1	
5	1	1	3	2	3								2	1	

## **Articulation Matrix**

## UNIT I

## INTRODUCTION TO NEW PRODUCT DEVELOPMENT

Product life cycle - Product policy of an organization. Selection of a profitable product, Product design process- New product strategy-Idea generation and screening- Concept development and testing -Business analysis -Product development testing and analysis -Commercialisation - Collaboration- Gantt chart -product life cycle management

### UNIT II

## VALUE ENGINEERING AND PRODUCT DESIGN TOOLS

Value engineering in product design; Advantages, Applications in product design- Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA, Ergonomics in product design

#### 236

#### 9 Hours

#### 9 Hours

## 9 Hours

## 9 Hours

#### **Total: 45 Hours**

- 1. T. Karl, Ulrich and D. Steven, and Eppinger, Product Design and Development, Mcgraw Hill 2009
- 2. Harry Peck, Designing for Manufacture, Pitman Publishing, London, 1973
- 3. Robert Matousek, Engineering Design A Systematic Approach, Blackie and Son Limited, London, 1974
- 4. M. F. Spotts, Dimensioning and Tolerance for Quantity Production, Prentice Hall, New Jersey, 2007
- 5. Kevin otto, Kristin wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson education, 2003
- 6. https://nptel.ac.in/courses/112107217/

#### UNIT III

#### **ENGINEERING CHANGE MANAGEMENT**

Product Data Management - Engineering Change Management process- Impact of ECM- Typical steps followed - Different roles in an ECM Process- Participating in an ECM process -Engineering Change Request - Engineering Change Notice - Engineering Change Orders

#### UNIT IV

#### **DFMA GUIDELINES**

Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc - Design for Environment (DFE) methods - Design guide lines - Lifecycle assessment- Design to minimize material usage - Design for disassembly, Recyclability, Remanufacture, Energy efficiency - Design to regulations and standards

#### UNIT V

**Reference**(s)

#### **REVERSE ENGINEERING AND APPLICATIONS OF ADDITIVE MANUFACTURING**

Reverse Engineering - Application of CMM, Laser scanner, CT and MRI scan in acquiring point data - Software for STL file processing. Application of Rapid prototyping in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries. Leading manufacturer of RP Systems

#### 18ME031 NANOMATERIALS AND NANOTECHNOLOGY

3003

### **Course Objectives**

- To provide knowledge on basic concepts and size dependent properties of nano materials
- To familiarize nano materials based on property and structure
- To impart knowledge on different synthesis techniques of nano materials
- To perform different characterization techniques.
- To apply the concepts of nano materials in Nano devices.

### **Course Outcomes (COs)**

- 1. Illustrate the size dependent properties of nano materials
- 2. Classify the different types of nano materials based on property and structure
- 3. Explain different experimental methods used for the preparation of nano materials
- 4. Analyze the data using different characterization techniques
- 5. Identify the impact of nano materials and their applications in Nano devices

## **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1				1							2	
2	2	1	1				2							2	
3	3	2	2	2			3							2	
4	3	1		3	3	-								2	
5	1	1	2			-	2							2	

#### UNIT I

## INTRODUCTION

Nano scale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra thin films multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

#### UNIT II

#### NANO MATERIALS

Nano forms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT) - Nano metal oxides- ZnO, TiO2,MgO, ZrO2,NiO, nano alumina, CaO, AgTiO2, Ferrites, Nano clays-functionalization and applications-Quantum wires.

#### UNIT III

#### SYNTHESIS OF NANO MATERIALS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process - chemical vapour deposition, plasma enhanced CVD, colloidal and sol-gel methods - template based growth of nano materials -ordering of nano systems, self-assembly - DC sputtering and RF sputtering process

## 9 Hours

9 Hours

#### **CHARACTERIZATION TECHNIQUES**

# UNIT V APPLICATIONS

Nano InfoTech: Information storage- nano computer, molecular switch, super chip, nano crystal, Nano bio technology: nano probes in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bio imaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nano sensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery.

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - Electron microscopy, Scanning electron microscopy, Transmission electron microscopy, Atomic force microscopy X ray diffraction techniques - thermo gravimetric analysis of nano materials

#### **Reference**(s)

- 1. G Timp, Nanotechnology, AIP press/Springer, 1999
- 2. Akhlesh Lakhtakia, The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations, Prentice- Hall of India (P) Ltd, New Delhi, 2007
- 3. William A. Goddard, Donald Brenner, Handbook of Nano science, Engineering, and Technology, CRC Press, 2012.
- 4. Charles P. Poole Jr and Frank J. Owens, Introduction to Nanotechnology, Wiley Inter science, 2007
- 5. Guozhong Cao, Y. Wang, Nanostructures and Nano materials-Synthesis, Properties & Applications, Imperials College Press, 2011

#### 9 Hours

## 9 Hours

#### 18ME032 TOTAL QUALITY MANAGEMENT 3003

#### **Course Objectives**

- To learn concepts, dimension quality and philosophies of TQM
- To study the TQM principles and its strategies
- To learn the seven tools of statistical quality and management
- To impart knowledge on TQM tools for continuous improvement
- To introduce international quality management systems

### **Course Outcomes (COs)**

- 1. Use the concepts, dimension of quality and philosophies of TQM
- 2. Apply the principles of TQM and its strategies in industries
- 3. Apply the statistical quality tools and seven management tools
- 4. Choose the suitable TQM tools for continuous improvement
- 5. Use the concept of QMS, EMS and EnMS in industries

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1					2		3					1	1	
2						2		3			2		1	1	
3	2	3	1		2								1	2	
4	1	2	2										2	1	
5						1	2	2					1	1	

#### UNIT I

#### INTRODUCTION

Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Analysis Techniques for Quality Costs - Basic concepts of Total Quality Management - Historical Review -Quality Statements - Strategic Planning, Deming Philosophy - Crosby philosophy - Continuous Process Improvement - Juran Trilogy, PDSA Cycle, 5S, Kaizen - Obstacles to TQM Implementation

#### UNIT II

#### TQM PRINCIPLES

Principles of TQM, Leadership Concepts, Role of Senior Management, Quality Council, Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement - Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits - Supplier Partnership - Partnering, Sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures

# 9 Hours

#### UNIT III

## STATISTICAL PROCESS CONTROL (SPC)

The seven tools of quality - Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, nP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma - New seven Management tools

#### UNIT IV

#### **TQM TOOLS**

Benchmarking, Quality Function Deployment (QFD) - House of Quality, QFD Process, and Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM), FMEA - Stages of FMEA, Case studies

#### UNIT V

#### QUALITY SYSTEMS

Need for ISO 9000 and Other Quality Systems - Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2015, ISO 9001:2015 and ISO 9004:2018, TS 16949, ISO 14000, ISO 50001 - Concept, Requirements and Benefits

#### **Reference**(s)

- 1. Dale H. Bester filed, Total Quality Management, Pearson Education Inc., New Delhi, 2003
- 2. N. Gupta and B. Valarmathi, Total Quality Management, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2009
- 3. James R. Evans and William M.Lidsay, The Management and Control of Quality, SouthWestern 2002
- 4. Dr. S. Kumar, Total Quality Management, Laxmi Publications Ltd. New Delhi, 2006
- 5. P. N. Muherjee, Total Quality Management, Prentice Hall of India, New Delhi, 2006

#### 9 Hours

## 9 Hours

#### 9 Hours

#### 18GE0E1ENTREPRENEURSHIP DEVELOPMENT I3003

#### **Course Objectives**

• Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc

#### **Course Outcomes (COs)**

- 1. Analyze the role of entrepreneurship in economic development.
- 2. Explain the types of ideas that to be used for entrepreneurship development.
- 3. Examine the legal aspects of business and its association.
- 4. Examine the sources of business and its analysis.
- 5. Analyse the different modes of operation management.

#### **Articulation Matrix**

CO No	<b>PO1</b>	PO2	PO3	PO4	PO5	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

#### UNIT I

#### **BASICS OF ENTREPRENEURSHIP**

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

#### UNIT II

#### **GENERATION OF IDEAS**

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

#### **UNIT III**

#### LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act-Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

#### 9 Hours

#### 9 Hours

#### UNIT IV BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

### UNIT V

#### **OPERATIONS MANAGEMENT**

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

### **Total: 45 Hours**

## **Reference**(s)

- 1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
- 2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
- 3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.

## 9 Hours

## 18GE0E2 ENTREPRENEURSHIP DEVELOPMENT II 3003

## **Course Objectives**

- Evolve the marketing mix for promoting the product / services
- Handle the human resources and taxation
- Understand Government industrial policies / support provided and prepare a business plan

## **Course Outcomes (COs)**

- 1. Examine the strategies and plans in marketing management.
- 2. Analyse the cases involved in human resource management.
- 3. Classify the direct and indirect taxes in business.
- 4. Analyze the supports given by government for improving the business.
- 5. Examine the various steps involved in preparing the business plan.

## **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2							2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

#### UNIT I

## MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases)

## UNIT II

#### HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

#### UNIT III

#### **BUSINESS TAXATION**

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases).Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases).

#### 9 Hours

9 Hours

#### **GOVERNMENT SUPPORT**

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State Level Institutions-TIIC, CED, MSME, Financial Institutions.

#### UNIT V

#### **BUSINESS PLAN PREPARATION**

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

#### **Total: 45 Hours**

#### **Reference**(s)

- 1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
- 2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
- 3. Aswathappa K, Human Resource and Personnel Management Text and Cases, Tata McGraw Hill: 2007.
- 4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
- 5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
- 6. http://niesbud.nic.in/agencies.htm.

#### 9 Hours

#### 18ME0YA INDUSTRIAL PROCESS ENGINEERING 3003

### **Course Objectives**

- To impart the knowledge on production planning methodologies and layout design
- To learn about production planning and its control methods
- To provide the knowledge of work study, process charts and ergonomic condition
- To impart the knowledge on inventory control and material handling
- To learn about system analysis and different types of maintenance processes

### **Course Outcomes (COs)**

- 1. Select proper plant layout for the required production system
- 2. Plan the resources required for the production and to perform the control methods
- 3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
- 4. Analyze the inventory required based on production needs and material handling
- 5. Perform system analysis and use different types of maintenance process for smooth operations.

## **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1		1									2	
2	3	3	1		2						2			2	
3	1	3	3		2									2	
4	2	3	1		2									2	
5	2	3	1		2									2	

#### UNIT I

#### INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM

Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer- Production management, Industrial engineering versus production management, operations management. Plant layout, Criteria for good layout, Types of layout - Process layout, Product layout, Combination layout and fixed position layout, Flow (material movement) pattern, Workstation Selection and design.

