

B.E. (Mechatronics)

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)

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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 / Seminar / Project Work / etc.)	1

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 VII 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, but will not be considered for computing the Cumulative Grade Point Average (CGPA). However, if a student wishes to avail the exemption from any one of the Electives (other than open elective) of the Semester VIII, he / she can do so by exercising his / her option in writing to the respective Head of the Department during the beginning of the VIII Semester, following the equivalence norm, that one **regular elective** (in the **VIII Semester**) is equivalent to **three one-credit courses** completed by the student during the previous semesters, IV to VII. Details of the one credit courses offered by the department shall be forwarded to the Office of the Controller of Examinations. However one credit courses completed during I to III semesters shall be maintained in the Grade sheet as “Additional credits earned” (not considered for the computation of SGPA/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 enrollment 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:

Branch of Study	Minimum Credits	
	Regular Admission	Lateral 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	I
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:

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

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

[#] Reports / Record Note / Integrated Lab Manual to be retained for 1 year for Academic Audit, by respective Department

VIII	INDUSTRIAL TRAINING/ INTERNSHIP (CONTINUOUS ASSESSMENT ONLY)	Marks
	Assessment by Industry	30
	Viva-voce	20
	Presentation	30
	Case Study / Report	20
	Total Marks	100
IX	SOFT SKILLS (CONTINUOUS ASSESSMENT ONLY)	Marks
	Test I	25
	Test II	25
	Final Examination	50
	Total Marks	100
	Grades (Excellent / Good / Satisfactory)	
X	VALUE ADDED / CERTIFICATE COURSES (CONTINUOUS ASSESSMENT ONLY)	Marks
	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:	
	<i>Exercise (Minimum 10 Exercises/Modelling)</i>	60
	<i>Model Examination</i>	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.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- I. Graduates possess adequate knowledge on mechanical, electronics and electrical engineering to solve problems pertaining to mechatronics
- II. Graduates are capable of integrating and using systems or devices incorporating information technologies and modern engineering tools for product design, development and manufacturing
- III. Graduates aspire for higher studies and can reveal professional interaction and work effectively on multi-disciplinary teams along with professional and ethical responsibility

PROGRAM OUTCOMES

Engineering Graduates will be able to:

- 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.

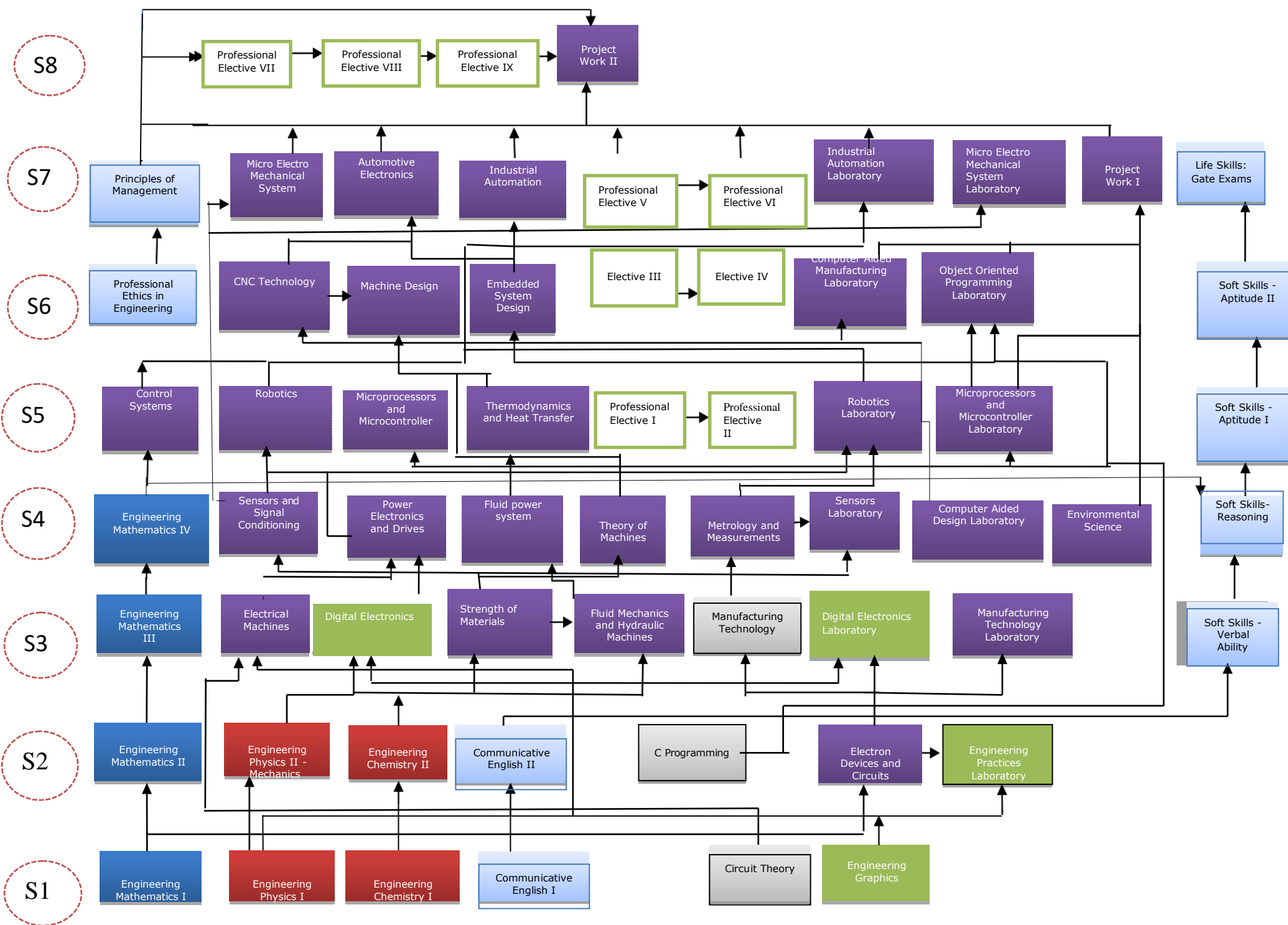
- k. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OBJECTIVE (PSO)

- Analyze, design and develop electro mechanical system using contemporary tools
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

MAPPING OF PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2
PEO1	X	X											X	X
PEO2			X	X	X		X						X	X
PEO3						X		X	X	X	X	X		X



DEPARTMENT OF MECHATRONICS										
Minimum Credits to be Earned : 170										
I SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18MC101	ENGINEERING MATHEMATICS I	3	1	0	4	4	50	50	100	BS
18MC102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18MC103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18MC104	CIRCUIT THEORY	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
18MC106	ENGINEERING GRAPHICS	1	0	4	3	5	100	0	100	ES
Total		11	1	12	18	24	400	200	600	
II SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18MC201	ENGINEERING MATHEMATICS II	3	1	0	4	4	50	50	100	BS
18MC202	ENGINEERING PHYSICS II - MECHANICS	3	1	0	4	4	50	50	100	ES
18MC203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18MC204	C PROGRAMMING	2	0	2	3	4	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
18MC206	ELECTRON DEVICES AND CIRCUITS	2	0	2	3	4	50	50	100	ES
18MC207	ENGINEERING PRACTICE LABORATORY	0	0	2	1	2	100	0	100	ES
Total		13	2	10	20	25	450	250	700	

III SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18MC301	ENGINEERING MATHEMATICS III	3	1	0	4	4	50	50	100	BS
18MC302	ELECTRICAL MACHINES	3	0	2	4	5	50	50	100	ES
18MC303	DIGITAL ELECTRONICS	3	0	0	3	3	50	50	100	PC
18MC304	STRENGTH OF MATERIALS	3	1	0	4	4	50	50	100	ES
18MC305	FLUID MECHANICS AND HYDRAULIC MACHINES	2	0	2	3	4	50	50	100	ES
18MC306	MANUFACTURING TECHNOLOGY	3	0	0	3	3	50	50	100	PC
18MC307	DIGITAL ELECTRONICS LABORATORY	0	0	2	1	2	100	0	100	PC
18MC308	MANUFACTURING TECHNOLOGY LABORATORY	0	0	2	1	2	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
Total		17	2	10	23	29	600	300	900	
IV SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18MC401	ENGINEERING MATHEMATICS IV	3	1	0	4	4	50	50	100	BS
18MC402	SENSORS AND SIGNAL CONDITIONING	3	0	0	3	3	50	50	100	PC
18MC403	POWER ELECTRONICS AND DRIVES	3	0	2	4	5	50	50	100	PC
18MC404	FLUID POWER SYSTEM	2	0	2	3	4	50	50	100	PC
18MC405	THEORY OF MACHINES	3	1	0	4	4	50	50	100	PC
18MC406	METROLOGY AND MEASUREMENTS	3	0	0	3	3	50	50	100	PC
18MC407	SENSORS LABORATORY	0	0	2	1	2	100	0	100	PC
18MC408	COMPUTER AIDED DESIGN LABORATORY	0	0	4	2	4	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
18GE401	SOFT SKILLS – BUISNESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		19	2	12	24	33	700	300	1000	

V SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18MC501	CONTROL SYSTEMS	3	1	0	4	4	50	50	100	PC
18MC502	ROBOTICS	3	0	0	3	3	50	50	100	PC
18MC503	MICROPROCESSORS AND MICROCONTROLLER	3	0	0	3	3	50	50	100	PC
18MC504	THERMODYNAMICS AND HEAT TRANSFER	3	1	0	4	4	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	50	50	100	PE
18MC507	ROBOTICS LABORATORY	0	0	4	2	4	100	0	100	PC
18MC508	MICROPROCESSORS AND MICROCONTROLLER LABORATORY	0	0	2	1	2	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		18	2	8	23	28	600	300	900	-
VI SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18HS002	PROFESSIONAL ETHICS IN ENGINEERING	2	0	0	2	2	50	50	100	HSS
18MC602	CNC TECHNOLOGY	3	0	0	3	3	50	50	100	PC
18MC603	MACHINE DESIGN	3	1	0	4	4	50	50	100	PC
18MC604	EMBEDDED SYSTEM DESIGN	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	50	50	100	PE
18MC607	COMPUTER AIDED MANUFACTURING LABORATORY	0	0	2	1	2	100	0	100	PC
18MC608	OBJECT ORIENTED PROGRAMMING LABORATORY	0	0	4	2	4	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		17	1	10	22	28	600	300	900	

VII SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18HS003	PRINCIPLES OF MANAGEMENT	2	0	0	2	2	50	50	100	HSS
18MC702	MICRO ELECTRO MECHANICAL SYSTEM	3	0	0	3	3	50	50	100	PC
18MC703	AUTOMOTIVE ELECTRONICS	3	0	0	3	3	50	50	100	PC
18MC704	INDUSTRIAL AUTOMATION	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	50	50	100	PE
18MC707	INDUSTRIAL AUTOMATION LABORATORY	0	0	2	1	2	100	0	100	PC
18MC708	MICRO ELECTRO MECHANICAL SYSTEM LABORATORY	0	0	2	1	2	100	0	100	PC
18MC709	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total		17	0	10	22	27	550	350	900	
VIII SEMESTER										
Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	50	50	100	PE
18MC804	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total		9	0	18	18	27	200	200	400	

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	Course	L	T	P	C	Hours/Week	Maximum Marks			Category
							CA	ES	Total	
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
PHYSICS ELECTIVES										
18GE0P1	NANOMATERIALS SCIENCE	3	0	0	3	3	50	50	100	BS
18GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	50	50	100	BS
18GE0P3	APPLIED LASER SCIENCE	3	0	0	3	3	50	50	100	BS
CHEMISTRY ELECTIVES										
18GE0C1	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	50	50	100	BS
18GE0C2	ENERGY STORING DEVICES	3	0	0	3	3	50	50	100	BS
18GE0C3	POLYMER SCIENCE	3	0	0	3	3	50	50	100	BS
MATHEMATICS ELECTIVES										
18GE0M1	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	50	50	100	BS
18GE0M2	ALGEBRA AND NUMBER THEORY	3	0	0	3	3	50	50	100	BS
18GE0M3	MATHEMATICAL FINANCE AND QUEUEING THEORY	3	0	0	3	3	50	50	100	BS
ENTREPRENEURSHIP 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