#### UNIT II

#### PROCESS PLANNING AND PRODUCTION CONTROL

Introduction to Process planning-Definition, Procedure, Process selection, Machine capacity, Process sheet.Process analysis - Group technology, classification and coding system, formation of component family - Production planning, loading, scheduling. Production control -dispatching, routing - Progress control bar, curve, Gantt chart, route and schedule chart.

#### 246

# 10 Hours

#### UNIT III

#### WORK STUDY AND ERGONOMICS

Work study - Definition, Need, Advantages, objectives of method study and work measurement, method study procedure, Process chart - symbols, outline process chart, flow process chart, principles of motion economy, ergonomics- applications of ergonomic principles in the shop floor- work benches-seating arrangement, Industrial physiology.

#### UNIT IV

#### **INVENTORY MANAGEMENT**

Inventory control, classification, management, objectives, functions. Economic order quantity, Economic batch quantity, inventory models, ABC analysis, Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, lean manufacturing, Supply chain management - Material handling.

#### UNIT V

#### SYSTEM ANALYSIS AND MAINTENANCE

System concept - system analysis, systems engineering, value engineering, value control, types of values. Plant maintenance - objectives, importance. Maintenance engineer - duties, functions and responsibilities. Types - breakdown, scheduled, preventive and predictive - Plant maintenance schedule, Condition monitoring.

#### **Reference**(s)

- 1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications, 2010
- 2. Martand T. Telsang, Industrial Engineering and Production Management, S Chand Publishers, 2006
- 3. Panneerselvam R., Production and operations management, Heritage Publishers, 2006
- 4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009

#### 8 Hours

**8** Hours

**10 Hours** 

## 18ME0YB SAFETY ENGINEERING 3003

## **Course Objectives**

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

## **Course Outcomes (COs)**

- 1. Explain safety management system of an industry.
- 2. Implement the provisions of acts and rules in industries.
- 3. Implement and review the safety performance followed in various industries
- 4. Evaluate safety appraisal in chemical industries.
- 5. Generate safety reports on construction industries.

## **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1					2	1		1						2	2
2					1			3					2	1	
3	2											3	1		2
4	2	3							2				2		1
5					2					3				3	

## UNIT I

## SAFETY MANAGEMENT

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Reporting and Investigation - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

## UNIT II

## SAFETY AND LAW

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, ,Building and other construction works act 1996, Electricity Rules.

## UNIT III

## SAFETY IN ENGINEERING INDUSTRIES

Safety in machine shop,- Principles of machine guarding - Personal protective equipment- Safety in handling industrial gases - Safety in cold forming and hot working of metals- Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

# 8 Hours

**10 Hours** 

#### **10 Hours**

#### 248

## SAFETY IN CHEMICAL INDUSTRIES

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, Plant maintenance and emergency planning, management of maintenance HAZOP study.

## UNIT V

## SAFETY IN CONSTRUCTION INDUSTRY

Construction regulations, contractual clauses, permit to work, - Education and training-Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights,-Working on fragile roofs, work permit systems-Construction machinery, cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, - Safety in confined spaces

## FOR FURTHER READING

Case Studies- Major accidents at Flixborough, UK, Seveso, Italy, Victoria Dock, India, Bhopal, India. Total: 45 Hours

## **Reference**(s)

- 1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey, 1973.
- National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988
- 3. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules, 1950, Madras
- 4. Environmental Pollution Control Act, 1986
- 5. BOCW Act,1996, Madras Book agency, Chennai-1
- 6. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.

## 8 Hours

#### 18ME0YC MAINTENANCE ENGINEERING 3003

## **Course Objectives**

- To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
- To introduce different maintenance categories, its merits and types of lubrication.
- To expose the idea of condition monitoring, methods and instruments used for allied measurements.
- To learn about failure analysis and repair methods for few mechanical elements.
- To promote computerization in maintenance and inventory management.

## **Course Outcomes (COs)**

- 1. Explain the principles, objectives and importance of maintenance adopted in industry.
- 2. Select the suitable maintenance category and lubrication type.
- 3. Apply the appropriate methods and instruments for condition monitoring.
- 4. Analyze the failures of mechanical systems and select suitable repair methods.
- 5. Utilize computers in maintenance and inventory management.

## **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2												2	
2	2	2												2	
3					2	2	1							2	
4	1	2	1		2	2	2							2	
5	2	2	2		1	1	1							2	

#### UNIT I

#### PRINCIPLES OF MAINTENANCE PLANNING

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

#### UNIT II

#### MAINTENANCE CATEGORIES AND LUBRICATION

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

#### UNIT III

## **CONDITION MONITORING**

Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.

# 9 Hours

9 Hours
## UNIT IV

## FAILURE ANALYSIS AND REPAIR METHODS

Failure analysis - Failures and their development - Role of Non Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.

#### UNIT V

#### COMPUTER AIDED MAINTENANCE MANAGEMENT

Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

#### FURTHER READING

Retrofitting, objectives, classification of retrofitting, cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features and selection for retrofitting.

#### **Reference**(s)

- 1. Srivastava S.K, Maintenance Engineering, S Chand and Company, 2010.
- 2. Mishra R.C, Pathak K, Maintenance Engineering and Management, Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.
- 3. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, Maintenance Engineering Handbook, Seventh edition, McGraw-Hill Professional, 2008.
- 4. Davies A, Handbook of Condition Monitoring: Techniques and Methodology, Springer, 2012.
- 5. Otegui Jose Luis, Failure Analysis, Fundamentals and Applications in Mechanical Components, Nineteenth edition, Springer, 2014.

251

# 9 Hours

9 Hours

#### 18ME0YD BASICS OF NON-DESTRUCTIVE TESTING

3003

# **Course Objectives**

- To learn different surface inspection techniques.
- To provide knowledge on sub surface testing methods.
- To impart knowledge on ultrasonic testing method.
- To provide knowledge on radiography testing method.
- To study various special non-destructive testing methods.

# **Course Outcomes (COs)**

- 1. Select appropriate surface inspection techniques for the components to be inspected.
- 2. Explain the non destructive testing method to identify the sub surface defects in materials.
- 3. Select and explain the suitable testing method for testing internal defects.
- 4. Apply radiography testing methods for different suitable applications.
- 5. Choose the suitable special non-destructive technique for various applications.

# **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	2			1							2	
2	1	2	2	2			1							2	
3	1	2	2	2			1							2	
4	1	2	2	2			1							2	
5	1	3	3	2			1							2	

# UNIT I

# SURFACE TECHNIQUES

Introduction and Scope of NDT, Discontinuities and Defects in various manufactured Components, Various physical characteristics of materials and their applications in NDT, Relative merits and limitations of NDT, Types of NDT techniques, Visual or Optical Testing - Direct and remote visual inspection and Aides. Liquid Penetrant Testing (LPT) Principles - Types and properties of liquid penetrants and developers - Preparation of test materials - Advantages and limitations - Application of penetrants to parts - Fluorescent penetrant test

# UNIT II

# SUB SURFACE TECHNIQUES

Magnetic Particle Testing (MPT) - Principles, applications, magnetization methods, magnetic particles - Dry particle technique and Wet fluorescent particle technique - Advantages and Limitations. Eddy Current Inspection - Principle, Methods, Equipment for ECT, Techniques, Sensitivity, Application, scope and limitations

#### 9 Hours

## 9 Hours

9 Hours

9 Hours

Total: 45 Hours

Ultrasonic Testing (UT) - Principle, Types and characteristics of Ultrasonic waves - Attenuation, Couplants, Probes - Inspection methods - Pulse echo, Transmission and Phased Array techniques (PAUT), Types of scanning and displays - Angle beam inspection of welds - Calibration of ASTM Test blocks, International Institute of Welding IIW) reference blocks - Applications

#### UNIT IV

UNIT III

#### **RADIOGRAPHY TESTING**

ULTRASONIC TESTING

Radiographic testing (RT) -Principle, Sources of X-rays and Gamma rays and their characteristics -Absorption, scattering, Filters and screens, imaging modalities - Film radiography and Digital Radiography - Problems in shadow formation, Exposure factors, film handling and storage- Inverse square law, Exposure charts, and Radiographic equivalence, Penetrometers - Safety in radiography-Applications

#### UNIT V

#### **SPECIAL NDT TECHNIQUES**

Acoustic Emission Testing (AET) Principle - Instrumentation and applications, advantages and limitations. Infra-Red Thermography (IRT) - Principle, Techniques and applications. Leak Testing - Principle, Testing Procedure and applications. LASER Stereography- Typical applications-Requirements - advantages and disadvantages.

#### **Reference**(s)

- 1. Charles J. Hellier, "Handbook Of Nondestructive Evaluation", McGraw-Hill Education; 2 edition 2012.
- 2. Baldev Raj, Jayakumar T, Thavasimuthu M, "Practical Non-Destructive Testing", Narosa Publishing, 2009.
- 3. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 2001.
- 4. Mc Gonnagle W T, "Non-Destructive Testing", McGraw Hill Book Co., 1988
- 5. Louis Cartz, "Non-Destructive Testing", ASM International, Metals Park Ohio, US, 1995.
- 6. https://onlinecourses.nptel.ac.in/noc19\_mm07/course

# 18ME0YE DIGITAL MANUFACTURING 3003

# **Course Objectives**

- To understand the process of generating 3D Computer Aided Design (CAD) model by different method.
- To explain the constructional features and develop simple program for CNC lathe and Milling machines.
- To provide an exhaustive knowledge on various generic process and benefits of Additive Manufacturing.
- To familiarize about materials and process parameters of liquid and solid based AM techniques.
- To educate powder based methodology and emerging trends with case studies, applications of AM techniques.

# Course Outcomes (COs)

- 1. Design a 3D model from the 2D data.
- 2. Develop a CNC program for simple components.
- 3. Generate stl file and manipulate parameters of AM machine
- 4. Select appropriate liquid or solid materials based AM process to the respective application
- 5. Select appropriate process to fabricate a functional/prototype for aerospace, automotive, electronics, manufacturing and medical applications.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2		2								1	2	
2	2	2	2		2								1	2	
3	2	2	2		2								1	2	
4	2	2	2		2								1	3	
5	2	2	2		2								1	2	

# **Articulation Matrix**

# UNIT I

# **CAD MODELING**

Introduction - Design process - Stages. CAD - Input and Output devices, Modeling methods - Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

# UNIT II

# **AUTOMATION AND CNC MACHINES**

Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications. CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

# 9 Hours

#### 7 Hours

8 Hours

**11 Hours** 

Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development -Distinction between AM and CNC Machining - The Generalized AM Process chain - CAD Model -Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - AM Benefits - Classification of AM process

## UNIT IV

### LIQUID AND SOLID MATERIAL BASED SYSTEMS

Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

#### UNIT V

#### POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING

Selective Laser Sintering (SLS), Color Jet Printing (CJP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Reverse Engineering using 3D scanner. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

#### **Reference**(s)

- 1. Ibrahim Zeid, R. Sivasubramania, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
- 2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.
- 3. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
- 4. D. T. Pham, S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
- 5. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015 http://www.springer.com/978-1-4939-2112-6
- 6. www.grabcad.com, www.all3dp.com

#### UNIT III

#### **ADDITIVE MANUFACTURING**

#### 18ME0YF WORK STUDY AND ERGONOMICS 3003

#### **Course Objectives**

- To develop concepts related to principles of productivity & work study as a tool for increasing the efficiency and effectiveness in organizational systems
- To study the existing method, compare and propose a new method
- To provide the usage of the various tools and techniques used in work measurement
- To develop basic ideas of ergonomics and its design
- To develop concepts related Man-Machine Interfaces and Design of Displays and controls

#### **Course Outcomes (COs)**

- 1. Calculate the basic work content of a specific job for employees of an organization.
- 2. Analyse and calculate the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems
- 3. Rate a worker engaged on a live job and calculate basic, allowed and standard time for the same.
- 4. Demonstrate a sound knowledge of Ergonomics in engineering applications
- 5. Demonstrate a sound knowledge of Man-Machine Interfaces and design of displays and controls in engineering systems

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1					1					1		1		
2	1	-				1					1		1		
3	2	2			2								2		
4	2	2	2		2			2					2		
5	2	2	2		2								2		

#### **Articulation Matrix**

#### UNIT I

#### PRODUCTIVITY AND WORK STUDY

Definition of productivity, factors affecting productivity, definition, objective & scope of work study, human factors in work study, work study & management, work study & supervisor, work study &worker.

# UNIT II

**METHOD STUDY** 

Definition, objective & scope, charts to record movements in shop, process charts, flow process charts, Multiple activity charts, two handed process charts, SIMO chart, principles of motion economy

#### 8 Hours

#### 8 Hours

**10 Hours** 

**10 Hours** 

Definition, objectives, techniques of work measurement, work sampling, need of confidence levels, sample size determination, random observation with simple problems.Time study: Definition, time study equipments, selection of jobs, steps in time study, breaking jobs into elements, recording information, rating, standard performance, scales of rating, factors affecting rate of working, allowances, standard time determination

#### UNIT IV

UNIT III

WORK MEASUREMENT

#### INTRODUCTION TO ERGONOMICS

Introduction to Ergonomics: Human factors and ergonomics Physical Ergonomics: human anatomy, and some of the anthropometric, physiological and bio mechanical characteristics. Cognitive: mental processes, such as perception, memory, reasoning, Organizational ergonomics: optimization of socio-technical systems, organizational structures, policies, processes. Environmental ergonomics: human interaction with the environment.

#### UNIT V

#### **MAN-MACHINE INTERACTION**

Machine interaction cycle, Man-machine interfaces, Displays :factors that control choice of display, visual displays- qualitative displays; moving pointer displays, moving scale displays, digital displays Indicators, auditory displays, tactile displays. Factors affecting effectiveness of displays. Quantitative displays, check- reading displays, representational displays.Design guidelines for displays and controls. Standards for ergonomics in engineering and design, displays and controls.

#### **Total: 45 Hours**

#### **Reference**(s)

- 1. S. Dalela and Sourabh, Work Study and Ergonomics. Standard publishers 2013
- 2. Wesley Woodson, Peggy Tillman and Barry Tillman, Human Factors Design Handbook, McGraw-Hill; 2nd edition, 1992
- 3. Ralph M. Barnes, Motion and Time Study, Wiley International, 7th Edition
- 4. Mark S. Sanders and Ernest J. McCormick ,Human Factors in Engineering Design, 4th edition, 2013
- 5. B. Niebel and Freivalds, Niebel, Methods Standards and Work Design, McGraw-Hill, 12th Edition, 2009,

#### 18ME0YG METROLOGY IN INDUSTRY 3003

#### **Course Objectives**

- To familiarize the concept of metrology and measurement standards.
- To learn about the linear and angular measurements.
- To impart knowledge on measurement of straightness and surface roughness.
- To educate on the screw thread terminologies and comparator.
- To emphasis measurement procedure for machine tool metrology.

#### **Course Outcomes (COs)**

- 1. Explain about the metrology and measurement methods.
- 2. Measure the objects with necessary linear and angular measuring instruments.
- 3. Identify the squareness and surface roughness of a component.
- 4. Select the suitable measuring instrument for screw thread terminologies.
- 5. Assess the different parameters of machine tool.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2										1		2	
2	2	2										1		2	
3	2	2			1							1		2	
4	2	2										1		2	
5	2	2			1							1		2	

#### UNIT I

#### INTRODUCTION TO METROLOGY

Definition, types, need for inspection, methods of measurement, selection of instruments, errors in measurement, units - Characteristics of measuring instrument : sensitivity, Accuracy, Readability, Reliability, Repeatability and Reproducibility - Measurement standards, calibration, care taking of measuring instruments.

#### UNIT II

#### LINEAR AND ANGULAR MEASUREMENTS

Linear metrology: Steel rule, calipers, vernier caliper, vernier height gauge, vernier depth gauge, micrometers, slip gauge, limit gauging and its classification - Limits, fit and tolerances. Angular Measurements: Bevel protractor and Sine bar.

#### UNIT III

#### MEASUREMENT OF GEOMETRICAL AND DIMENSIONAL TOLERANCE

Measurement of straightness, flatness, squareness, parallelism, roundness and cylindricity. Measurement of surface finish: Introduction, terminology, specifying roughness on drawings, surface roughness parameters, factors affecting surface roughness, roughness measurement methods, precautions in measurement. Comparator: Features of comparators, classification of comparators, different comparators, advanced comparators.

# 7 Hours

#### **10 Hours**

#### UNIT IV

#### FORM MEASUREMENT

# Screw thread metrology: Introduction, screw thread terminology, errors in thread - External screw thread measurement: Tool makers microscope, Floating carriage micrometer and pitch gauge - Internal thread measurement: Taper parallels and roller method. Gear measurement: Introduction, types of gears, gear terminology, gear tooth vernier caliper, profile projector, Parkinson gear tester - External and Internal Radius measurement.

#### UNIT V

#### **ADVANCED AND MACHINE TOOL METROLOGY**

Digital devices - Interferometry: Principle of interference, interference patterns, NPL flatness interferometer - Coordinate Measuring: Basic concept, Types, Constructional features, Probes and Accessories - Computer Aided Inspection: Machine Vision System - Measurement of Temperature: Infrared Thermometer - Machine tool alignment test on Lathe, Drilling and Milling machine.

#### **Reference**(s)

- 1. R. K. Jain, Engineering Metrology, Khanna Publishers, New Delhi, 2009.
- 2. K.J. Hume, Engineering Metrology, Macdonald and Co. (publisher) London, 1970.
- 3. Czichos (Ed), The Springer handbook of metrology and Testing, 2011.
- 4. Jay. L. Bucher (ed), The Metrology Hand book- American Society for Quality, 2012.
- 5. Smith GT, Industrial Metrology, Spinger, 2002
- 6. https://onlinecourses.nptel.ac.in/noc18\_me62/

#### **10 Hours**

**10 Hours** 

#### 18ME0YH PLANT LAYOUT AND MATERIAL HANDLING 3003

# **Course Objectives**

- To provide knowledge in Selection of plant locations.
- To offer knowledge in developing layout for various industries incorporating the safety aspects.
- To provide knowledge on creating and maintaining safe working environment
- To impart knowledge in Manual Material Handling and Lifting Tackles
- To educate on Manual Material Handling equipment

# Course Outcomes (COs)

- 1. Analyse plant locations suitable to the process requirements of an industrial unit.
- 2. Execute the plant layout for various industries incorporating the safety aspects considering the society
- 3. Create and maintain safe working environment without any harm to employee and society.
- 4. Generate suitable Manual Material Handling and Lifting Tackles
- 5. Classify Manual Material Handling equipment and testing requirement.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2											1	2	
2		2											1	2	
3			3										1	2	
4				2		3							1	2	
5	1	2											1	2	

# Articulation Matrix

#### UNIT I

#### PLANT LOCATION

Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions-Safe location of storage of chemicals in the form of bullets, spheres, cylinders for LPG, LNG, CNG, acetylene, ammonia, chlorine - explosives and propellants.

#### UNIT II

#### PLANT LAYOUT

Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers. Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powder manufacturing, fireworks and match works.

#### 9 Hours

#### UNIT III

#### PLANT ATMOSPHERE

Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application. Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- Housekeeping, principles of 5S.

#### UNIT IV

#### MANUAL MATERIAL HANDLING AND LIFTING TACKLES

Preventing common injuries, handling specific shape machines and other heavy objects - accessories for manual handling - problems with hazardous materials - storage and handling of cryogenic liquids - shipping and receiving - personal protection ergonomic considerations. Fiber rope and wire rope, types, strength and working load inspection, - slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection.

#### UNIT V

#### **MATERIAL HANDLING EQUIPMENTS**

Hoisting apparatus - cranes, types, design and construction, guards and limit devices, signals, maintenance safety rules, inspection checklist - conveyors, types, applications. Powered industrial trucks, principles, operators selection and training and performance test, maintenance, electric trucks, gasoline operated trucks, LPG trucks - power elevators, types of drives, requirements for the physically challenged, types- Escalator, safety devices and brakes, moving walks - man lifts, construction, brakes, inspection.

#### **Reference**(s)

- 1. M.P. Alexandrov. Material handling equipment Mir Publishers, Moscow, 1981
- 2. Accident prevention manual for industrial operations N.S.C., Chicago, 2012
- 3. Spivakosky, Conveyors and related Equipment, Vol.I and II Peace Pub. Moscow, 1985.
- 4. Apple M. James Plant layout and material handling, 3rd edition, John Wiley and sons.1978
- 5. Encyclopedia of occupational safety and health, ILO Publication, 2009
- 6. Industrial ventilation (A manual for recommended practice), American conference of Governmental Industrial Hygiene, USA, 1984

#### 9 Hours

#### 9 Hours

9 Hours

#### 18ME0YICONCEPTS OF ENGINEERING DESIGN3003

#### **Course Objectives**

- To provide knowledge on fundamental engineering principles and problem identification.
- To acquire knowledge about concept generation and concept selection.
- To learn the detailed design process and design of manufacture and assembly.
- To impart knowledge on planning for manufacture and design review.
- To impart knowledge on report preparation and intellectual property right.