DISCIPLINE ELECTIVES										
18MC001	ENGINEERING MATERIALS AND METALLURGY	3	0	0	3	3	50	50	100	PE
18MC002	INDUSTRIAL ENGINEERING	3	0	0	3	3	50	50	100	PE
18MC003	FINITE ELEMENT ANALYSIS	3	0	0	3	3	50	50	100	PE
18MC004	DESIGN OF JIGS AND FIXTURES	3	0	0	3	3	50	50	100	PE
18MC005	DESIGN OF MATERIAL HANDLING SYSTEMS	3	0	0	3	3	50	50	100	PE
18MC006	DESIGN OF MECHATRONICS SYSTEM	3	0	0	3	3	50	50	100	PE
18MC007	NON- CONVENTIONAL MACHINING	3	0	0	3	3	50	50	100	PE
18MC008	COMPUTER INTEGRATED MANUFACTURING	3	0	0	3	3	50	50	100	PE
18MC009	ADVANCED MANUFACTURING	3	0	0	3	3	50	50	100	PE
18MC010	NON - DESTRUCTIVE TESTING	3	0	0	3	3	50	50	100	PE
18MC011	DESIGN FOR MANUFACTURING AND ASSEMBLY	3	0	0	3	3	50	50	100	PE
18MC012	PROCESS PLANNING AND COST ESTIMATION	3	0	0	3	3	50	50	100	PE
18MC013	VIRTUAL INSTRUMENTATION	3	0	0	3	3	50	50	100	PE
18MC014	MEDICAL MECHATRONICS	3	0	0	3	3	50	50	100	PE
18MC015	MODELLING OF INDUSTRIAL ROBOTS	3	0	0	3	3	50	50	100	PE
18MC016	FUZZY LOGIC & ARTIFICIAL NEURAL NETWORK	3	0	0	3	3	50	50	100	PE
18MC017	ARTIFICIAL INTELLIGENCE	3	0	0	3	3	50	50	100	PE
18MC018	OPTIMIZATION TECHNIQUES	3	0	0	3	3	50	50	100	PE
18MC019	MACHINE LEARNING	3	0	0	3	3	50	50	100	PE
18MC020	LINEAR INTEGRATED CIRCUITS	3	0	0	3	3	50	50	100	PE
18MC021	CONTROL SYSTEM AND DRIVES FOR ELECTRIC VEHICLES	3	0	0	3	3	50	50	100	PE
18MC022	PROCESS CONTROL	3	0	0	3	3	50	50	100	PE

18MC023	AD-HOC AND SENSOR NETWORK	3	0	0	3	3	50	50	100	PE
18MC024	INDUSTRIAL IOT	3	0	0	3	3	50	50	100	PE
18MC025	INDUSTRIAL DRIVES AND CONTROL	3	0	0	3	3	50	50	100	PE
OPEN ELECTIVES										
18MC0YA	INDUSTRIAL ROBOTICS	3	0	0	3	3	50	50	100	PE
18MC0YB	BASICS OF MECHATRONICS	3	0	0	3	3	50	50	100	PE
18MC0YC	MICRO ELECTRO MECHANICAL SYSTEMS	3	0	0	3	3	50	50	100	PE
18MC0YD	INDUSTRIAL DRIVES AND AUTOMATION	3	0	0	3	3	50	50	100	PE
ONE CREDIT COURSES										
18MC0XA	COMMUNICATION PROTOCOLS	-	-	-	1	-	100	0	100	EEC
18MC0XB	AC/DC DRIVES	-	-	-	1	-	100	0	100	EEC
18MC0XC	ADVANCED METROLOGY AND QUALITY CONTROL	-	-	-	1	-	100	0	100	EEC
18MC0XD	INDUSTRIAL HYDRAULICS	-	-	-	1	-	100	0	100	EEC
18MC0XE	DESIGN AND ASSEMBLY OF ELECTRONICS COMPONENTS IN PCB	-	-	-	1	-	100	0	100	EEC
18MC0XF	CNC SERVICING	-	-	-	1	-	100	0	100	EEC
ADDITIONAL ONE CREDIT COURSE										
18GE0XA	ETYMOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XB	GENERAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XC	NEURO BEHAVIORAL SCIENCE	-	-	-	1	-	100	0	100	EEC
18GE0XD	VISUAL MEDIA AND FILM MAKING	-	-	-	1	-	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLENCE	-	-	-	1	-	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	-	-	-	1	-	100	0	100	EEC
18GE0XG	HEALTH AND FITNESS	-	-	-	1	-	100	0	100	EEC
18GE0XH	CONCEPT, METHODOLOGY AND APPLICATIONS OF	-	-	-	1	-	100	0	100	EEC

	VERMICOMPOSTING									
18GE0XI	BLOG WRITING	-	-	-	1	-	100	0	100	EEC
18GE0XJ	INTERPERSONAL SKILLS	-	-	-	1	-	100	0	100	EEC
18GE0XK	COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT	-	-	-	1	-	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	-	-	-	1	-	100	0	100	EEC
18GE0XM	NEW AGE INNOVATION AND ENTREPRENEURSHIP	-	-	-	1	-	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES	-	-	-	1	-	100	0	100	EEC
18GE0XO	SOCIAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XP	FM RADIO BROADCASTING TECHNOLOGY	-	-	-	1	-	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S. No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	7	4	4					25	15%	15%	20%
2	ES	6	11	11						28	16%	15%	20%
3	HSS	2	2				2	2		8	5%	5%	10%
4	PC			8	20	17	14	11		70	41%	30%	40%
5	PE					6	6	6	9	27	16%	15%	20%
6	EEC							3	9	12	7 %	7%	10%
Total		18	20	23	24	23	22	22	18	170	100%	-	

BS - Basic Sciences
 ES - Engineering Sciences
 HSS - Humanities and Social Sciences
 PC - Professional Core
 PE - Professional Elective
 EEC - Employability Enhancement Course
 CA - Continuous Assessment
 ES - End Semester Examination

18MC101 ENGINEERING MATHEMATICS I

3 1 0 4

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.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigen values and Eigenvectors.
2. Analyze 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.

Articulation Matrix

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

UNIT I

9 Hours

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

9 Hours

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.

UNIT III

9 Hours

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

9 Hours

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolle s Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hopital s 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

9 Hours

COMPLEX ANALYSIS

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

Total: 60 Hours

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. Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
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.

18MC102 ENGINEERING PHYSICS I**2 0 2 3****Course Objectives**

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

Programme Outcomes (POs)

- 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.
- i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

Course Outcomes (COs)

1. Illustrate the Newton's three laws of motion and apply the same to solve the real world problems involving elevator, at wood machine and acceleration of objects
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings
5. Outline the importance of special theory of relativity, quantum physics and analyse the wave and particle nature of matter

Articulation Matrix

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

UNIT I**6 Hours****MECHANICS**

Newtons laws of motion: Concept of force and its nature - Newtons first law and inertial frame definition of mass - Newtons second law-gravitational force and weight - Newtons third law Applications of Newtons laws: particle in equilibrium, particle under net force - weighing a mass in elevator, the atwood machine and acceleration of two objects connected by a cord

UNIT II

6 Hours

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion -energy of simple harmonic oscillator - spring mass system - time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations. Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission - rate of energy transfer in wave motion

UNIT III

6 Hours

ELECTRICITY AND MAGNETISM

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance - energy stored in a capacitor.

Concept and source of magnetic fields - Amperes theorem determination of magnetic field due to different current distributions - Faradays law self-induction and mutual induction - energy stored in an inductor

UNIT IV

6 Hours

LIGHT AND OPTICS

Nature of light -laws of reflection and refraction -refractive index and Snells law - dispersion of light - total internal reflection - image formation: concave mirrors - convex mirrors - thin lenses - compound microscope -human eye.

Conditions of interference -Youngs double slit experiment intensity distribution of interference - phase change due to reflection - diffraction-narrow slit diffraction - single slit and two slit - intensity distribution - diffraction grating - applications

UNIT V

6 Hours

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation -twin paradox - length contraction - relativistic mass variation - space time graph.

Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission-Germer experiment

1

5 Hours

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

2

5 Hours

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3

5 Hours

EXPERIMENT 3

Determination of wavelength of mercury spectral lines-spectrometer

4

4 Hours

EXPERIMENT 4

Determination of refractive index of solid and liquid-travelling microscope

5

3 Hours

EXPERIMENT 5

Determination of wavelength of laser-diffraction grating

6

4 Hours

EXPERIMENT 6

Determination of frequency of a tuning fork-Melde's apparatus

7

4 Hours

EXPERIMENT 7

Thickness of a thin wire using interference of light-Air wedge method

Total: 60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, NewDelhi, 2017
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, Dhanpat Rai Publications, 2012

18MC103 ENGINEERING CHEMISTRY I

2023

Course Objectives

- Assess the purpose of alloying and heat treatment in the field of metallurgy applications
- Identify the types of corrosion and its suitable prevention method
- Classify polymers based on its properties and molding techniques
- Interpret the properties and applications of lubricants
- Classify polymers based on its properties and molding techniques

Programme Outcomes (POs)

- 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.
- 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

Course Outcomes (COs)

1. Apply the concept of alloying in the field of metallurgy
2. Explain the importance of heat treatment of steel
3. Analyze the factor influencing rate of corrosion on metals and identify suitable corrosion control methods
4. Identify various polymeric materials for the manufacture of automobiles and its waste management
5. Outline the properties and application of lubricants used in automobiles

Articulation Matrix

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

UNIT I

6 Hours

ALLOYS

Purpose of alloying - function and effects of alloying elements - classification of alloys. Composition - properties - uses of ferrous alloys (steel, cast iron and stainless steel) and non-ferrous alloys (aluminum, nickel, copper) - shape memory alloys.

7 Hours

UNIT II

HEAT TREATMENT

Purpose of heat treatment, hot working and cold working - cooling curves - recrystallization temperature - annealing, normalizing, hardening and tempering of steel - isothermal transformation diagram (TTT diagram) - carburizing (three types), nitriding, cyaniding, carbonitriding, flame and induction hardening.

UNIT III

7 Hours

CORROSION SCIENCE

Corrosion - chemical and electrochemical corrosion - Pilling-Bedworth rule - types of oxide layer, oxygen absorption, hydrogen evolution mechanism - galvanic series. Types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, pipeline and stress). Factors influencing corrosion. Corrosion control: Sacrificial anode - impressed current method.

UNIT IV

5 Hours

POLYMER

Polymers - polymerization - functionality - degree of polymerization - classification of polymers. Types of polymerization. Structure, properties and applications of thermosetting (epoxy resin and bakelite) and thermoplastics (poly vinyl chloride and PMMA). Rubber: SBR. Compounding of plastics (injection and extrusion).

UNIT V

5 Hours

LUBRICANTS

Functions - properties (viscosity index, oiliness, carbon residue, aniline point, cloud and pour point) - classification: Grease (calcium based, sodium based and lithium based) - solid lubricants (graphite and molybdenum disulphide). Grading of lubricants. Hydraulic oils - Properties and applications - gas as a lubricant.

FURTHER READING

Biogas production, its benefits and disadvantages. Polymers in automobiles. Pollution of water in India in a decade.