#### **Course Outcomes (COs)**

- 1. Identify engineering design principles and problem identification for product development.
- 2. Select suitable concept to design effectively for various engineering problems.
- 3. Prepare the detailed design process and design for manufacture and assembly.
- 4. Make process plan for production based on quality function deployment and value engineering.
- 5. Make concept sketch and scheme drawing for report preparation and intellectual property right.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1			2										1		
2			2				2						1		
3		2												2	
4			2				2						1	2	
5					2									2	

#### UNIT I

#### PRINCIPLES AND PROBLEM IDENTIFICATION

Engineering design- introduction and definition, Considerations of a good design, Engineering design interfaces, Principles of engineering design, Problem identification, Design process, Product Design Specification (PDS) criteria, Content of a PDS.

#### UNIT II

#### **CONCEPT GENERATION AND SELECTION**

Identifying customer needs, Societal considerations in engineering, Creativity and problem solving, creativity methods - Brainstorming, Morphological analysis, Concept selection - Subjective decision-making, Criteria ranking, Criteria weighting, Datum method, Computer aided decision making.

#### UNIT III

#### **DESIGN PROCESS**

Detailed description of design process, five basic patterns of decision making, decision making based on state of knowledge, Design for manufacturing (DFM), Design for Assembly (DFA), Industrial design, Design for environment, engineering design principles.

# 9 Hours

9 Hours

# UNIT IV

# PLANNING FOR MANUFACTURE

Quality function deployment (QFD), Design review, Value analysis/engineering, Factor of safety, Materials selection, break even analysis - problem, cost evaluation, Elements of cost, ISO concepts.

# UNIT V

# REPORT PREPARATION AND INTELLECTUAL PROPERTY RIGHTS

Presentation Techniques - Introduction, Concept sketches, Scheme drawing, Design Validation Design report. Intellectual Property Rights - Introduction, Patent, Trademark, copyright, Patentability, patenting process.

# **Reference**(s)

- 1. Ken Hurst, Engineering Design Principles, Elsevier Science and Technology Books, 2004.
- 2. George E Dieter, Engineering Design, Tata McGraw Hill publishing Company Pvt Ltd, New Delhi, 2008
- 3. Danlel E. Whitney, Mechanical Assembles: Design Manufacture and Role in Product Development, Oxford University, Press, 2008
- 4. K. Otto, Product Design, Pearson Publications, 2005.
- 5. Richard Birmingham, Graham Cleland, Robert Driver and David Maffin, Understanding Engineering Design, Prentice Hall of India, 1997

# 9 Hours

9 Hours

# 18ME0YJ OIL HYDRAULICS AND PNEUMATICS3003

# **Course Objectives**

- To impart knowledge on various types of hydraulic pumps and actuators
- To learn about various hydraulic components and its working functions
- To provide knowledge on the selection of hydraulic components
- To learn about various types of pneumatic components and servo systems
- To emphasis fluid power circuit design methods and its applications

# **Course Outcomes (COs)**

- 1. Identify suitable hydraulic pumps and actuators for different applications
- 2. Interpret the functions of various hydraulic components and apply for suitable applications
- 3. Select suitable fluid power components for various applications
- 4. Explain the functions of various pneumatic components& servo systems and apply for suitable applications
- 5. Design fluid power circuit for given applications

# **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3												1		
2	3												1		
3	3	1			1								1		
4	3												1		
5	2	2	3		3								3		

#### UNIT I

#### HYDRAULIC PUMPS AND ACTUATORS

Introduction to fluid power system - Applications of Pascal's Law - Hydraulic pumps - Pumping theory, classification - Gear pump, Vane pump, piston pump, construction and working principles - Fluid power Actuators - Single acting, Double acting, cushioning and telescopic cylinder, construction and working principles. Gear Motors, Vane motors, Piston motors.

#### UNIT II

#### HYDRAULIC COMPONENTS

Direction control valve - check valve, shuttle valve, 3/2, 4/2 and 4/3 way valve and solenoid valve - Actuation methods. Pressure control valves-pressure relief valve, compound pressure relief valve, pressure reducing valve, unloading valve, sequence valve, counterbalance valve. Flow control valves-types. Accumulators and intensifier - Types.

#### UNIT III

#### SELECTION OF HYDRAULIC COMPONENTS

Selection factors-Selection of pumps. Actuators - cylinders, motors versus load - Piston rod buckling. Selection of Hydraulic pipe and hoses, valves, reservoir, filters, Accumulators and intensifiers.

# 10 Hours

**10 Hours** 

#### UNIT IV

#### **PNEUMATIC COMPONENTS**

# Compressors- Filter, Regulator, Lubricator (FRL) unit, mufflers. Valves- direction control valves - shuttle valve, two way air piloted valve, push button valve, quick exhaust valve, lever control valve and solenoid valve - Pneumatic actuators. Servo system - Hydro mechanical, Electro hydraulic and proportional valve.

#### UNIT V

#### **DESIGN OF FLUID POWER CIRCUIT**

Fluid power circuits- Speed control circuits, synchronizing circuit, sequential circuit and design for simple application using cascade and stepper sequencer method. Application of Accumulator and Intensifier circuit.

#### FOR FURTHER READING

Design and simulation of simple circuit using Simulation software. Causes and trouble shootings of fluid power system.

#### **Reference**(s)

- 1. Anthony Esposito, Fluid power with applications, 7th Edition, Pearson Education, New Delhi, 2013
- 2. Andrew Parr, Hydraulics and Pneumatics, 2nd Edition, Butterworth Heinemann, New Delhi, 2006.
- 3. S.R Majumdar, Oil Hydraulic Systems: Principles and Maintenance, McGraw Hill publishing company Pvt. Ltd. 28th Edition New Delhi, 2017.
- 4. S.R. Majumdar, Pneumatic systems-Principles and maintenance, McGraw Hill publishing company Pvt. Ltd., New Delhi, 2017.
- 5. S. Ilango Introduction to Hydraulics and Pneumatics, 3rd Revised Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2017.

#### 9 Hours

#### 8 Hours

#### 18ME0YK ENERGY AUDITING AND MANAGEMENT

3003

#### **Course Objectives**

- To emphasis on the concept of energy management and its importance
- To impart the knowledge on energy auditing and instrument selection skills
- To learn about the energy management tools and financial analysis
- To perform an energy efficiency assessment in thermal systems
- To measure the performance and efficiency of electrical utilities

#### **Course Outcomes (COs)**

- 1. Explain the types of energy based on three criteria's and importance of energy conservation
- 2. Implement appropriate steps to be followed for conducting preliminary and detailed energy audit in industries
- 3. Assess the economic need for a project using financial analysis techniques
- 4. Evaluate the efficiency of thermal utilities such as boilers, pumps, compressors and RAC systems
- 5. Evaluate the efficiency of electrical utilities such as electrical motors, heating and lighting systems

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2					3	3								
2	2					2	2				2				3
3	3	3				2	2				2	2			
4	3	3				2	2					3	3		3
5	3	3				2	2					3			

#### **Articulation Matrix**

#### UNIT I

#### **GENERAL ASPECTS OF ENERGY MANAGEMENT**

Current energy scenario - India and World, Current energy consumption pattern in global and Indian industry, Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Energy and environment, Need of Renewable and energy efficiency.

#### UNIT II

#### **ENERGY AUDITING**

Energy audit - need, types of energy audit, Components of energy audit, Energy audit methodology, Instruments, equipment used in energy audit, Analysis and recommendations of energy audit examples for different applications, Energy audit reporting. Energy conservation opportunities in boiler and steam system, furnace, HVAC system, pumping system, cooling tower and compressed air system.

#### 8 Hours

#### UNIT III

#### **ENERGY ECONOMICS**

Importance of energy management, Financial analysis techniques - cash flow, discount rate, simple payback period, Net present value (NPV) and cash flow, Return on Investment (ROI) and Internal Rate of Return (IRR), life cycle costing.

#### UNIT IV

#### **ENERGY EFFICIENCY IN THERMAL UTILITIES**

Energy performance assessment and efficiency improvement of boilers, furnaces, heat exchangers, fans and blowers, pumps, compressors and HVAC systems. Steam distribution, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system.

#### UNIT V

#### ENERGY EFFICIENCY IN ELECTRICAL MOTOR AND LIGHTING SYSTEM

Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit, Selection and location of capacitors, Distribution and transformer losses. Electrical motors- types, efficiency and selection. Speed control, Energy efficient motors. Electricity Act 2003. Lighting - Lamp types and their features, recommended illumination levels, lighting system energy efficiency.

#### FOR FURTHER READING

Cogeneration - need, applications, advantages, classification, the cogeneration design process. Waste heat recovery - classification and application, potential for waste-heat recovery in industry, commercial WHR devices, saving potential.

# Total: 45 Hours

#### **Reference**(s)

- 1. Albert Thumann, Terry Niehus, William J. Younger, Handbook of Energy Audit, The Fairmont Press Inc., 9th Edition, 2013.
- 2. Wayne C. Turner, Steve Doty, Energy Management Handbook, The Fairmont Press Inc., 6th Edition, 2007.
- 3. Abbi Y. A., Jain Shashank, Handbook on Energy Audit and Environment management Press, TERI, New Delhi, 2006.
- 4. Energy Performance assessment for equipment and Utility Systems.-Vol. 2, 3 & 4 Bureau of Energy Efficiency, Govt. of India.
- 5. Anthony L Kohan, Boiler Operator's Guide Fourth Edition, McGraw Hill, 4th Edition, 1997.
- 6. http://www.aipnpc.org/GuideBooks.aspx

#### **8 Hours**

# 10 Hours

#### **18ME0YL LEAN SIX SIGMA** 3003

# **Course Objectives**

- To acquire the knowledge to deliver consistently high quality and value added products and • services to the customers in a lean environment
- To introduce quality management concepts of industrial processes through Six Sigma •
- To develop the ability to define and measure the intensity of the industrial problems •
- To analyse and improve the industrial processes •
- To design and control the industrial processes •

# **Course Outcomes (COs)**

- 1. Understand technologies related lean operations and its significance in manufacturing processes.
- 2. Understand problems in a industrial process flow and generate possible solutions.
- 3. Apply management tools to measure the impact of problems in a industrial processes.
- 4. Analyse and improve the industrial processes with help of management tools.
- 5. Evaluate the design of and control the process flow in industries using management tools.

# **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2		3				2		3			1	
2			2		3				2		3			1	
3			2		3				2		3			1	
4			2		3				2		3			1	
5			2	2	3				2		3			1	

#### UNIT I

#### LEAN MANUFACTURING

History evolution - Power laws of speed - Toyota production system - Lean manufacturing overview -Pull production and Cellular manufacturing, Obstacles of lean; Over production, Waiting, Work in progress, Transportation, Inappropriate processing, Excess motion or ergonomic problems, Defective products, Under utilization of employees - Just in time manufacturing - 5S workplace maintainance.

#### UNIT II

#### SIX SIGMA

Difference between six sigma and TQM - Elements of successful deployment - Personnel requirements: Developing a training plan, Training needs analysis, Hierarchy of staffs - Process improvement: Elimination of variation, improvement of process flow and speed - Customer focus -Project selection - 5 laws of Six sigma - DMAIC problem solving.

9 Hours

#### UNIT III

#### **DEFINE AND MEASURE STAGES**

Objectives of Define - Project definition - Process definition - Team formation - Tools: SIPOC diagram, Value stream maps. Objectives of Measure - Process definition - Metric definition - Process baseline estimation - Measurement system analysis - Tools: Time value maps, Pareto charts.

#### UNIT IV

#### **ANALYSE AND IMPROVE STAGES**

Objectives of Analyse - Value stream analysis - Analysing source of variation - Determining process drivers - Tools: Cause and effect diagrams, Scatter plots. Objectives of Improve - Defining new process - Assessing benefits of proposed system - Implementation and verification - Tools: PICK charts.

#### UNIT V

#### CONTROL STAGE AND DESIGN FOR LEAN SIX SIGMA

Objectives of Control - Standardization of new methods - Measuring impact - Tools: control charts, charts for variables, charts for attributes. Design for lean six sigma: Quality Function Deployment, Failure Mode Effect Analysis, Design of Experiments.

#### **Reference**(s)

- 1. Dennis P Hobbs, Lean manufacturing implementation, J. Ross publication, 2004
- 2. Jay Arthur, Lean six sigma Demystified, Tata McGraw-Hill publication, New Delhi, 2007
- 3. Paul Keller, Six sigma Demystified, Tata McGraw-Hill publication, New Delhi, 2005
- 4. Mike George, Dave Rowlands, Bill Kastle, What is Lean Six Sigma?, Tata McGraw-Hill publication, New Delhi, 2004
- 5. Tapan P. Bagchi, Six Sigma, NPTEL Course, link : https://nptel.ac.in/courses/110105039/

#### 9 Hours

#### 9 Hours

#### 9 Hours

#### 18ME0YM HEATING VENTILATION AND AIRCONDITIONING

3003

# **Course Objectives**

- To provide knowledge on heat transfer, heating and cooling load
- To learn the different methods of ventilation and its rates.
- To study methods of air Distribution, diffusion and applications of ventilation.
- To impart knowledge on Psychometric processes and its applications.
- To provide knowledge on different components and parameters involved in designing of air conditioning systems.

# Course Outcomes (COs)

- 1. Interpret heat transfer rate, heating and cooling load
- 2. Infer the different methods of ventilation and estimate their rate ventilation.
- 3. Explain the methods of air Distribution, diffusion and demonstrate the applications of ventilation.
- 4. Resolve the psychometric problems in various applications
- 5. Analyse different components and parameters involved in design of air conditioning systems.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2		2	1	1								2
2	1	2	2		2	1	1								2
3	1	2	2		2	1	1								2
4	2	2	2		2	2	2								2
5	2	2	2		2	2	2								2

## **Articulation Matrix**

#### UNIT I

#### 9 Hours

# INTRODUCTION TO HEAT TRANSFER, HEATING AND COOLING LOAD

Heat transfer in wall and roof, sol-air temperature, insulation, cooling load temperature difference -Fenestration, types of glass, sun shade, shading coefficient, maximum radiation, cooling load factor. Cooling Load Estimation - Design conditions, outdoor, indoor - External load, wall, roof, glass -Internal load, occupancy, lighting, and equipments - Ventilation, air quantity, and loads - Load estimation methods. Heating load estimation - Vapour transfer in wall, vapour barrier, load estimation basics

#### UNIT II

#### VENTILATION

Ventilation - Need, threshold limits of contaminants, estimation of ventilation rates, decay equation, air flow around buildings. Methods of Ventilation - Natural, wind effect, stack effect, combined effect - Mechanical, forced, exhaust, combined - Displacement ventilation

#### UNIT III

#### AIR DISTRIBUTION, DIFFUSION AND VENTILATION APPLICATION

Air Distribution - Ducts, types, fittings, air flow, friction chart, methods of sizing, Balancing. Air Diffusion - Isothermal jet, throw, drop, types of outlets, ADPI, outlet/inlet selection, Ventilation System Design - Exhaust ducts, filters, blowers, hoods, chimney. Industrial Ventilation - Steel plants, car parks, plant rooms, mines.

#### UNIT IV

#### HUMAN COMFORT AND PSYCHROMETRIC PROCESS

Human Comfort - Heat transfer from body, convection, radiation, conduction, evaporation, clothing resistance, activity level - Concept of human comfort - Thermal response - comfort factors -Environmental indices - Indoor air quality. Psycrhometric - Evolution of air properties and psychrometric chart - Basic Psychrometric processes - Bypass factor and Sensible heat ratio.

#### UNIT V

#### AIR CONDITIONING

AC Equipments - Filters, types, efficiency - Fans-basic equations, parallel and series configurations -Air washer, adiabatic, heated and cooled - Cooling tower, enthalpy potential, types, tower efficiency, NTU and characteristics, sizing and off design performance - Cooling and dehumidifying coil, dry and wet, sizing, performance. Summer and Winter AC - Simple summer AC process, Room sensible heat factor, Coil sensible heat factor, ADP - Precision AC - Winter AC.

#### **Reference**(s)

- 1. Auto Heating and Air Conditioning Chris Johanson. Goodheart Willcox Company, Inc. ISBN 978-1-61960-763-7; 4th edition.
- 2. Haines, W.R. and Wilson, C.L., HVAC Systems Design Handbook, McGraw Hill, 2nd Ed., New Delhi, 1994.
- 3. Legg, R.C., Air Conditioning Systems Design, Commissioning and maintenance, Batsford Ltd, London 1991.
- 4. ASHRAE Handbook, HVAC Systems and Equipments, American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc., Atlanta, USA, 2008.
- 5. McQuiston, F.C., Parker, J.D. and Spitler, J.D. Heating, Ventilating and Air Conditioning, John Wiley & Sons Inc., 2001.
- 6. Abrams, D. W., Low Energy Cooling A guide to the practical application of passive cooling and cooling energy conservation measures, Van Nostrand Reinhold Company, New York, 1985.

#### 8 Hours

**10 Hours** 

**10 Hours** 

# **18ME0XA GEOMETRIC DIMENSIONING AND** TOLERANCING

# **Course Objectives**

- To understand the basics of GD&T and its practical applications
- To understand the proper way to specify dimensions and tolerances, symbols, datum, position, location, run out and profile

# **Course Outcomes (COs)**

- 1. Classify the standards and fundamentals of limits, fits and tolerance.
- 2. Explain the rules and symbols of dimension and tolerance in various products.

# UNIT I

# **GEOMETRIC DIMENSIONING AND TOLERANCING**

Introduction to Geometric Dimensioning and Tolerancing - Dimensioning and Tolerancing Fundamentals -Symbols, Terms, and Rules-Datum Application, Datum feature identification-Inclined, cylindrical datum feature. Form flatness, straightness, circularity, cylindricity - Position Maximum Material Condition, Least material Condition - Location - Position, Coaxiality - Concentricity Symmetry Exercises - Run out - Definition, circular run out, total run out Profile Definition, Specifying profile, radius refinement with profile of conical feature.

#### Total: 15 Hours

# **Reference(s)**

- 1. Gene R Cogorno, Geometric Dimensioning and Tolerancing Mechanical for Design, McGraw Hill, 2006
- 2. Alex Krulikowski, Fundamentals of Geometric Dimensioning and Tolerancing, Delmar Cengage Learning, 1997
- K Griffith, Geometric Dimensioning and Tolerancing: Application 3. Gary and Inspection, Prentice Hall, 2001.

#### 1001

## 18ME0XB LEAN MANUFACTURING 1001

#### **Course Objectives**

- To acquire the general knowledge to deliver consistently high quality and value added products and services to the customer in a lean environment
- To understand the terminology relating to lean operations in both service and manufacturing organizations

#### **Course Outcomes (COs)**

- 1. Summarize the quality requirements to provide products and services in lean environment
- 2. Implement technologies related lean operations and its significance in manufacturing processes

#### UNIT I

#### LEAN MANUFACTURING

History Evolution - Toyota production system - Lean manufacturing overview - Work place organization - Visual controls - Pull production and cellular manufacturing - Value flow pull - Value and perfection lean Mapping the present Mapping the future - Product and process development Value stream analysis - Over production - Waiting - Work In Progress - Transportation - Inappropriate processing - Excess motion or ergonomic problems - Defected products - Under-utilization of employees - Just In Time - Kanban tooling - Total Productive Maintenance 5S - Single Minute Die Exchange - Lean six sigma - Flow charting - Identifying and eliminating unnecessary steps - Setup time - reduction approaches - Steps in implementing lean strategy Lean accounting system.

#### **Reference**(s)

- 1. Dennis P Hobbs, Lean Manufacturing Implementation, J. Ross Publications, 2004
- 2. Jeffrey K Liker, The Toyota Way-14 Management Principles, Mc-Graw Hill, New York, 2004
- 3. Pascal Dennis, Lean Production Simplified, Productivity Press, USA, 2002
- 4. James P Womack, Daniel T. Jones, Lean Thinking: Banish waste and create wealth in your corporation, Simon & Schuster, UK Limited, Free Press, 2003
- 5. Jay Arthur, Lean Six-Sigma Demystified, Tata McGraw-Hill Company, New Delhi, 2007
- 6. Richard J Schonberger, World Class Manufacturing, Free Press, 2008

#### **15 Hours**

#### 18ME0XC PIPING ENGINEERING

# **Course Objectives**

- To impart knowledge on piping processes.
- To create expertise in Preparation of Plot Plan-Preparation of Equipment Layouts

# Course Outcomes (COs)

- 1. Construct the process diagram for piping network
- 2. Plan the process layouts and design efficient piping systems

#### UNIT I

#### **PIPING ENGINEERING**

Introduction to Piping, Process Diagrams (PFD, UFD, P&ID, Line List etc) Pipe Fittings- Pipe Flanges, Valves and Piping Special Items -Various codes and standards used in power and process industries-. Overview of Technical Queries and Technical Bid Evaluations - Preparation of Plot Plan-Preparation of Equipment Layouts-Preparation of Piping General Arrangement Drawings-Preparation of Cross Sectional Drawings-Piping Isometric Drawings-Material Take off-Preparation of Piping Material Specification-, Valve Material Specification-Pipe Wall thickness Calculations-Branch reinforcement calculations-Introduction to Stress Analysis-Types of stresses-Significance of forces and moments in piping system-Expansion Loop and Bellows-Pipe Supports-Support Types-Support Selection-Support Location-Support Span Calculation **Total: 15 Hours** 

#### **Reference**(s)

- 1. Sam Kannappan, Introduction to piping stress analysis, John Wiley & sons, 2006.
- 2. Mohinder L. Nayyar, Piping Engineering Hand book, McGraw Hill, 2000.
- 3. M. W. Kellogg Company, Design of Piping Systems John Wiley & Sons, 2006.