1

2 Hours

EXPERIMENT 1

Instruction about safety rules, reagent handling and precautions need to be followed in lab

2

4 Hours

EXPERIMENT 2

Estimation of copper in brass alloy

3

4 Hours

EXPERIMENT 3

Estimate the amount of iron present in the given solution using spectrophotometer by thiocyanate method

4

4 Hours

EXPERIMENT 4

Determination of hardenability using Jominy end quench test

5 **4 Hours**

EXPERIMENT 5

Determination of corrosion percentage by weight loss method

6 **4 Hours**

EXPERIMENT 6

Thermal stability of polymer using thermogravimetry analysis

7 **4 Hours**

EXPERIMENT 7

Determination of molecular weight of a polymer by viscosity measurement method

8 **4 Hours**

EXPERIMENT 8

Comparison of viscosity for liquid lubricants by Ostwald viscometer

Total: 60 Hours

Reference(s)

1. P. C. Jain and Monica Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publisher, New Delhi, 2013.
2. G.E.Dieter, Mechanical Metallurgy, McGraw Hill, 2007.
3. William D Callister Jr., Materials science and engineering: An introduction, 7th Edition, John Wiley&sons Inc.,New York,2007.
4. B.R. Puri, L. R. Sharma, M.S. Pathania, Principles of Physical Chemistry, 41st Edition, Vishal Publishing Co., (2004)
5. R. Gowariker, N.V. Viswanathan, J. Sreedhar, Polymer Science,1st Edition, New age International Publishers, New Delhi, 2014.
6. R. Mukhopadhy and S. Datta, Engineering Chemistry, New Age International Pvt. Ltd, New Delhi, 2010

18MC104 CIRCUIT THEORY

2 0 2 3

Course Objectives

- To understand the basic concepts of electrical circuits and machines
- To examine the speed control methods of DC motor
- To illustrate the construction and operation of three phase systems

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Apply the fundamental laws to electric circuits and compute the different alternating quantities
2. Apply the laws of magnetism for the operation of DC motor and its applications
3. Examine the construction, working principle and applications of different AC machines
4. Analyze the different concepts of electromagnetic field theory
5. Analyze the performance characteristics and applications of three phase systems

Articulation Matrix

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

UNIT I

6 Hours

DC CIRCUITS

Definition of voltage, current, power, energy, resistor, inductor and capacitor - Ohms statement, illustration and limitations- Kirchoffs laws statement and illustration - current and voltage division technique - resistance in series and parallel - problems, mesh and nodal analysis.

UNIT II

6 Hours

AC CIRCUITS

Generation of single phase alternating emf - RMS value, average value, peak factor and form factor, analysis of pure resistive, inductive and capacitive circuits J operator - Representation of alternating quantities in rectangular and polar forms - star to delta transformation - simple problems.

UNIT III

6 Hours

ELECTROMAGNETIC FIELD THEORY

Gauss And Stokes Theorem - Maxwell equations and significance. Electric Charge - Coulombs law - Electric field and potential - Electric field due to a point charge, electric dipole - line of charge and charge disc

UNIT IV

6 Hours

THREE PHASE SYSTEM

Advantage of 3 phase system - phase sequence - Interconnection of three phase - Star and Delta connection - Voltage current and power in star and delta connection

UNIT V

6 Hours

RESONANCE AND COUPLED CIRCUITS

Series and parallel resonance - Q factor and bandwidth - Resonant frequency of a tank circuit - Basics of magnetic circuits - Simple and Composite magnetic circuits - Self and Mutual inductances - Coefficient of Coupling - Coupled circuits - Dot convention - Coupled circuits in Series and Parallel

FOR FURTHER READING

Voltage Regulator - BLDC Motor -SMPS-Autotransformer-Ac Servomotor

1

5 Hours

EXPERIMENT 1

Identification of basic Electronic components such as Resistor, Capacitor, and Inductor and measuring the fundamental characteristics

2

5 Hours

EXPERIMENT 2

Residential house wiring using switches, fuse, indicator, lamp and energy meter, Fluorescent lamp wiring, Stair case wiring

3

5 Hours

EXPERIMENT 3

Verify KCL and KCL using simple circuits

4

5 Hours

EXPERIMENT 4

Implement star to delta and delta to star transformation circuits

5

5 Hours

EXPERIMENT 5

Measurement of electrical quantities voltage, current, power

6

5 Hours

EXPERIMENT 6

Apply the voltage division and current division techniques for series and parallel connections of lamp loads.

Total: 60 Hours

Reference(s)

1. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010
2. R. Muthusubramanian, S. Salivahanan, Basic Electrical and Electronics Engineering, Tata McGraw-Hill Education, Reprint 2012
3. William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin, Engineering Circuit Analysis, Eighth Edition, Tata McGraw Hill, 2013

4. Charles K. Alexander, Fundamentals of Electric Circuits, Fifth Edition, Tata McGraw Hill Publishing Co Ltd, 2013.
5. Mahmood Nahvi, Joseph A Edminister, Electric Circuits, Fifth Edition, Tata McGraw Hill Publishing Company Limited, 2017.
6. S P Ghosh, A K Chakraborty, Network Analysis and Synthesis, Tata McGraw Hill Education Private Limited, 2010.

18HS101 COMMUNICATIVE ENGLISH I

1 0 2 2

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

Programme Outcomes (POs)

- Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- 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.

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

Articulation Matrix

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

UNIT I

9 Hours

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

9 Hours

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.

UNIT III

9 Hours

WRITING

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

9 Hours

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

9 Hours

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

Total: 45 Hours

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.

18MC106 ENGINEERING GRAPHICS

1 0 4 3

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

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Understand the engineering drawing concepts as per industrial standards.
2. Construct orthographic projections of points and lines
3. Create projection of planes and simple solids
4. Develop section of solids and surfaces
5. Demonstrate the conversion of orthographic to isometric and vice versa

Articulation Matrix

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

UNIT I

12 Hours

FUNDAMENTALS OF ENGINEERING DRAWINGS

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

UNIT II

15 Hours

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

16 Hours

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

16 Hours

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.

UNIT V

16 Hours

ORTHOGRAPHIC PROJECTIONS AND ISOMETRIC VIEW

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

Total: 75 Hours

Reference(s)

1. K Venugopal, Engineering Drawing and Graphics, Third edition, New Age International, 2005
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

18MC201 ENGINEERING MATHEMATICS II

3 1 0 4

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.

Programme Outcomes (POs)

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

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. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

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

UNIT I

9 Hours

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

9 Hours

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Green's theorem and Gauss Divergence theorem).

UNIT III

9 Hours

SEQUENCES AND SERIES

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, Taylor's Theorem with remainder.

UNIT IV

9 Hours

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoulli's equation, applications.

UNIT V

9 Hours

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

Total: 60 Hours

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. Kreyszig E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil, Advanced Engineering Mathematics, Seventh Edition, Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014.

**18MC202 ENGINEERING PHYSICS II -
MECHANICS****3 1 0 4****Course Objectives**

- To impart knowledge in crystallography and the crystal growth methods
- To understand the properties of conductors and semiconductors
- To familiarise basic concepts of force and system of forces in real world environment
- To analyse the properties of surface and friction between the surfaces

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Identify the seven crystal systems, crystal planes and the stacking sequences in metallic crystal structures
2. Illustrate the characteristics of conducting, semiconducting materials in terms of crystal lattice, charge carriers and energy band diagrams
3. Apply the conceptual knowledge to solve problems of particles and rigid bodies in two dimension under equilibrium conditions
4. Outline the properties of surfaces and solids using the parallel and perpendicular axis theorems
5. Differentiate between static and dynamic friction and analyse the equilibrium of bodies on an inclined plane

Articulation Matrix

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

UNIT I**8 Hours****CRYSTAL PHYSICS**

Lattice - unit cell - Bravais lattice - lattice planes - miller indices - d-spacing in cubic lattice - calculation of number of atoms per unit cell - atomic radius - coordination number - packing density for SC, BCC, FCC and HCP structures- crystal growth: Bridgman and Czochralski techniques -X- ray diffraction methods

UNIT II

8 Hours

CONDUCTING AND SEMICONDUCTING MATERIALS

Conductors: Classical free electron theory -electrical and thermal conductivity -Wiedemann-Franz law -success and drawbacks of classical free electron theory -quantum theory - Fermi level -Fermi distribution function

Semiconductors: Elemental and compound semiconductors -intrinsic semiconductor - Fermi level - electrical conductivity - band gap -extrinsic semiconductor -variation of Fermi level with temperature and impurity concentration -Hall Effect -applications of Hall Effect -solar cell -I-V characteristics

UNIT III

10 Hours

EQUILIBRIUM OF PARTICLES AND RIGID BODIES

Introduction - system of forces - resultant force - determination of resultant force of concurrent force system. Equilibrant - Equilibrium of a particle -Lamis theorem - free body diagram - types of supports and their reactions -moment of force - Varignons theorem - determination of resultant: parallel, non-parallel, non-concurrent coplanar force systems - equilibrium of rigid bodies in two dimension

UNIT IV

10 Hours

PROPERTIES OF SURFACES AND SOLIDS

Determination of area, volume and mass of centroid - Pappus and Guldinus theorem -moment of inertia of plane and area - Parallel axis theorem - perpendicular axis theorem - product of inertia - mass moment of inertia - radius of gyration

UNIT V

9 Hours

FRICTION

Frictional force - laws of Coulomb friction - angle of friction - cone of friction - equilibrium of bodies on an inclined plane - ladder friction - wedge friction - belt friction - rolling resistance

Total: 60 Hours

Reference(s)

1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Wiley, India Pvt limited New Delhi 2012
2. Arthur Beiser, Shobjit Mahaja and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hil Education Pvt Ltd New Delhi, 2010
3. M.N. Avadhanalu, P.G. Kshirsagar, A Text Book of Engineering Physics S. Chand Company New Delhi 2018
4. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2007
5. N. H. Dubey, Engineering Mechanics - Statics and Dynamics, Tata McGraw-Hill Education Private Limited, New Delhi, 2013
6. D. P. Sharma, Engineering Mechanics, Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2010
S. Rajasekaran and G. Sankarasubramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2010

18MC203 ENGINEERING CHEMISTRY - II

2023

Course Objectives

- Identify the importance of microsystem and substrate materials for MEMS
- Summarize the terminologies of electrochemical reactions and explain the function of batteries and chemical sensors
- Characterize the chemical compounds using suitable analytical techniques

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Explain the concept of chemistry in microsystems
2. Indicate the importance of substrate materials for MEMS and its properties
3. Identify the chemical sensors and electrodes used in electrochemical devices
4. Interpret the role of electrodes, electrolyte and cell reactions in batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
5. Select suitable analytical method for the estimation of alkali and alkaline earth metals in aqueous media

Articulation Matrix

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

UNIT I

6 Hours

CHEMISTRY FOR MICROSYSTEMS

Introduction - atomic structure of matter - ions and ionization - molecular theory of matter - intermolecular forces - doping of semiconductors - the diffusion theory

UNIT II

6 Hours

MATERIALS FOR MEMS

Introduction - substrates and wafers - active substrate materials. Silicon as a substrate material: The ideal substrate for MEMS - single crystal silicon and wafers - crystal structure - Miller indices - mechanical properties of silicon. Silicon compounds (silicon dioxide, silicon carbide, silicon nitride and polycrystalline silicon).

UNIT III

6 Hours

CHEMICAL SENSORS

Electrode potential: Single and standard electrode potential - half-cell reactions. Cells: Cell representation, types (electrochemical and electrolytic cells), Types of electrodes. Sensor: Definition - classification of chemical sensors - electrochemical devices: pH sensors, pellistors, NPK sensor, solid electrolyte sensor for sensing oxygen.

UNIT IV

6 Hours

BATTERIES

Batteries: Difference between cell and battery - characteristics and types. Construction, working and applications of primary battery: Alkaline - secondary battery: Lead acid - modern battery: Lithium battery. Environmental and safety issues in disposal of batteries

UNIT V

6 Hours

INSTRUMENTAL METHODS

Beer-Lamberts law. Principle, instrumentation (block diagram only) and applications: Ultra violet spectroscopy - infrared spectroscopy - atomic absorption spectroscopy - colorimetry (estimation of transition metals) - thermogravimetric analyzer (TGA).

FURTHER READING

Energy resources: Renewable (solar and wind) and nonrenewable (fossil fuels). Fuel cells.