#### 1001

#### **18ME0XD PROBLEM SOLVING TECHNIQUES**

#### **Course Objectives**

- To understand the basic concepts of quality control method of problem solving •
- To create an awareness and understanding of quality control tools & techniques •

#### **Course Outcomes (COs)**

- 1. Explain the quality control method of problem solving techniques.
- 2. Carry out quality control measures using the quality control tools & techniques

#### **UNIT I**

#### **PROBLEM SOLVING TECHNIQUES**

Quality Control Tools and story -seven steps of story -seven quality control tools-problem definition observation - analysis - solution identification - actions and execution - checking - standardization case study -basic problem solving. **Total: 15 Hours** 

#### **Reference**(s)

1. L. Suganthi and Anand A Samuel, Total Quality Management, PHI Learning, 2009.

#### 1001

#### 18ME0XEAUTOMOTIVE EXHAUST SYSTEM1001

#### **Course Objectives**

- To understand the concepts and design of exhaust systems and catalytic converters
- To disseminate information about various types of exhaust systems and strategies relevant to Indian automotive industry
- To identify the various factors to be considered for selection of exhaust manifold system

#### **Course Outcomes (COs)**

- 1. Explain the various factors influencing the performance of exhaust systems and catalytic converters
- 2. Execute design and modeling of exhaust manifold systems
- 3. Implement the CFD tool to improve the automotive exhaust systems

#### UNIT I AUTOMOTIVE EXHAUST SYSTEM

Exhaust system - Exhaust system Function -Parts - Types - Catalytic Convertor - Types - 2 way - 3 way CATCON Mufflers - Types - Principles - Design trade off - BS IV and above norms - EGR - SCR- EGR Function - Pollution control - SCR - Function -Pollution control - CATIAV5 application for Exhaust system - Modeling - Assembly - Drafting - Basics with Exhaust manifold modeling practical session - CFD analysis - Uniformity index - Space velocity - Flow analysis - Pressure drop - CPSI optimization

#### Total: 15 Hours

**15 Hours** 

#### **Reference**(s)

- 1. Dr. Kirpal Singh, Automobile Engineering (Volume II), Standard publishers distributors.
- 2. Ronald M. Heck, Robert J. Farrauto and Suresh T. Gulati, Catalytic Air Pollution Control: Commercial Technology, Wiley, 3rd Edition, 2009.

#### 18ME0XF CONTINUOUS IMPROVEMENT 1001

#### **Course Objectives**

- To acquire the general knowledge to deliver consistently high quality and value added products and services to the customer in a Manufacturing environment
- To understand the terminology relating to continuous improvement in manufacturing organizations

#### **Course Outcomes (COs)**

- 1. Identify the continuous improvement metrics
- 2. Understand and appreciate various tools applied and methodology adopted to run a KAIZEN event

#### UNIT I

#### **CONTINUOUS IMPROVEMENT**

History -Evolution - Toyota production system - Lean Manufacturing - Fundamentals, Importance, Definitions, Phases, Lead time - Supplier - Manufacturer - Customer Chain, Work place organization -Visual controls - Pull production and cellular manufacturing -Waste identification - Over production -Waiting - Work In Progress - Transportation - Inappropriate processing - Excess motion or ergonomic problems - Defected products - Under utilization of employees - Organizations Vision, Mission, Strategy Deployment and Key performance Indicators. Importance of Measurement. Gap Analysis, Identification of KAIZEN projects. Methodology, team formation, Problem statement, Data collection, Brainstorming, Analysis, containment action, corrective action and preventive action. Overview of performance metrics visual control.

#### Total: 15 Hours

**15 Hours** 

#### **Reference**(s)

- 1. Dennis P Hobbs, Lean Manufacturing Implementation, J. Ross Publications, 2004
- 2. Jeffrey K Liker, The Toyota Way-14 Management Principles, Mc-Graw Hill, New York, 2004
- 3. Pascal Dennis, Lean Production Simplified, Productivity Press, USA, 2002
- 4. James P Womack, Daniel T. Jones, Lean Thinking: Banish waste and create wealth in your corporation, Simon & Schuster UK Limited, Free Press, 2003
- 5. Jay Arthur, Lean Six-Sigma Demystified, Tata McGraw-Hill Company, New Delhi, 2007
- 6. Richard J Schonberger, World Class Manufacturing, Free Press, 2008.

1001

# 18ME0XG INDIAN PATENT LAW

# **Course Objectives**

- To make students familiar about Indian patent law
- To make the students find the patentability of any invention
- To make the students aware of legal background of various process of Indian Patent

# **Course Outcomes (COs)**

- 1. Summarize the various provisions of Indian Patent Law
- 2. Find patentability of any invention
- 3. Assess the legal provisions of Indian patent system

## UNIT I

**Reference**(s)

# INDIAN PATENT LAW

Preliminary, Inventions Not Patentable, Applications for Patents, Publication and Examination of Applications, Opposition Proceedings to Grant of Patents, Anticipation, Provisions for Secrecy of Certain Inventions, Grant of Patents and Rights Conferred Thereby, Patents of Addition, Restoration of Lapsed Patents, Surrender and Revocation of Patents, Register of Patents, Patent Office and Its Establishment, Powers of Controller Generally, Working of Patents, Compulsory Licenses and evocation, Central Government, Suits Concerning Infringement of Patents, Appeals to the Appellate Board, Penalties, Patent Agents, International Arrangements

#### Total: 15 Hours

- 1. Indian Patent Act ,1970
- 2. Indian Patent Rules, 2003
- 3. www.ipindia.nic.in

### 18ME0XH RAILWAY TRACK TECHNOLOGY 1001

#### **Course Objectives**

- To familiar about Indian Railway and types
- To understand the Railway track and its types.

#### **Course Outcomes (COs)**

- 1. Summarize Indian Railway system and types of rails
- 2. Explain Railway track system

#### UNIT I

## **RAILWAY TRACK TECHNOLOGY**

Indian Railway overview, Evolution, Structure, Grades, Coning of Wheels and Caning of Rails, Types of Rails, Rail Material, Rail Joints, Sleepers, Rail and Sleeper Fastening, Railway Curves, Track Maintenance, Modern Track Construction, Track Inspection, High Speed Tracks and Special Tracks, Derailment Investigations. Total: 15 Hours

#### **Reference**(s)

1. Railway Track Engineering, Fourth Edition, by J.S. Mundrey, McGraw Hill Education (India) Private Limited, 2009.

## **18ME0XI GLASS ENGINEERING**

#### **Course Objectives**

- To understand the basics of Glass making and various types in real world practice •
- To understand the applications of commercial and special purpose glasses for various • engineering applications

#### **Course Outcomes (COs)**

- 1. Classify glasses and select suitable glass for suitable engineering application.
- 2. Explain the glass making and treatment processes in a glass Industry.

#### UNIT I

#### **GLASS ENGINEERING**

Introduction, History of Glass, Raw Materials & Manufacturing Process, Glass Properties, Care and Storage, Glass Processing, Types of glass based on application, Float Glass, Processed Glasses -(Laminated Safety Glass, Heat Treated Glass, Curved Toughened Glass, Insulated Glass), Reflective & Coated Glass, Special Purpose Glasses for fire resistance, bullet proof & sound proof requirements, Decorative Glass, Standards and Testing, Fields of application - applied engineering - facades selection of glass for facades.

## **Reference**(s)

- 1. Glass Engineering Handbook, by Errol Bertram Shand (Author), W. H. Armistead (Foreword), Literary Licensing, LLC (May 19, 2012)
- 2. Introduction to Glass Science and Technology, Royal Society of Chemistry, James E Shelby, 12 Jan 2005

#### 1001

#### **15 Hours**

#### 18ME0XJ PLASTICS - DESIGN, PROCESSING, TOOLING, ASSEMBLY AND TESTING

1001

**15 Hours** 

#### **Course Objectives**

- To know the various plastic materials used in Automotive, home appliance, Medical fields
- To Understand the basic and advanced methods of plastic processing and the tooling & equipments used for it.
- To learn various post processing requirements such as painting, foiling, pad printing.
- To learn the various plastic joining processes and plastic testing methods.

#### **Course Outcomes (COs)**

- 1. Classify the plastic material and its applications
- 2. Explain the plastic processing methods & machine, tooling used for it
- 3. Indicate the post processing requirements and its significance
- 4. Assess the plastic joining processes characteristics

#### UNIT I

#### PLASTICS - DESIGN, PROCESSING, TOOLING, ASSEMBLY AND TESTING

Introduction on Plastics, Types of plastics - Thermo plastics, Thermo setting plastics, Applications in Automobiles, Home appliances etc., Basic concepts on plastic design, Mould flow analysis Plastic processing- Preheating, Molding, Molding types - Injection molding, compression molding, Roto molding, 2K molding, Tooling- Core, Cavity, Inserts, heating & cooling circuits, Tool materials, Molding machines - Types, Tonnage & other specifications. Molding defects -Warpage, Catching, Weld line, burning, Sink marks etc, Method of avoiding defects Post molding process- Annealing, Texturing, color foiling, Pad printing, Painting etc., Assembly of Plastics- Ultrasonic welding, Heat sinking, Vibration welding. Testing of Plastics-UV testing, scratch resistance, Flammability, Resistance against chemicals, impact test.

#### **Reference**(s)

- 1. Hand book of Plastic Technologies Charles A Harper
- 2. Plastic Engineering R.J Crawford
- 3. Plastic Materials and Processes-A Concise Encyclopedia Charles A. Harper & Edward M. Petrie

#### 18ME0XK 5S - INTRODUCTION AND IMPLEMENTATION

 $1 \ 0 \ 0 \ 1$ 

#### **Course Objectives**

- To impart the knowledge on 5S fundamental and implementation concepts
- To provide the 5S training for implementation in engineering fields

#### **Course Outcomes (COs)**

- 1. Demonstrate various steps of 5S implementation principles
- 2. Practice 5S in real time life and engineering fields

#### UNIT I

**5**S

Need for implementing 5S and advantages-Explanation on 5S- methodology -zone formation, individual responsibility, hidden and common area and no man- land-Introduction to SEIRI-Tagging system, Disposal Policy, SEIRI Museum - 1S Practical - Introduction to SEITON -PEEP, Points for Storage, Safety, Quantity Identification - 2S Practical - Introduction to SEISO-Cleaning methods, Schedules, Accessories, Responsibilities - 3S Practical, Introduction to SEIKETSU - Evolving Standard Practices, Visual Controls - 4S Practical- Introduction to SHITSUKE- Self audit, Check lists. Evaluation - 5S Practical, Management audit, Jagruthi groups, Motivation, Awards, manuals.