1

4 Hours

EXPERIMENT 1

Virtual fabrication of silicon cantilever using Intelli FAB MEMS software

2

4 Hours

EXPERIMENT 2

Determination of standard electrode potential of zinc/copper/silver using calomel as reference electrode

3

4 Hours

EXPERIMENT 3

Determination of pH of an unknown solution using pH sensor

4

4 Hours

EXPERIMENT 4

Estimate the amount of ferrous iron present in the given sample solution using potentiometer

5

4 Hours

EXPERIMENT 5

Construct a battery (using scrap metal/ other sources) exhibiting valid output and compare it with the existing commercial batteries based on cost and output. (Marks awarded based on battery output)

6

4 Hours

EXPERIMENT 6

Conductometric titration of mixtures of acid using a conductivity cell

7

4 Hours

EXPERIMENT 7

Estimate the amount of Prussian blue dye in the given solution using spectrophotometer by thiocyanate method

8

2 Hours

EXPERIMENT 8

Analysis of NPK fertilizer compounds by using IR Spectroscopy

Total: 60 Hours

Reference(s)

1. Tai-Ran Hsu, MEMS and Microsystems, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2010
2. P. C. Jain and Monica Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publisher, New Delhi, 2013.
3. William D Callister Jr., Materials science and engineering: An introduction, 7th Edition, John Wiley&sons Inc.,New York,2007.
4. B.R. Puri, L. R. Sharma, M.S. Pathania, Principles of Physical Chemistry, 41st Edition, Vishal Publishing Co., (2004)
5. R. Gowariker, N.V. Viswanathan, J. Sreedhar, Polymer Science,1st Edition, New age International Publishers, New Delhi, 2014.
6. R. Mukhopadhy and S. Datta, Engineering Chemistry, New Age International Pvt. Ltd, New Delhi, 2010

18MC204 C PROGRAMMING

2 0 2 3

Course Objectives

- To learn the basics of computer organisation
- To study the basics of C primitives, operators and expressions.
- To understand the different primitive and user defined data types

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Recognize the basic concepts of computers
2. Implement programs using operators and expressions
3. Demonstrate the usage of control structures
4. Execute programs using Arrays and strings.
5. Summarize the concepts of structures and functions

Articulation Matrix

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

UNIT I

6 Hours

INTRODUCTION TO COMPUTERS

Introduction to computers - Characteristics of Computers - Evolution of Computers - Computer Generations - Basic Computer Organization - Number System - Problem Solving Techniques - Features of a Good Programming Language.

UNIT II

6 Hours

INTRODUCTION TO C PROGRAMMING

Overview of C-Structure of C program-Key words-Constants- Variables-Data types-Type conversion Operators and Expressions: Arithmetic-Relational-Logical-Assignment- Increment and Decrement-Conditional-Bitwise -Precedence of operators-Managing I/O operations-Formatted I/O-Unformatted I/O.

UNIT III

6 Hours

CONTROL STATEMENTS

Decision Making and Branching: simple if statement-if else statement-nesting of if else Statement-Switch Statement.Decision Making and Looping: while statement-do while statement-for statement-Nested for statement Jump Statements: goto-break-continue-return statement

UNIT IV

6 Hours

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays, multi dimensional arrays. Strings: Declaring and initializing string variables- Reading strings from terminal - writing string to screen - String handling functions.

UNIT V

6 Hours

STRUCTURES AND FUNCTIONS

Structures and Unions: Introduction-defining a structure- declaring structure variables-accessing structure members- structure initialization-Unions-Enumerated data type User Defined Functions: Elements of user defined functions -Definition of functions-return values and their types- function calls-function declaration-categories of function -call by value and call by reference-recursion-Preprocessor directives and macros

1

3 Hours

EXPERIMENT 1

Write a C program to perform arithmetic operations on integers and floating point numbers

2

3 Hours

EXPERIMENT 2

Write a C program to implement ternary operator and relational operators

3

3 Hours

EXPERIMENT 3

Write a C program to find the greatest of three numbers using if-else statement.

4

3 Hours

EXPERIMENT 4

Write a C program to display the roots of a quadratic equation with their types using switch case

5

3 Hours

EXPERIMENT 5

Write a C program to generate pyramid of numbers using for loop.

6

3 Hours

EXPERIMENT 6

Write a C program to perform Matrix Multiplication

7

4 Hours

EXPERIMENT 7

Write a C program to check whether the given string is Palindrome or not.

8

4 Hours

EXPERIMENT 8

Write a C program to find the factorial of given number

9

4 Hours

EXPERIMENT 9

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student

details: rollno, name, branch, year, section, cgpa.

NAME:

ROLL NO:

BRANCH:

YEAR:

SECTION:

CGPA:

Total: 60 Hours

Reference(s)

1. Pradeep K. Sinha, Priti Sinha, Computer Fundamentals, BPB publications, 2008
2. Ashok. N. Kamthane, Computer Programming, Second Edition, Pearson Education, 2012
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
5. Byron Gottfried, Programming with C, Schaum's Outlines, Tata McGraw-Hill, 2013

18MC206 ELECTRON DEVICES AND CIRCUITS**2 0 2 3****Course Objectives**

- To understand the characteristics, operations, and application of solid state devices like diode, BJT, FET, MOSFET and various optoelectronic devices
- To understand various applications of electronic devices.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Understand the characteristics of semiconductor devices and analyze the small signal model of BJT & FET
2. Analyse the voltage and current characteristics of BJT, & BJT as amplifier.
3. Apply amplifiers for tuning, feedback and multistage applications and analyze its gain, stability and efficiency
4. Analyse the Characteristics of JFET & MOSFET with their equivalent circuit models and parameters
5. Applications of diodes & BJT with different display devices

Articulation Matrix

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

UNIT I**6 Hours****SEMICONDUCTOR DIODES**

Semiconductor material and Properties, PN junction diode, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Switching Characteristics - Zener diodes

UNIT II**6 Hours****BIPOLAR JUNCTION TRANSISTOR**

Device structure and physical operation, current voltage characteristics, the BJT as an amplifier and a switch, DC Analysis of BJT Circuits, Biasing BJT Amplifier Circuits

UNIT III **6 Hours**

BJT AMPLIFIERS

Small Signal operations and models, transconductance, input resistances, voltage gain, hybrid pi model, T-model, Small Signal equivalent circuit, Early effect, Single stage BJT amplifiers CE, CB, CC, Comparison.

UNIT IV **6 Hours**

FIELD EFFECT TRANSISTOR

JFETs Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Current equation - Equivalent circuit model and its parameters.

UNIT V **6 Hours**

DISPLAY DEVICES

LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD.

1 **3 Hours**

EXPERIMENT 1

Volt-Ampere characteristics of diode and zener diode

2 **3 Hours**

EXPERIMENT 2

Volt-Ampere characteristics of Transistor and MOSFET

3 **3 Hours**

EXPERIMENT 3

Volt-Ampere characteristics of SCR

4 **3 Hours**

EXPERIMENT 4

Experimental verification of half and full wave rectifiers with and without filters

5 **3 Hours**

EXPERIMENT 5

Design and verification of series voltage regulator

6 **3 Hours**

EXPERIMENT 6

Design and implementation of CE amplifier

7 **3 Hours**

EXPERIMENT 7

Design and implementation of class B push pull amplifier

8 **3 Hours**

EXPERIMENT 8

Design and implementation of RC Phase shift and wein bridge oscillator

9

3 Hours

EXPERIMENT 9

Design and implementation of multivibrator circuits using transistor

10

3 Hours

EXPERIMENT 10

Design of audio amplifier using any one type of power amplifier

Total: 60 Hours

Reference(s)

1. Jacob. Millman, Christos C.Halkias, Electronic Devices and Circuits, 3rd Edition ,Tata McGraw Hill Publishing Limited, New Delhi, 2010.
2. David A. Bell, Electronic Devices and Circuits,5th Edition,Oxford University Press,2009.
3. Allen Mottershead, Electronic Devices and Circuits-An Introduction, Prentice Hall of India Private Limited, New Delhi, 2003
4. N.P.Deshpande, Electronic Devices and Circuits,1st Edition,Tata McGraw Hill Publishing Limited, New Delhi,2013.
5. R.L.Boylestad and Louis Nashelsky,Electronic Devices and Circuits , 9th Edition, Pearson/Prentice Hall,,2013.
6. Thomas L Floyd, Electronic Devices, Prentice Hall of India, New Delhi, 2011.

18MC207 ENGINEERING PRACTICE LABORATORY

0 0 2 1

Course Objectives

- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To gain the skills for making turning, facing operations using suitable Lathe.
- To develop the skills for making wood/sheet metal models using suitable tools

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Fabricate simple components using carpentry tools
2. Make the machining process and measure the dimensions using Vernier Caliper
3. Prepare corner joint, Butt joint, Lap joint using welding equipment/tools.
4. Make simple models using wood and sheet metal
5. Develop an object using different sheets.

Articulation Matrix

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

1

2 Hours

EXPERIMENT 1

For the given wire, plate measure the dimensions using screw gauge and Vernier caliper

2

3 Hours

EXPERIMENT 2

Perform turning, facing operations on given work piece to produce the stepped diameter on the MS rod. Measure the dimensions using Vernier caliper

3 **3 Hours**

EXPERIMENT 3

Perform turning, facing, chamfering operations on given work piece to produce tapered diameter on the MS rod. Measure the dimensions using Vernier caliper

4 **2 Hours**

EXPERIMENT 4

Perform drilling, reaming, tapping operation on the given work piece.

5 **4 Hours**

EXPERIMENT 5

Make lap joint, Corner joint, Butt joint using Arc and gas welding methods on the given two plates

6 **6 Hours**

EXPERIMENT 6

Develop a rectangular tray, hopper, cylinder using the sheet metal operations

7 **4 Hours**

EXPERIMENT 7

Making of Pen Stand, Teapoy using carpentry power tools

8 **2 Hours**

EXPERIMENT 8

Use hand grinder to make a square plate from the given object and make a hole of multiple diameters.

9 **4 Hours**

EXPERIMENT 9

Fabrication of a simple component using thin and thick plates to make a Book rack

Total: 30 Hours

18MC301 ENGINEERING MATHEMATICS III**3 1 0 4****Course Objectives**

- Aimed to provide basic knowledge on periodic, Non periodic functions and their representations using Fourier series and Fourier transforms respectively
- Assess the electrical and mechanical potentials using Laplace transform techniques through partial differential equations
- Predict the changes in the manufacturing process using the concepts of statistics

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Represent the periodic motions of mechanical appliances with the help of Fourier series
2. Demonstrate the non periodic vibrations and their properties using Fourier Transforms
3. Formulate a function in frequency domain for which the function defined in time domain through the techniques of Laplace transforms
4. Find the position of a moving particle which are depending on more than one Parameter, using partial differential equations
5. Summarise and analyse the properties of the parameters of any mechanical process with the help of Statistics

Articulation Matrix

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

UNIT I**10 Hours****FOURIER SERIES**

Definition of periodic function, Eulers formula, Functions having points of discontinuity, Change of intervals, Odd and Even functions, Expansion of odd or even periodic functions, Half range sine and cosine series, Elements of harmonic analysis

UNIT II**9 Hours****FOURIER TRANSFORMS**

Fourier Transform and Inverse Fourier Transform, Sine and Cosine Transforms Properties , Transforms of Simple Functions, Convolution Theorem, Parseval's Identity

UNIT III

9 Hours

LAPLACE TRANSFORM

Laplace Transform, Existence Condition, Transforms of Standard Functions, Unit step function, Unit impulse function, Properties, Transforms of Derivatives and Integrals, Initial and Final Value Theorems, Laplace transform of Periodic Functions, Inverse Laplace transforms. Applications to ordinary differential equations

UNIT IV

10 Hours

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION

Classification of Second Order Quasi Linear Partial Differential Equations, Fourier Series Solutions of One Dimensional Wave Equation, One Dimensional Heat Equation, Steady State Solution of Two-Dimensional Heat Equation, Fourier Series Solutions in Cartesian Coordinates

UNIT V

7 Hours

BASIC STATISTICS

Mean, Median, Mode, Variance, Standard Deviation, Covariance, Correlation and Regression

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993
2. Johnson Richard A. and Bhattacharyya 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

18MC302 ELECTRICAL MACHINES**3 0 2 4****Course Objectives**

- To understand the working principle and performance characteristics of DC Generator and DC Motor
- To understand the working principle of induction motor and synchronous machines
- To Impart knowledge on special electrical machines

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Compare the excitation and magnetisation characteristics of DC Machines
2. Implement the equivalent circuit of transformer with help of construction details of transformer
3. Compute the essential parameters for slip-speed characteristics of induction motor
4. Carry out various operating characteristics of synchronous motor to find the regulation
5. Identify the special electrical machines for specified application

Articulation Matrix

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

UNIT I**8 Hours****DC MACHINES**

Introduction-Constructional Features-Motoring and generation principle -Emf And Torque equation - Circuit Model- Methods of Excitation and magnetisation characteristics - Starting and Speed Control - Universal Motor.