Practice: Form students group, assign areas and do 5S practice.

Total: 15 Hours

## **18ME0XL ENERGY AUDITING AND INSTRUMENTS**

#### 1001

#### **Course Objectives**

- To acquire knowledge about various thermal and electrical energy audit instruments used in the field as per Bureau of Energy Efficiency, Govt. of India
- To gain the skill in using the Energy Audit Instruments for field measurements

#### **Course Outcomes (COs)**

- 1. Apply the measurement skill of energy related parameters in industrial environment
- 2. Interpret the measurements for its accuracy and genuineness
- 3. Express the analytical skill in quantification of energy flow in and out of an energy system

#### UNIT I

Introduction to Energy Conservation Act 2001, Basics of Energy Audit, Instruments : Clip on power meter, Infrared Thermometer, Vane Anemometer, Pitot tube with digital pressure meter, Stroboscope, Hygrometer, Combustion efficiency Monitor, Light Meter, Specifications, Limitations, applications and measurement calculations for Pressure, flow (Air and Water), power consumption, waste heat recovery calculations.

#### **Total: 15 Hours**

**15 Hours** 

#### **Reference**(s)

- 1. Energy Audit Manual published by Energy Management Centre, Govt of Kerala, Kerala Manual-2017.
- 2. CO<sub>2</sub> Emission Mitigation through Energy Conservation- A Practical Guide. by Dr. M. Thirugnanasambandam, Published by Shanlax Publishers- 2018.

#### 18ME0XM INDUSTRIAL CONTROL VALVES

#### **Course Objectives**

- To understand the basics of control valves and its applications
- To understand the global market outlook, competition, growth in industries and job opportunities in a global scale

#### **Course Outcomes (COs)**

- 1. Explain the basics of control valves, manufacturers, global presence and market outlook.
- 2. Interpret the control valves application in industries like power plant and compressors.

#### INTRODUCTION TO CONTROL VALVES

Introduction - Principle of control valves – Classification of control valves - Application of control valves – Advantages and disadvantages of control valve in power plant and compressor industries - The makers in global scale - Indigenized control valves makers in India - Market overlook and trends - Job opportunities.

#### **18ME0XN INDUSTRIAL GEARBOX DESIGN**

#### **Course Objectives**

1001

- To provide knowledge of industrial gear design and safety of gear safety
- To understand the lubrication systems and heat treatment of gears
- To impart the knowledge on gear life calculation for planetary gear

#### **Course Outcomes (COs)**

- 1. Identify the loads on gear tooth and gear safety.
- 2. Select suitable lubrication system and heat treatment process.
- 3. Design the planetary gear box for industrial application.

#### UNIT 1

#### INDUSTRIAL GEARBOX DESIGN

Gears-Introduction, type of gear drives, tooth profile, loads on gear tooth and safety, bearing and seal selection, lubrication system, material, heat treatment and gear engineering drawing format. Planetary gearbox-Introduction, different planetary gear arrangement, planet bearing load and life calculation, gearbox installation, maintenance, Practical applications.

#### Total: 15 Hours

#### **Reference Books:**

- 1. Dudley's Gear Handbook, The design, manufacture, and Application of Gears by Dennis P. Townsend, Tata Mcgraw Hill edition.
- 2. Gustav Niemann Machine elements, Design and Calculation in Mechanical Engineering, Volume-II-Gears-Translated by K. Lakshminarayanan, M.A. Parameswaran and G.V.V. Rayudu.
- 3. Handbook of Gear Design, by Gitin M Maitra section edition, Tata McGraw Hil

#### 18GE0XA ETYMOLOGY

#### 1001

#### **Course Objectives**

- To increase vocabulary and enhance use, knowledge, and understanding of the English language.
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic.
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication.

#### **Course Outcomes (COs)**

- 1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
- 2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

#### **Articulation Matrix**

CO No	<b>PO1</b>	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										2					
2										2					

#### UNIT I

#### CONVENTIONS

Acronyms, Abbreviations, Initialises, Jargon Neologisms - Idiomatic Expressions, Euphemisms Spoonerisms Malapropisms; Mondegreens - Words Derived from Latin - Words Derived from Greek -Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Apheresis - Blend word Assimilation - Colloquial language Clipped word.

#### UNIT II

#### WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism -Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics -Loan words Metathesis; Modify - Philology Onomatopoeia - Romance language Prefix - Semantics -Root-base word - Suffix Slang - Word component Synonym.

#### **Total: 15 Hours**

#### 8 Hours
- 1. Norman, Lewis. Word Power Made Easy, Goyal Publisher. Edition 2. 2014.
- 2. C T Onions. The Oxford Dictionary of English Etymology, Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont, Oxford University Press.1965.
- 3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library. 1961.

#### 18GE0XB GENERAL PSYCHOLOGY 1001

#### **Course Objectives**

- To provide a basic understanding of psychology.
- Defining Psychology and the subject matter of psychology.
- To provide an awareness of various methods and branches of psychology.
- To explain social and work psychology of people and the need for mental health.

#### **Course Outcomes (COs)**

- 1. Apply the basics of human behavior in the workplace and society at large.
- 2. Apply the different fields of psychology and its uses.
- 3. Deal people effectively in their personal and social life.

#### **Articulation Matrix**

CO No	<b>PO1</b>	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1								2	1						
2								2	2						
3								2	3						

#### UNIT I

#### **GENERAL PSYCOLOGY**

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology -Motivation-Types of needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ- measurement - Social psychology: individual behavior and group behavior - Group dynamics- group formation- social influence-social cognition, stereotypes- prejudice- discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude.

#### Total: 15 Hours

**15 Hours** 

- 1. Atkinson & Atkinson, Introduction to Psychology, 6th Ed., McGraw-Hill Publications. 1975
- 2. Mishra, B. K, Psychology: The study of human behavior, 2nd Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016.
- 3. Baron, R.A., Branscombe. N.R, Social Psychology, 14th Ed., New Delhi; Pearson Education. 2016
- 4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7th Ed., New Delhi: Tata McGraw Hill, 1993.

#### 18GE0XC NEURO BEHAVIORAL SCIENCE 1001

#### **Course Objectives**

- To provide an introduction to the Cognitive Neuro Science of languages.
- To provide an understanding of the Cognitive processes.

#### **Course Outcomes (COs)**

- 1. Identify the psychological problems that will impact mental health.
- 2. Value ethical conduct in professional and personal life.
- 3. Recognize the need for rationale and evidence in decision-making.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									1						
2									2						
3									3						

#### UNIT I

#### **NEURO BEHAVIOURAL SCIENCE**

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science Behaviour and Hormones, Behaviour Modifications - Relaxation Therapy - Psycho Education for minds.

#### **Total: 15 Hours**

**15 Hours** 

- 1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
- 2. Horon C Philip. Sexology and Mind. Academic Press. 1993
- Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996.

#### 18GE0XD VISUAL MEDIA AND FILM MAKING 1001

#### **Course Objectives**

- To acquire fundamental knowledge on development of filmmaking as an art
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

#### **Course Outcomes (COs)**

- 1. Interpret the significance and techniques of visual medium
- 2. Analyse and produce visual clippings

#### **Articulation Matrix**

CO No	<b>PO1</b>	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						2	2								
2						2	2								

#### UNIT I

#### **15 Hours**

#### ART OF FILMMAKING

History of Cinema (Origin and Narrative) Cinema as a visual medium -Significance of Editing Styles of Editing Editing as a methodology (Hollywood s Invisible Editing) Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) Different types of shots and angles - Film style and Narrative (Italian Neo-realism, Avant Garde, Russain Formalism,AlternativeCinema etc.,) Regional Cinema to National Cinema Basics of Script Writing (Double and Single Column) Basics of Video Production (script to screen) Final submission of a script for five minutes short film.

#### **Total: 15 Hours**

- 1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
- 2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

#### 18GE0XE YOGA FOR HUMAN EXCELLENCE 1001

#### **Course Objectives**

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individual consciousness
- To apply the knowledge by the way of practice and introspection

#### **Course Outcomes (COs)**

- 1. Analyze the historical aspects and schools of yoga
- 2. Ensure their physical & mental wellness through yoga practice
- 3. Develop the power to concentrate and have stress free mind

#### **Articulation Matrix**

CO No	<b>PO1</b>	<b>PO2</b>	PO3	<b>PO4</b>	PO5	PO6	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1								2	2						
2								2	2						
3								2	2						

#### UNIT I

#### YOGA FOR HUMAN EXCELLENCE

What is Yoga, History of Yoga - Yoga in today's scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas - Mudras Relaxation - Pranayama - Meditation

#### **Total: 15 Hours**

**15 Hours** 

- 1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
- 2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
- 3. Ramesh Partani, The Complete Secret, Ru Education, 2013.
- 4. http://www.sarvyoga.com/
- 5. http://www.wikihow.com/Do-Superbrain-Yoga.

#### 18GE0XF VEDIC MATHEMATICS 1001

#### **Course Objectives**

• To improve their calculation speed, analytical thinking and numerical skills

#### **Programme Outcomes (POs)**

- PO1. Apply the knowledge of mathematics, science, electronic fundamentals, and communication specialization to provide solution for complex engineering problems.
- PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using principles of electronic devices and circuits.

#### **Course Outcomes (COs)**

1. Solve problems creatively in mathematics and its applications

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3													

#### UNIT I

#### VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

#### **Total: 15 Hours**

**15 Hours** 

- 1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
- 2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997

#### 18GE0XG HEALTH AND FITNESS 1001

#### **Course Objectives**

• To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness

#### **Course Outcomes (COs)**

- 1. Acquire the knowledge and training of the individual physical, mental and social concepts
- 2. Understand the fundamental concepts of yogic practice and physical fitness
- 3. To acquire the knowledge about nutrition and health consciousness.

### Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	<b>PO8</b>	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1							1		2						
2				1		2			2						
3				1		2			2						

#### UNIT I

#### FITNESS

Meaning & definition, need & importance of Physical fitness, Types Physical fitness - Exercise, Training and Conditioning and it is important

#### UNIT II

#### YOGA AND MEDITATION

Meaning and definition; Principles of practicing; Basic Asana and it important; Pranayama and Meditation - Relaxation Techniques

#### UNIT III

#### NUTRITION AND BALANCE DIET

Nutrition and Balance Diet: Needs and Important, Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases - cause prevention-First aid for common sports injuries.

#### **5 Hours**

**5** Hours

#### **Total: 15 Hours**

- 1. Anderson, Bob., Pearl, Bill., Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men & Women. Mumbai: Jaico Publishing House
- 2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics
- 3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers
- 4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications
- 5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited

## 18GE0XH CONCEPT, METHODOLOGY AND<br/>APPLICATIONS OF VERMICOMPOSTING1001

#### **Course Objectives**

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact procedures of biodegradation of unwanted solid residues

#### **Course Outcomes (COs)**

- 1. Understand the role of recycling of garbage leading to the sustenance of our health and environment.
- 2. Recognize the organic farming practices and production of healthy food products.
- 3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						2									
2						2									
3						2									

#### **Articulation Matrix**

#### UNIT I

#### VERMICOMPOSTING TECHNOLOGY

Ecological roles and economic importance of earthworms - need for earthworm culture, scope and importance of vermiculture, limiting factors - types of worm culturing and the relative benefits Small scale and commercial methods: process & advantages, Vermicomposting equipments, devices, Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle), vermicastings in organic farming/horticulture - Marketing the products of vermiculture quality control, market research, marketing techniques, Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Artificial Earthworm as a standalone biodegradation assembly.

#### **Total: 15 Hours**

- 1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
- 2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
- 3. www.organicgrowingwithworms.com.au
- 4. New York Times, Scientists Hope to Cultivate and Immune System for Crops

#### 18GE0XI BLOG WRITING 1001

#### **Course Objectives**

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a web designer.

#### **Course Outcomes (COs)**

- 1. Understand the flow of language in natural manner.
- 2. Understand the elements of a blog and be able to use them effectively.
- 3. Find a niche for a long-term blog.
- 4. Gain insight into the strategies, methods and writing of successful bloggers.
- 5. Develop their creative thinking.

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	<b>PO8</b>	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										1					
2										1					
3						2									
4							2								
5							2								

#### UNIT I

Concept: What is blog writing - Types of blog posts -personal experience, opinion, reviews, advice, news/updates. Focusing your blog - concept, audience, uniqueness, posts. Company blogs. Structure: Types of structure - inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

#### UNIT II

Voice: Defining and achieving voice. Exploring various voices. Stylistic tips rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. Reliability - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

#### **Total: 15 Hours**

#### **Reference**(s)

- 1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Lecce's and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9.
- 2. Blogging Heroes, by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
- 3. Complete Guide to Blogging, Huffington Post.

#### 8 Hours

#### 18GE0XJ INTERPERSONAL SKILLS

#### 1001

#### **Course Objectives**

- To communicate and work effectively, both individually and in groups
- To be able to understand and manage ones own and others emotions
- To define and solve problems by making decisions about the best course of action

#### **Course Outcomes (COs)**

- 1. Express themselves clearly and confidently
- 2. Listen to others completely and with empathy
- 3. Assert an opinion without diminishing others opinion
- 4. Be responsible and timely with a willingness to collaborate
- 5. Develop innate personality traits to handle certain social situations

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1							2		2						
2							2		2						
3							2		2						
4							2		2						
5							2		2						

#### UNIT I

#### INTRODUCTION

Conversational Skills - Active Listening - Team working Empathy - Emotional Intelligence

#### UNIT II

#### **8 Hours**

**Total: 15 Hours** 

7 Hours

SKILLS

Conflict Resolution and Mediation skills - Decision making and Problem Solving - Negotiation and Persuasion skills

- 1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015
- 2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006
- 3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organisations, McGraw-Hill Education; 5th Edition, 2014.

#### 18GE0XK COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

1001

#### **Course Objectives**

- Understand the role of National Service Scheme in community
- Identify the needs and problems of the community and involve in problem solving
- Develop competence required for group living and acquire leadership qualities

#### **Course Outcomes (COs)**

- 1. Understand the community in which they work and render their service
- 2. Develop among themselves a sense of social and civic responsibility

#### **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1							2		2						
2							2		2						

#### UNIT I

#### 15 Hours

#### COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structure - roles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, Day Camps-Basis of adoption of village/slums-Methodology of conducting Survey -Financial pattern of the scheme -Coordination with different agencies-Maintenance of the Diary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth-adult partnership. Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise -Role of financial and support service Institutions.

**Total: 15 Hours** 

- 1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
- 2. http://nss.nic.in/intro.asp
- 3. Delgado-Gaitn and Concha, The Power of Community: Mobilizing for Family and Schooling New York: Rowman & Littlefield Publishing, Inc. 2001
- 4. James Bailey, Guide to Hygiene and Sanitation in Aviation, World health organization, 2nd edition, 1980.
- 5. Anuradha Basu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009.

#### **18GE0XL NATIONAL CADET CORPS**

#### 1001

#### **Course Objectives**

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity
- To identify the utility of smart materials in engineering applications.

#### **Course Outcomes (COs)**

- 1. Recall the motto and aim of NCC.
- 2. Implement synergy in disaster management.
- 3. Execute an example patriotic leader to serve nation

# CO No PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS02 PS03 1 2 2 -

#### **Articulation Matrix**

#### UNIT I

#### NCC STRUCTURE AND TRAINING

#### **10 Hours**

NCC ORGANIZATION: National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets. DRILL AND WEAPON TRAINING: Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22 and INSAS - Stripping, Assembling and Cleaning of weapons. NATIONAL INTEGRATION AND SOCIAL AWARENESS National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGOs role and Contribution - Social Security schemes.

#### UNIT II

#### PERSONALITY DEVELOPMENT AND LEADERSHIP

PERSONALITY DEVELOPMENT AND LEADERSHIP : Personality Development: Introduction -Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader. DISASTER MANAGEMENT AND FIRST AID Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipments - First aid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

#### **Total: 15 Hours**

**5 Hours** 

- 1. Cadets Hand book Common subject, DG NCC, New Delhi.
- 2. Cadets Hand book Special subject, DG NCC, New Delhi
- 3. Misra R.C and Sanjaykumar Mishra, A HAND BOOK OF NCC(English), Kanti Prakashan, 2016
- 4. Gupta R. K, NCC: Handbook of NCC Cadets for A, B and C Certificate Examinations (English) RPH Editorial Board, 2018.

#### 18GE0XM NEW AGE INNOVATION AND ENTREPRENEURSHIP

1001

#### **Course Objectives**

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

#### **Course Outcomes (COs)**

- 1. Understanding entrepreneurship as an important career option
- 2. Concept and methodology of idea translation to viable start-ups
- 3. Events to occur in the building of a technology based venture for students or working professionals or women
- 4. Overview of Indian trends in the start-up scene

#### **Articulation Matrix**

CO No	<b>PO1</b>	<b>PO2</b>	PO3	PO4	PO5	PO6	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		1				2			2						
2			1			2			2						
3		1				2			2						
4			1			2			2						

#### UNIT I

#### NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification ideation -MVP Positioning as an Entrepreneur Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business Plan Mentoring Session with Investors- Legal and Ethical Foundation for startup. Types of startups and licensing systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for NewVenture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship - Intrapreneurship Sustainability - Exit strategies and Start-up trends in India.

#### **Total: 15 Hours**

**15 Hours** 

- 1. Kathleen R. Allen, Launching New Ventures, South-Western Cengage Learning, 6th Edition, 2012
- 2. Alex Osterwalder and Yves Pigneur, Business Model Generation, published by the authors, 2010
- 3. Branson. R. Business stripped bare, New York, Penguin books, 2011
- 4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3d Edition, Mason, Oh; Cengage/South Western publisher, 2011

#### 18GE0XN DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES 1001

#### **Course Objectives**

- To make the participants understand as to how to get along with the task disruption led innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity based disruption strategy

#### **Course Outcomes (COs)**

- 1. Understanding contemporary entrepreneurship as an important career option
- 2. Concept and methodology of creative disruption to viable start-ups
- 3. Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
- 4. Overview of Indian trends with reference to disruptive innovation based start-ups.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	<b>PO10</b>	PO11	PO12	PSO1	PSO2	PSO3
1							2	2							
2							2	2							
3							2	2							
4							2	2							

#### **Articulation Matrix**

#### UNIT I

#### DISRUPTIVE INNOVATION

Creativity linked innovation - Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market - Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company's capabilities and rethinking product, market and strategy - Right customers for DI: strategy in a world that is changing so rapidly - Application of disruptive theories to complex problems and opportunities.

#### **Total: 15 Hours**

- 1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x
- 2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation
- 3. https://hbr.org/2006/12/disruptive-innovation-for-social-change

#### 18GE0XO SOCIAL PSYCHOLOGY 1001

#### **Course Objectives**

- To provide a basic understanding of social psychology.
- Defining psychological & physical changes during puberty age.
- To provide an awareness of various psychological problems and social problems.
- To explain social and work psychology of people and the need for mental health.

#### **Course Outcomes (COs)**

- 1. Understand the basics of human behavior in the workplace and society at large
- 2. Understand the various psychological, physical, social problems and management skills.
- 3. Deal people effectively in their personal and social life.

#### **Articulation Matrix**

CO No	<b>PO1</b>	PO2	PO3	<b>PO4</b>	PO5	PO6	<b>PO7</b>	<b>PO8</b>	PO9	<b>PO10</b>	PO11	<b>PO12</b>	PSO1	PSO2	PSO3
1						2	2		1						
2						1	2		1						
3						2	2		3						

#### UNIT I

#### INTRODUCTION

Introduction - Ice breaker - Time Line - Tasks and Challenges of the age(Erik Erikson)Physical changes - Introduction to Reproductive Health - Reproductive Organs - Menstruation - Changes during Puberty - Abortions - Contraception - Difference between Sex and Gender - Introduction to the origins of Patriarchy - Gender.

#### UNIT II

#### **PSYCHOLOGY**

Developmental changes - Attraction - Friendship - Differences and Similarities - Images of Beauty and Body Image -Introduction to Media-Feedback - Sexuality - Boundaries Relationships - Marriage -Love - Emotional Health - Sexual Abuse and Safety - Role of Media - Abortions, Contraception, Wrapping up the Course.

#### **Total: 15 Hours**

#### **Reference**(s)

- 1. Baron, R. A., Branscombe. N.R.(2016), Social Psychology, 14th Ed. New Delhi; Pearson Education
- 2. Morgan C.T., King, R.A., Weisz, J.R, & Schopler, J., (1993), Introduction to Psychology, 7th Ed., New Dehi, Tata McGraw Hill.

#### 7 Hours