UNIT II**10 Hours****TRANSFORMERS**

Introduction -Ideal Transformer - Accounting For Finite Permeability And Core Loss - Circuit Model Of Transformer - Per Unit System - Determination Of Parameters Of Circuit Model Of Transformer - Voltage Regulation - Nameplate Rating - Efficiency - Three Phase Transformers -Auto Transformers

UNIT III **9 Hours**

INDUCTION MACHINES

Three phase induction motors: Constructional details - Types of rotors - Principle of operation - Slip - Slip-torque characteristics - Condition for maximum torque - Losses and efficiency - Starters - Single Phase induction motors: Double field revolving Theory -Types-Applications

UNIT IV **10 Hours**

SYNCHRONOUS MACHINES

Constructional details - Types of rotors, operating characteristics - Emf equation - Synchronous reactance - Armature reaction - Voltage regulation - EMF, MMF, methods - Synchronous motor: Principle of operation - Torque equation - Starting methods - V and inverted V curves.

UNIT V **8 Hours**

SPECIAL MACHINES

Special machines - reluctance motor, repulsion motor, hysteresis motor, stepper motor, servo motor, BLDC. Dynamic, regenerative and plugging.

FOR FURTHER READING

Phasor Diagram of Transformer, Blocked rotor test of induction motor, power factor correction using synchronous motor, Analysis of mechanical characteristics of special machines.

1 **4 Hours**

EXPERIMENT 1

Load test on DC shunt motor.

2 **4 Hours**

EXPERIMENT 2

Load test on DC series motor

3 **5 Hours**

EXPERIMENT 3

Load characteristics of separately excited DC generator

4 **5 Hours**

EXPERIMENT 4

Load test on single phase transformer

5 **4 Hours**

EXPERIMENT 5

O C and S C test on single phase transformer

6 **4 Hours**

EXPERIMENT 6

Load test on three phase Induction motor.

7 **4 Hours**

EXPERIMENT 7

Load test on 1 phase Induction motor.

Total: 75 Hours

Reference(s)

1. D.P.Kothari and J.J.Nagrath, Electric Machines, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2017
2. A.E.Fitzgerald, Charles Kingsley and Stephen D. Umans, Electric Machinery, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2003
3. Stephen J. Chapman, Electric Machinery Fundamentals, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017
4. P. S. Bhimbhra, Electrical Machinery, Khanna Publishers, New Delhi, 2011.
5. B.L.Theraja and A.K.Theraja, A Text Book of Electrical Technology - Volume II, S.Chand and Company Ltd, New Delhi, 2014

18MC303 DIGITAL ELECTRONICS**3 0 0 3****Course Objectives**

- To understand the fundamentals of digital logic
- To understand the various number systems and codes
- To design various combinational and sequential circuits
- To study the basics about synchronous and asynchronous circuits

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

- Apply Boolean algebra principles and different types of number systems to design the digital circuits
- Design and realize the combinational circuits using logic gates
- Design and construct synchronous sequential circuits using basic flip flops
- Analyze the various memory devices, Programmable Logic Devices and logic families
- Design and analyze the synchronous, asynchronous logic families & Hazards and mapping of data path elements using VHDL

Articulation Matrix

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

UNIT I**9 Hours****LOGIC GATES AND MINIMIZATION CIRCUITS**

Basic digital circuits AND - OR - NAND - NOR - EX-OR - EX-NOR operations - universal building block construction using logic gates - Boolean Algebra- Simplification of Boolean functions - special forms of Boolean functions - minterm (SOP) - maxterm (POS) - K Map representation of logic functions - simplification of logic functions using K Map - Don't care conditions ,Quine-McCluskey method of minimization.

UNIT II **9 Hours**

COMBINATIONAL CIRCUITS

Half and Full Adders - Half and Full Subtractors - Code converters Encoder - Decoder - Multiplexer-Demultiplexer - Binary/ BCD adders, subtractors - Carry look ahead adder - parity checker - parity generators - Magnitude comparator

UNIT III **9 Hours**

SEQUENTIAL CIRCUITS

General model of sequential circuits - flip-flops - latches - level triggering, edge triggering - master-slave configuration - Mealy/Moore models - state diagram - state table - State minimization - State assignment - Excitation table and maps - shift registers - Ring counter

UNIT IV **9 Hours**

MEMORY DEVICES

Memory types and terminology - static and dynamic RAM - ECL RAM - Non Volatile RAM - Sequential Memories: Recirculation shift registers-First in first out memories - Magnetic core memories - magnetic disk memories - Programmable Logic Devices (PLD) - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

UNIT V **9 Hours**

SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS AND VHDL

Design of synchronous sequential circuits - parity checker - sequence detector - Asynchronous sequential logic: Race conditions and Cycles - Hazards in combinational circuits. Introduction to VHDL -Behavioral, Data Flow and Structural Model - Operators - Data objects - Data types, Attributes - Test Benches - Simple programs

FOR FURTHER READING

Memory types and terminology - static and dynamic RAM - ECL RAM - Non Volatile RAM --First in first out memories - Magnetic core memories - magnetic disk memories- Magnetic tape and Bubble memories

Total: 45 Hours

Reference(s)

1. M. Morris Mano, Michel D. Ciletti, Digital Design, Pearson Education, New Delhi, 6th edition, 2018
2. Ronald J. Tocci Neal S. Widmer and Gregory L. Moss, Digital Systems: Principles and Applications, Prentice Hall of India, New Delhi, 12th Edition, 2018
3. A. Anand Kumar, Fundamentals of Digital Circuits, PHI Learning Pvt. Ltd. 2014.
4. Thomas L. Floyd, Digital Fundamentals, Pearson Education Inc, New Delhi, 10th Edition, 2006
5. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, Tata McGraw-Hill, Delhi, 8th Edition 2015
6. Charles H. Roth. Fundamentals of Logic Design, Thomson Learning, 7th Edition, 2013

18MC304 STRENGTH OF MATERIALS

3 1 0 4

Course Objectives

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To determine the stresses and understand their behaviour on beams, shafts and thin cylinders
- To assess the deflections in beams, columns and springs
- To compute the power transmitted by shafts and strain energy stored in deformed bodies

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

- Compute stress induced in any structural member including composite bars
- Use Mohr's circle to determine the stresses and also illustrate stress distribution pattern in bending and shearing
- Draw shear force and bending moment distributions in loaded beams
- Compute the strain energy stored and apply double integration method to find slope and deflection of beams
- Determine shaft and spring parameters

Articulation Matrix

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

UNIT I

9 Hours

STRESS, STRAIN AND DEFORMATION OF SOLIDS

Rigid bodies and deformable solids - Simple stresses and strains - Stress-strain curve for ductile materials - Deformation of axially loaded member - Composite bars - Thermal stresses - Elastic constants - Relationship between elastic constants - Volumetric strains

UNIT II

9 Hours

STRESSES IN BEAM

Stresses on inclined planes - Principal stresses and principal planes - Mohr's circle of stress - Theory of simple bending - Bending stress distribution - Load carrying capacity - Proportioning of sections - Shear stress distribution - Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses - Thick cylinders - Lamé's equation - Shrink fit

UNIT III

9 Hours

TRANSVERSE LOADING ON BEAMS

Beams and its types - Transverse loading on beams - Shear force and bending moment in beams: cantilever, simply supported beam and overhanging beam - Determination of maximum bending moment - Point of contra flexure

UNIT IV

9 Hours

STRAIN ENERGY AND DEFLECTION

Strain energy - Resilience and proof resilience - Strain energy stored in the member due to gradually applied load, suddenly applied load and impact load - Stress strain diagram showing ductile and brittle behaviour of materials - Elastic curve - Governing differential equation - Double integration method for computation of slope and deflection of determinant beams - Deflection in columns - Long column - Euler's Theory - Short column - Empirical formulae

UNIT V

9 Hours

TORSION IN SHAFTS AND SPRINGS

Theory of Torsion - Stresses and Deformations in Solid and hollow circular shafts - Power transmitted to shaft - Shaft in series and parallel - Stepped shafts - Deflection in shafts fixed at the both ends - Closed and open coiled helical springs - springs in series and parallel - Stresses in helical springs - Deflection of helical springs - Leaf springs

FURTHER READING

Bending stress distribution of flitched beams - Stresses in compound cylinders - Stress-strain curve for brittle materials

Total: 60 Hours

Reference(s)

1. Rattan, S. S., Strength of Materials, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2012
2. Egor. P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2002
3. Ferdinand P. Beer, E. Russell Johnston, Jr., John T. Dewolf and David F. Mazurek, Mechanics of Materials, McGraw-Hill Education, New York, 2015.
4. Bansal. R. K., A Textbook of Strength of Materials, Laxmi Publications Pvt. Ltd., New Delhi, 2018
5. Subramanian, R., Strength of Materials, Oxford University Press, Oxford Higher Education Series, 2016.
6. https://onlinecourses.nptel.ac.in/noc17_ce22/preview

18MC305 FLUID MECHANICS AND HYDRAULIC MACHINES**2023****Course Objectives**

- To understand the fluid properties and its application
- To acquire knowledge on kinematics and dynamics of internal flows of fluids
- To carry out the dimensional and model analysis of systems using Newtonian fluid
- To understand the concepts of hydraulic machines

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
 - 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.
- Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

Course Outcomes (COs)

- Analyze the dynamic behavior of fluid motion using various theorems
- Examine the nature of internal fluid flow and determine the losses occurring in the fluid path
- Predict the performance of hydraulic machine using dimensional and model analyses
- Analyze the performance of major turbines by applying principles of fluid mechanics.
- Analyze the performance of centrifugal pump and outline the working principle of positive displacement pumps

Articulation Matrix

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

UNIT I**6 Hours****FLUID PROPERTIES**

Fluid - Fluid Mechanics - Properties of fluids - Types of fluid - Capillarity and Surface Tension - Two dimensional Continuity equation, Bernoulli equation, energy equation, momentum equation and moment of momentum equation.

UNIT II**6 Hours****INTERNAL FLUID FLOW AND FRICTIONAL LOSSES**

Types of Fluid flow - Flow in circular pipe, - Darcy Weisbach equation - Chezy's formula - Minor losses in pipes - Flow through syphon - Flow through pipes in series and in parallel

UNIT III **6 Hours**

DIMENSIONAL ANALYSIS

Dimensional analysis - Rayleigh's Method, Buckingham's Pi Theorem - Similitude - Types of Similarities - Dimensionless parameters - Model laws

UNIT IV **6 Hours**

HYDRAULIC TURBINES

Turbines- definition - Classification, Types of Heads and Efficiencies - Construction and working principle - Pelton Wheel - Francis Turbine, Kaplan Turbine - specific speed - Characteristic curve for hydraulic turbines - Governing of turbines

UNIT V **6 Hours**

HYDRAULIC PUMPS

Types of Pumps- Construction and Working - Centrifugal pump, Reciprocating Pump, Jet Pumps, Gear Pump -Definitions of Head and Efficiencies - Minimum speed - Priming and Cavitation- Slip - Characteristic curves. Slip - Indicator diagram (Description only)

FOR FURTHER READING

Pressure Measurement - Types of manometer - Lift and drag in air foils - Propeller Turbine - Air vessel - Pitot Tube

1 **3 Hours**

EXPERIMENT 1

Determination of fluid properties for the given samples

2 **3 Hours**

EXPERIMENT 2

Determination of coefficient of discharge by selecting a simple flow and efficient flow measuring device to measure the flow of water in a closed pipe

3 **3 Hours**

EXPERIMENT 3

Measurement of discharge of a pipe flow using a vertically oriented flow measuring device and identifying the significant parameters

4 **3 Hours**

EXPERIMENT 4

Measure the discharge of open channel flow using V notch or trapezoidal notch

5 **3 Hours**

EXPERIMENT 5

Measure and Comparison of major losses in two pipes in which the water flowing inside them

6 **3 Hours**

EXPERIMENT 6

Selection of suitable pump for domestic application and determining its optimum performance parameters.

7	3 Hours
EXPERIMENT 7	
Selection of a non rotary positive displacement pump and determining its optimum performance parameters	
8	3 Hours
EXPERIMENT 8	
Determine the efficiency and characteristics of Impulse turbine	
9	3 Hours
EXPERIMENT 9	
Determine the efficiency and characteristics of Kaplan Turbine	
10	3 Hours
EXPERIMENT 10	
Design an experiment to verify the various fluid laws	

Total: 60 Hours

Reference(s)

1. R. K. Bansal, A textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, New Delhi, 2018
2. Bruce R. Munson , Donald F. Young, Theodore H. Okiishi and Wade W. Huebsch, Fundamentals of Fluid Mechanics, John Wiley and Sons (Asia) Pvt. Ltd., New Delhi, 2012.
3. Pijush K. Kundu and Ira M. Cohen, Fluid Machines, Academic Press, Burlington, USA, 2010
4. Yunus A. Cengel and John M. Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw-Hill Publishing Company Ltd, New Delhi 2013
5. John F. Douglas, J. M. Gasiorek, John Swaffield and Lynne Jack, Fluid Mechanics, Pearson Education, New Delhi, 2008.
6. S. K. Som , Gautam Biswas and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill Publishing Company Ltd, New Delhi 2017

18MC306 MANUFACTURING TECHNOLOGY**3 0 0 3****Course Objectives**

- To understand working principle of conventional and non conventional casting, welding and metal working processes
- To study the working of machining processes including non-conventional types
- To learn about the production methods of thermo and thermosetting plastics

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Explain the basics and working principle of sand casting and special casting processes
2. Explain the principles of different joining processes like welding, brazing, soldering and adhesive bonding
3. Identify the suitable metal forming processes for various application
4. Demonstrate the process of conventional machining and explain the principles of non-conventional machining processes
5. Recognize the suitable method to produce thermo and thermosetting plastics

Articulation Matrix

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

UNIT I**9 Hours****CASTING PROCESSES**

Introduction to Foundry - Procedure to make sand mould, types of cores, moulding tools, machine moulding - pattern, sand testing, - casting defects and remedies. Introduction to Plastics - Moulding of Thermoplastics - Injection moulding -Plunger and screw machines -Blow moulding -Rotational moulding -Flim blowing - -Thermoforming - Compression moulding -Transfer moulding

UNIT II**9 Hours****JOINING PROCESSES**

Types of Metal Joining Process - Introduction to welding process - Principle of arc and gas welding - Tools and equipment - Filler and flux materials - Flame types - Weld defects - Safety in welding - Special welding processes: resistance welding, friction welding, TIG welding, MIG welding - Brazing and soldering - Adhesive bonding

UNIT III

9 Hours

METAL FORMING THEORY

Introduction to hot and cold working - Forging: open and close die, upsetting - Rolling: high roll mills and shape rolling - Extrusion: forward and backward, tube extrusion - Drawing of wires, rods and tubes - Sheet metal work: Shearing, bending and drawing operations - Powder metallurgy (basics only)

UNIT IV

9 Hours

MACHINE TOOLS

Cutting tools & materials, cutting fluids, metal cutting theory, Merchant's circle, constructional features of machine tools: Universal milling machine, shaping machine, cylindrical grinding machine, capstan and turret lathe - Basics of CNC machines

UNIT V

9 Hours

NON CONVENTIONAL MACHINING

General principles and applications - Water jet machining (WJM), Abrasive Jet Machining (AJM) Electro Discharge Machining (EDM), Electro Chemical Machining (ECM) and Laser Beam Machining (LBM), Ultrasonic Machining (USM)

FOR FURTHER READING

Additive Manufacturing, Laser Beam welding, Automated Molding system

Total: 45 Hours

Reference(s)

1. J. P. Kaushish, Manufacturing Processes, Prentice Hall of India Learning Private Limited, New Delhi, 2014
2. P. N. Rao, Manufacturing Technology - Vol I and II, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2013.
3. D. K. Singh, Fundamentals of Manufacturing Engineering, ANE Books, New Delhi, 2008
4. Roy A. Lindberg, Processes and Materials of Manufacture, Prentice Hall of India Learning. Ltd., New Delhi, 2009
5. T. R. Mishra, Non-Conventional Machining, Narosha Publishing House, New Delhi, 2012
6. Mikell P. Groover, Automation, Production System and Computer Integrated Manufacturing, Pearson Education, New Delhi, 2015.

18MC307 DIGITAL ELECTRONICS LABORATORY**0 0 2 1****Course Objectives**

- To design and implement the digital circuits
- To gain expertise in digital systems and simulation of digital circuits with ICs

Programme Outcomes (POs)

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.

m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Design the digital circuits for a given application
2. Knowledge on digital systems and implementations of various math operations using ICs
3. Design of signal converter using ICs

Articulation Matrix

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

1 **3 Hours**

EXPERIMENT 1

Design and implementation of Adders and Subtractor using logic gates.

2 **3 Hours**

EXPERIMENT 2

Design and implementation of code converters using logic gates

(i) BCD to excess-3 code and vice versa

(ii) Binary to gray and vice-versa

3 **3 Hours**

EXPERIMENT 3

Design and implementation of 4 bit binary adder/ subtractor and BCD adder.

4 **3 Hours**

EXPERIMENT 4

Design and implementation of 2 bit magnitude comparator using logic gates, 8 bit magnitude comparator

5	3 Hours
EXPERIMENT 5	
Design and implement a 16 bit odd/even parity generator and checker using ICs	
6	3 Hours
EXPERIMENT 6	
Design and implement a multiplexer and demultiplexer using ICs	
7	3 Hours
EXPERIMENT 7	
Design and implement an encoder and decoder using ICs	
8	3 Hours
EXPERIMENT 8	
Design and implement a synchronous counter	
9	3 Hours
EXPERIMENT 9	
Design a sequential circuit using ROMs and PLAs	
10	3 Hours
EXPERIMENT 10	
Design flip flops (JK,SR,D and T) VHDL using data level of abstraction	

Total: 30 Hours

Reference(s)

1. N. Nagrath, Electronics: Analog and Digital, Prentice Hall of India Pvt. Ltd, New Delhi, 2009
2. Anant Agarwal, Joffrey H. Lang, Foundations of Analog and Digital Electronic Circuit, Elsevier, 2006

**18MC308 MANUFACTURING TECHNOLOGY
LABORATORY****0 0 2 1****Course Objectives**

- To operate conventional machine tools such as lathe, milling machine, shaping machine, drilling machine, gear hobbing machine, surface grinding machine and tool and cutter grinder
- To correlate the theory course on machining processes
- To measure various linear dimensions

Programme Outcomes (POs)

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

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.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Summarise and classify various machine tools and measure various linear dimensions
2. Demonstrate various conventional machine tools for drilling and welding operations
3. Create various machine parts according to required design

Articulation Matrix

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

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

Machining a cotter pin whose diameter is continuously varying throughout its length

2**3 Hours****EXPERIMENT 2**

Making a model of screw used in vernier caliper

3**3 Hours****EXPERIMENT 3**

Practicing to make models like table, chair, rack, teapoy, stool, etc using arc welding equipment

4**3 Hours****EXPERIMENT 4**

Fabrication of a pin and hole with push fit assembly using centre lathe

5 **3 Hours**

EXPERIMENT 5

Preparing the shaft/key/coupling assembly by selecting suitable machining operations and to list the sequence of operations.

6 **3 Hours**

EXPERIMENT 6

Machining of flange with four holes placed at 90° and with internal thread at the centre to connect pipes

7 **3 Hours**

EXPERIMENT 7

Machining a spur gear with n number of teeth with 2 mm module by selecting suitable machine tool.

8 **3 Hours**

EXPERIMENT 8

Grinding of single point cutting tool in the 10 mm MS square rod with standard nomenclature using tool and cutter grinding machine

9 **3 Hours**

EXPERIMENT 9

Preparing the surface of the shaft within the tolerance limit of ± 0.002 mm to assemble with a bearing of inside diameter 22 mm

10 **3 Hours**

EXPERIMENT 10

Producing a square bar from the given shaft with minimum material wastage by selecting suitable machining operations

Total: 30 Hours

Reference(s)

1. Central Machine Tool Institute (CMTI), Machine Tool Design Handbook, Tata McGraw-Hill Publishing Company Ltd, Bangalore, 2017
2. Geoffery Boothroyd and Winston A. Knight, Fundamentals of Machining and Machine Tools, CRC Press, Taylor and Francis Group, Indian Edition, 2008.
3. Heinrich Gerling and Karl H. Heller, All About Machine Tools, New Age International (P) Limited Publishers, Noida, 2008
4. Steve F. Krar, Arthur R. Gill and Peter Smid, Technology of Machine Tools, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2010

18GE301 SOFT SKILLS - VERBAL ABILITY**2 0 0 0****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

Programme Outcomes (POs)

- Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- 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.
- Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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
1										1				
2											2			
3									2					

UNIT I**15 Hours****INTRODUCTION**

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

UNIT II**15 Hours****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.

Total: 30 Hours**Reference(s)**

1. 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.

18MC401 ENGINEERING MATHEMATICS IV**3 1 0 4****Course Objectives**

- Recognize and develop a mathematical model representing all important characteristics of the physical system.
- Identify and solve any type of mathematical equations by numerical methods.
- Predict and control the process by control charts.

Programme Outcomes (POs)

- 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.

Course Outcomes (COs)

1. Compute the solution of nonlinear equations and to construct a mathematical model for the given data.
2. Assess the values of one and two dimensional partial differential equations like vibration of strings, heat distribution in a rod and plate
3. Identify the error committed by the numerical calculation of any type of mathematical models and able to rectify the errors
4. Predict the outcome of any mechanical process using the concepts probability and probability distributions.
5. Justify and validate the mathematical model for a mechanical process with the help of hypothesis testing

Articulation Matrix

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

UNIT I**10 Hours****NUMERICAL SOLUTIONS OF NON LINEAR EQUATIONS, INTERPOLATION AND ORDINARY DIFFERENTIAL EQUATIONS.**

Single and multi-variable nonlinear equations by Newton s method, convergence of fixed point iterations. Curve fitting: Least squares approximation, Normal equations. Polynomial interpolation and cubic spline interpolation. Single step method: Runge-Kutta method, Multi-step methods, Finite Difference Methods.

UNIT II**10 Hours****NUMERICAL SOLUTIONS OF INTEGRATIONS AND PARTIAL DIFFERENTIAL EQUATIONS.**

Integration using Simpson s and Trapezoidal rules. Classification of partial differential equations, solutions of Laplace s and Poisson s equations, Solutions of parabolic and hyperbolic equations.

UNIT III

6 Hours

ERROR ANALYSIS

Errors, Truncation and round off errors, measurement errors, Chebychev's Polynomial and data filtering.

UNIT IV

10 Hours

PROBABILITY THEORY

Probability. Random variables, probability densities and distributions, mean and variance of a distribution. Conditional probability. Bayes theorem. Binomial, Poisson and normal distributions.

UNIT V

9 Hours

DATA ANALYSIS

Data Sampling, Random Sampling, Reliability of Data, Testing of Hypothesis, Confidence Interval, Quality Control.

Total: 60 Hours

Reference(s)

1. Greenberg Michael D., Advanced Engineering Mathematics, Prentice-Hall International Inc, 1998.
2. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
3. Johnson Richard A. and Bhattacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
4. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Eastern Economy Edition, New Delhi.
5. 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.

18MC402 SENSORS AND SIGNAL CONDITIONING**3 0 0 3****Course Objectives**

- To recall the basic laws governing the operation of electrical instruments and the measurement techniques
- To discuss about units, standards, error analysis and characteristics of measurement systems
- To select a suitable sensor and signal conditioning circuit for a particular applications

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Familiar with various calibration techniques and signal types for sensors.
2. Summarize the different sensors associated in measuring motion, proximity and ranging sensors signals
3. Represent the working principle and characteristics of force, magnetic and heading sensors
4. Explain the basic principles of various pressure temperature, optical and smart sensors
5. Represent the need for signal conditioning system and their purpose

Articulation Matrix

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

UNIT I**9 Hours****SCIENCE OF MEASUREMENT**

Basics of Measurement - Classification of errors - Error analysis - Static and dynamic characteristics of transducers - Performance measures of sensors -Classification of transducers - Sensor calibration techniques -Sensor Output Signal Types

UNIT II**9 Hours****MOTION, PROXIMITY AND RANGING SENSORS**

Motion Sensors - Potentiometers, Resolver, Encoders - Optical, Magnetic, Inductive, Capacitive, LVDT - RVDT - Synchro - Microsyn, Accelerometer - GPS, Bluetooth, Range Sensors - RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III

9 Hours

FORCE, MAGNETIC AND HEADING SENSORS

Strain Gage, Load Cell, Magnetic Sensors - types, principle, requirement and advantages: Magneto resistive - Hall Effect -Current sensor Heading Sensors - Compass, Gyroscope, Inclometers.

UNIT IV

9 Hours

OPTICAL, PRESSURE AND TEMPERATURE SENSORS

Photo conductive cell, photo voltaic, Photo resistive, LDR - Fiber optic sensors - Pressure - Diaphragm, Bellows, Piezoelectric - Tactile sensors, Temperature - IC, Thermistor, RTD, Thermocouple. Acoustic Sensors - flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors

UNIT V

9 Hours

SIGNAL CONDITIONING SYSTEM

Wheatstone and Schering bridges - Amplification - Filtering - V/I, I/V and I/P converters - Sample and Hold circuits - D/A converter (R -2R ladder and weighted resistor types) - A/D converter (Dual slope, successive approximation and flash types) - Data logging - Display devices: CRO, LED and LCD

FOR FURTHER READING

Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors - applications - Automobile, Aerospace, Robotics and Manufacturing.

Total: 45 Hours

Reference(s)

1. A.K.Sawhney and P.Sawhney, A Course on Mechanical Measurement Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2011
2. E. O. Doebelin, Measurement Systems: Applications and Design, Tata McGraw-Hill Publishing Company Limited, 2003
3. C. Sujatha and Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
4. Hans Kurt Tonshoff (Editor), Ichiro, Sensors in Manufacturing, Volume 1, Wiley-VCH 2001.
5. Richard Zurawski, Industrial Communication Technology Handbook 2nd edition, CRC Press, 2015
6. <https://nptel.ac.in/courses/112103174/3>

18MC403 POWER ELECTRONICS AND DRIVES**3 0 2 4****Course Objectives**

- To obtain the switching characteristics of different types of power semi-conductor devices
- To determine the operation, characteristics and performance parameters of converters
- To understand the concept of DC and AC drives

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Classify the switching characteristic of different types of power semi-conductor devices
2. Interpret the operation, characteristics and performance parameters of converters
3. Interpolate various inverter techniques and harmonics elimination methods
4. Implement the knowledge of speed control of solid state DC drives
5. Execute the speed control methods of AC machines and power factor correction

Articulation Matrix

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

UNIT I**9 Hours****POWER SEMICONDUCTOR DEVICES**

Construction, Operation, Characteristics of Power Diode - SCR - TRIAC - Power transistor, MOSFET and IGBT - di/dt and dv/dt protection

UNIT II**9 Hours****CONVERTERS AND CHOPPERS**

Phase Control - Single Phase and Three phase uncontrolled and controlled rectifiers with R and RL load, Choppers, Time ratio control, Types, Buck-boost chopper-four quadrant operation, cycloconverters

UNIT III **9 Hours**

INVERTERS

Single phase and three phase (both 120° and 180° modes.) voltage source inverters - PWM techniques: Sinusoidal PWM modified sinusoidal PWM and multiple PWM - Current source inverters
- Harmonics elimination technique

UNIT IV **9 Hours**

SOLID STATE DC DRIVES

Types of electrical drives - selection of drives - heating and cooling curves - Four quadrant operation of hoist - Ward Leonard control system - Control of DC drives using rectifiers and choppers

UNIT V **9 Hours**

SOLID STATE AC DRIVES

Control of three phase induction motors using stator voltage and frequency control - variable frequency drive - static rotor resistance control - Slip power recovery schemes - Static Kramer control method - Static Scherbius control method - Power factor correction

FOR FURTHER READING

Sepic, pi, T converters, UPS-PV power conversion, Application of Closed Loop control method, Permanent magnet brushless DC motor drive

1 **3 Hours**

EXPERIMENT 1

Characteristics of SCR

2 **3 Hours**

EXPERIMENT 2

Characteristics of IGBT

3 **3 Hours**

EXPERIMENT 3

Single phase half wave uncontrolled rectifiers with R, RL load

4 **3 Hours**

EXPERIMENT 4

Single phase half wave controlled rectifiers with R, RL load

5 **3 Hours**

EXPERIMENT 5

Single phase half wave controlled rectifiers with R, RL load and feedback diode

6 **3 Hours**

EXPERIMENT 6

Single phase uncontrolled rectifiers with R, RL load

7 **3 Hours**

EXPERIMENT 7

Single phase controlled rectifiers with R, RL load

8 **3 Hours**

EXPERIMENT 8

Three phase uncontrolled rectifiers with R, RL load

9 **3 Hours**

EXPERIMENT 9

Three phase controlled rectifiers with R, RL load

10 **3 Hours**

EXPERIMENT 10

Single phase PWM inverter

Total: 75 Hours

Reference(s)

1. Muhammad H. Rashid, Power Electronics - Circuits, Devices and Applications, Prentice Hall of India Learning. Ltd., New Delhi, 2004
2. G. K. Dubey, Fundamentals of Electrical Drives, Wiley Eastern Ltd., New Delhi, 2007
3. S. K. Pillai, A First Course on Electrical Drives, New Age International Pvt. Ltd., New Delhi, 2012.
4. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008
5. Vedam Subrahmaniam, Electric Drives (concepts and applications), Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2007
6. P. S. Bhimbra, Power Electronics, Khanna Publishers, New Delhi, 2012

18MC404 FLUID POWER SYSTEM**2 0 2 3****Course Objectives**

- To gain knowledge on properties of fluid and various types of losses in fluid
- To understand the construction and working principle of various components used in hydraulic and pneumatic systems
- To design hydraulic and pneumatic circuits for various applications using software and hardware tools

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- m. Analyze, design and develop electro mechanical system using contemporary tools
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Describe the components of fluid power system and compute losses in hydraulic system
2. Classify hydraulic pumps and select suitable actuators used in hydraulic system
3. Select the hydraulic valves for the given applications.
4. Explain the fundamentals of pneumatic system
5. Design the hydraulic and pneumatic circuits for a given application using various methods.

Articulation Matrix

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

UNIT I**6 Hours****FLUID POWER SYSTEMS**

Introduction to fluid power – History- Pascal's law - Comparison between various type of energy medium - Advantages - Drawbacks - Applications of fluid power system in various sectors. Hydraulic fluids: Properties and functions. Filtration system – Darcy's equation: Frictional losses. Losses in valves and fittings - Determination of head losses & pump power in a hydraulic circuit.

UNIT II **6 Hours**

HYDRAULIC PUMPS AND ACTUATORS

Positive and non positive displacement pumps - Pumping theory and classification - Construction and working principle of Gear, Vane and Piston pumps - Variable Displacement Pumps (Vane and Piston), Pump performance curves - Hydraulic cylinders: Construction & Working principle - Single acting, Double acting, Double rod cylinder and Telescopic cylinder. Hydraulic motors: Gear, Vane and Piston motors

UNIT III **6 Hours**

HYDRAULIC VALVES

Directional Control Valves: Check valve - Pilot operated check valve - methods of valve actuation - working principle of 2/2, 3/2, 4/2, 4/3 and 5/2 DCV - Shuttle valve. Pressure control Valves: Pressure relief valves - Pressure reducing valve - Unloading valves - Counterbalance valves - Flow control valves - Proportional and Servo valves: Mechanical type.

UNIT IV **6 Hours**

PNEUMATICS SYSTEM

Introduction - Properties of air - gas laws - Compressors: Piston compressor, Screw compressor and Vane compressor. Fluid conditioners: Air filters, Air pressure regulators, Air lubricators, Pneumatic silencers, Aftercoolers and Air dryers. Pneumatic actuators: Pneumatic cylinders, Rotary air motors and Performance curves

UNIT V **6 Hours**

DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS

Fluid power Symbols - Basic circuit - Meter in and Meter Out Circuit - Counter balance Circuit - Pipe Sizing Calculations. Sequential circuit design for simple applications: Step counter method, Cascade methods & Karnaugh Veitch map method

FOR FURTHER READING

Servo pumps - variable displacement hydraulic motors-Pneumatic valves. Introduction to Hydraulic Accessories, Pressure switch, Pressure and Flow sensors - Accumulators

1 **3 Hours**

EXPERIMENT 1

Identification of fluid power system components.

2 **3 Hours**

EXPERIMENT 2

Drawing the standard symbols of Fluid Power System components.

3 **3 Hours**

EXPERIMENT 3

Actuation of a single acting cylinder using limit switch and push button in a kit and simulation software.

4 **3 Hours**

EXPERIMENT 4

Actuation of a double acting cylinder using limit switch in a kit and simulation software

5 **3 Hours**

EXPERIMENT 5

Simulation of fluid power circuits with logic controls (AND valve and OR valve).

6 **3 Hours**

EXPERIMENT 6

Design of PLC circuits using to actuate the double acting cylinder of Hydraulic lift

7 **3 Hours**

EXPERIMENT 7

Actuation of meter in, meter out, synchronizing and quick exhaust circuit in a simulation software

8 **3 Hours**

EXPERIMENT 8

Design of pneumatic circuit for a drilling operation and simulate the operation in a simulation software (use step counter method).

9 **3 Hours**

EXPERIMENT 9

Design of hydraulic circuit for a pick and place operation using cascade method and simulate the operation

10 **3 Hours**

EXPERIMENT 10

Design of fluid power circuit using Karnaugh Veitch method and simulate the operation in a simulation software.

Total: 60 Hours

Reference(s)

1. Anthony Esposito, Fluid Power with Applications, Pearson Education New Delhi, 2015
2. S. R. Majumdar, Oil Hydraulics, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2014
3. James L. Johnson, Introduction to Fluid Power, Delmar Thomson Learning, 2013
4. S. R. Majumdar, Pneumatic systems - Principles and maintenance, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi, 2014.
5. Andrew Parr, Hydraulics and Pneumatics, Jaico Publishing House, 2015
6. <https://nptel.ac.in/courses/112105047>

18MC405 THEORY OF MACHINES**3 1 0 4****Course Objectives**

- To learn various mechanisms and find their velocity and acceleration
- To perform force analysis and balancing of reciprocating engines
- To understand the function of flywheel and to determine basic parameters of flywheel
- To determine gear ratio for simple, compound, reverted and epicyclic gear train

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Compute the mobility of a given planar mechanism
2. Apply vector mechanics principles to draw the velocity and acceleration diagram of planar mechanisms
3. Analyze the static and dynamic forces in different parts of reciprocating engine
4. Apply the concept of balancing of masses in rotating shafts and explain the effect of vibration
5. Compute speed and torque ratio of major gear trains

Articulation Matrix

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

UNIT I**9 Hours****BASICS OF MECHANISMS**

Basic concepts of mechanisms: link, pair, chain, mechanism, machine and structure, degree of freedom, mobility of mechanism - Kutzbach criterion, Grashof's law - Inversions of mechanisms: Four bar and slider crank Mechanical advantage, Transmission angle, Description of some common mechanisms: Straight line generators, dwell mechanisms, ratchets and escapements, universal joint - Gyroscope and Mechanical Governors(Basics only) - Industrial robotic arms

UNIT II **9 Hours**

KINEMATICS OF MECHANISMS

Displacement, velocity and acceleration - Graphical method of velocity (relative velocity method) and acceleration diagrams for simple mechanisms - Coriolis component of acceleration

UNIT III **9 Hours**

KINETICS OF MECHANISMS

Static force analysis: Applied and constraint forces, Free body diagrams, Static equilibrium conditions: Two, three and four members - Static force analysis of simple mechanisms - The principle of superposition - Dynamic force analysis: Inertia force and Inertia torque, D'Alembert's principle, Dynamic Analysis in Four bar mechanism

UNIT IV **9 Hours**

BALANCING AND VIBRATION

Balancing Single Rotating mass by a single mass rotating in the same plane and two masses rotating in different planes - Several masses rotating in the same plane and different planes - Vibration and its effects - Types of vibration: Longitudinal, Transverse and torsional-free, forced and damped vibrations (basic only)

UNIT V **9 Hours**

GEARS AND GEAR TRAINS

Law of toothed gearing Involute and cycloidal tooth profiles Spur gear terminology and definitions Gear tooth action Interference and undercutting Problems Helical, bevel, worm, rack and pinion gears (Basics only) - Introduction to gear correction gear trains Speed ratio, train value, Parallel axis gear trains, Epicyclic gear trains - Determination of gear speeds and torque using tabular method

FOR FURTHER READING

Cams, dynamic analysis of reciprocating engine

Total: 60 Hours

Reference(s)

1. S. S. Rattan, Theory of Machines, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2014
2. R. L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2009
3. Sadhu Singh, Theory of Machines, Prentice Hall of India Learning, New Delhi, 2012
4. Kenneth J .Waldron and Garry L. Kinzel, Kinematics, Dynamics and Design of Machinery, John Wiley and Sons (Asia) Pvt. Ltd., New Delhi, 2007
5. R. S. Khurmi, J. K. Gupta, Theory of Machines, Eurasia Publishing House Pvt. Ltd., New Delhi, 2005
6. https://onlinecourses.nptel.ac.in/noc19_me29/preview

18MC406 METROLOGY AND MEASUREMENTS**3 0 0 3****Course Objectives**

- To familiarize the important terms connected to measurement and understand various techniques used in linear, angular, form, power, flow and temperature measurements
- To impart knowledge on fits, tolerances and gauges design

Programme Outcomes (POs)

- 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.
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

- Assess the parameters of a measuring instrument
- Select an appropriate instrument for linear and angular measurements
- Use gauges and comparators to make relative measurements
- Check the gear, thread and surface roughness parameters
- Identify and demonstrate the instruments used in process industries

Articulation Matrix

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

UNIT I**9 Hours****BASICS OF METROLOGY**

Introduction to metrology - Precision and accuracy - Terms associated with measurement: sensitivity, readability, reliability and repeatability - Errors in Measurements: systematic and random errors - Correction and calibration - Types of standards - Concepts of interchange ability and selective assembly

UNIT II**9 Hours****LINEAR AND ANGULAR MEASUREMENTS**

Linear measuring instruments - Classification - Vernier calliper - Micrometer - Limit gauges - gauge design - Angular measuring instruments: bevel protractor, clinometers, angle gauges, spirit levels, slip gauges and sine bar - Autocollimator - Laser interferometers - Machine vision - Nano-measurements

UNIT III

9 Hours

COMPARATORS AND GAUGES

Comparators: mechanical, mechanical optical comparators, electrical comparators and pneumatic comparators - Limits, fits and tolerances - Tolerance grades - Types of fits - GO and NO GO gauges: plug and snap gauges - Taylor's principle - Design of GO and NO GO gauges - Filler gauges

UNIT IV

9 Hours

FORM MEASUREMENT

Gear measurement: gear tooth vernier, constant chord method - Measurement of lead and run out - Backlash checking - Parkinson gear tester - Thread measurement: two wire and three wire methods - Errors in threads - Surface roughness parameters: Ra, Ry, Rz and RMS values - Surface roughness symbols

UNIT V

9 Hours

MEASUREMENT OF POWER, FLOW AND TEMPERATURE

Force - Torque - Power - Measurement of power: mechanical, pneumatic, hydraulic and electrical type - Flow measurement: venturimeter, orifice meter, rotameter, Pitot tube - Temperature measurement: Liquid in glass Thermometers, Pressure Thermometers, Pyrometer, bimetallic strip, thermocouple and electrical resistance thermometer

FOR FURTHER READING

Basic concept of CMM - Application of CMM - 3D Scanner

Total: 45 Hours

Reference(s)

1. Jain, R. K., Engineering Metrology, Khanna Publishers, New Delhi, 2018
2. Bewoor, A. K. and Kulkarni, V. A., Metrology and Measurement, Tata McGraw-Hill Publishing House, New Delhi, 2009.
3. Venkateshan, S. P., Mechanical Measurements, John Wiley and Sons, New Delhi, 2015
4. Backwith, Marangoni and Lienhard, Mechanical Measurements, Pearson Education, New Delhi, 2013
5. https://onlinecourses.nptel.ac.in/noc18_me62/preview

18MC407 SENSORS LABORATORY**0 0 2 1****Course Objectives**

- The purpose of this course is to acquire knowledge about LabVIEW programming and to study the interfacing of different sensors with LabVIEW.

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

- Develop a LabVIEW program to obtain a required measurement data for temperature
- Generate appropriate design procedure to obtain a required measurement data for force
- Create appropriate design procedure to obtain a required measurement data for displacement
- Develop an appropriate design procedure, suitable for signal conversion to interface with computer.
- Develop the LabVIEW program to control the speed and position of servomotor

Articulation Matrix

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

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

In automobiles, temperature of the radiator has to be monitored regularly. Normally RTD's are used to monitor the coolant temperature because of its linearity property. Develop a suitable program to measure the temperature of RTD.

2**3 Hours****EXPERIMENT 2**

Temperature measurement plays a vital role in milk processing industries. Because of high accuracy and stability, thermocouples are mostly preferred. Develop a suitable program to measure the temperature of J, K and E Type thermocouples

3 **3 Hours**

EXPERIMENT 3

Electronics produced by the telecommunications industry- out of all the devices thermistors are used in cellular phones. Thermistors helps to regulate the temperature from inside a mobile device. This is important with the accepted use of rechargeable lithium-ion battery packs. Thermistors are also an important part of the protective circuitry. Develop a suitable program to measure the temperature of using thermistor

4 **3 Hours**

EXPERIMENT 4

Aerospace products requires a continuous measure of weight and pressure on a near constant basis. These critical operations require the highest standard of accuracy. In which load cell are mostly preferred. Develop a suitable program to measure the force measurement using load cell

5 **3 Hours**

EXPERIMENT 5

Accurate and precise measurements of ligament strain, e.g. in the human knee, are still one of the most challenging tasks in biomechanical engineering. In order to measure the movement of knee joints and their reaction under mechanical load strain gauges are used. Develop a suitable program to measure the strain value using strain gauge.

6 **3 Hours**

EXPERIMENT 6

LVDTs are mostly used to measure spool position in a wide range of servo valve applications. Develop a suitable program to measure the displacement using LVDT.

7 **3 Hours**

EXPERIMENT 7

Vibration Measurement using Accelerometer and Frequency spectrum analysis, calculation of velocity and displacement using accelerometer

8 **3 Hours**

EXPERIMENT 8

Analog to Digital Conversion

9 **3 Hours**

EXPERIMENT 9

Digital to Analog Conversion

10 **3 Hours**

EXPERIMENT 10

Speed and Position Control of Servo Motor

Total: 30 Hours

Reference(s)

1. LabVIEW: Basics I & II Manual, National Instruments, Bangalore, 2011.
2. A. K. Sawhney and P. Sawhney, A Course on Mechanical Measurement Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2011

**18MC408 COMPUTER AIDED DESIGN
LABORATORY****0 0 4 2****Course Objectives**

- To provide knowledge and skills to draw orthographic projections of simple components using geometric modelling software
- To provide knowledge on three dimensional model of simple mechanism and animation using CAD software

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

- Sketch the orthographic projections of simple components using geometric modelling software
- Construct three dimensional assembly models of machine and robotic components using CAD Software.

Articulation Matrix

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

1 **4 Hours****EXPERIMENT 1**

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

2 **4 Hours****EXPERIMENT 2**

Construct a three dimensional assembly model of bearing

3 **4 Hours****EXPERIMENT 3**

Construct a three dimensional assembly model of bearing

4 **8 Hours****EXPERIMENT 4**

Generate a three dimensional shaft and coupling assembly model by considering tolerance in each Component.

5 **8 Hours****EXPERIMENT 5**

Create a three dimensional assembly model of Piston and Connecting Rod.

6	8 Hours
EXPERIMENT 6 Build a three dimensional assembly model of power drive system	
7	4 Hours
EXPERIMENT 7 Create a three dimensional assembly model of two wheeler suspension system	
8	4 Hours
EXPERIMENT 8 Construct a three dimensional assembly model of control valve	
9	4 Hours
EXPERIMENT 9 Generate a three dimensional assembly model of Jig/fixture	
10	8 Hours
EXPERIMENT 10 Create a three dimensional assembly model of cartesian robot and animate its working using modeling software.	
11	4 Hours
EXPERIMENT 11 Prepare technical documents for Cartesian robot Assembly by using 3D Via software.	

Total: 60 Hours

Reference(s)

1. Prof Sham Tickoo, Prabhakar Singh,Creo Parametric 2.0 for Engineers and Designers, Dreamtech press publication,New Delhi, 2013
2. Fumihiko Kimura, Geometric Modelling: Theoretical and Computational Basis towards Advanced CAD Applications,Springer publications, Newyork, 2001

18HS001 ENVIRONMENTAL SCIENCE**2 0 0 0****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

Programme Outcomes (POs)

- 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.
- 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

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
1	1	2												
2	1	1												
3	2	2					1							
4	1													
5	2													

UNIT I**6 Hours****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

6 Hours

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

UNIT III

6 Hours

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

7 Hours

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

5 Hours

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

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edition, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
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. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

18GE401 SOFT SKILLS-BUSINESS ENGLISH

2 0 0 0

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

Programme Outcomes (POs)

- Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- 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.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I

15 Hours

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

15 Hours

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)

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

18MC501 CONTROL SYSTEMS**3 1 0 4****Course Objectives**

- To describe feedback control and basic components of control systems
- To understand the various time domain and frequency domain tools for analysis and design of linear control systems
- To study the methods to analyze the stability of systems from transfer function forms
- To describe the methods of designing compensators

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Develop a mathematical model of a physical system and compute the transfer function using Block diagram reduction technique and Signal flow graph.
2. Analyze the performance of first and second order system and compute the steady state error for different test signals
3. Analyze the frequency domain response and determine the phase margin and gain margin using bode plot, polar plot and Nyquist plot.
4. Analyse the cascade compensation and design a lag, lead and lag-lead series compensator using bode plot
5. Check the system controllability and observability using state space approach

Articulation Matrix

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

UNIT I**9 Hours****SYSTEMS REPRESENTATION**

Basic elements in control systems - open loop and closed loop with applications - Transfer functions of mechanical, electrical and analogous systems - Block diagram reduction - signal flow graphs

UNIT II **10 Hours**

TIME RESPONSE ANALYSIS

Time response - Time domain specifications -Types of test inputs I and II order system response - Steady state error, error constants - Stability concept and definition - Characteristic equation - Location of poles - Routh Hurwitz criterion - Root locus techniques: construction

UNIT III **9 Hours**

FREQUENCY RESPONSE ANALYSIS

Bode plots - Polar plot - Nyquist stability criterion - Correlation between frequency domain and time domain specifications - stability analysis using frequency response methods.

UNIT IV **9 Hours**

COMPENSATOR AND CONTROLLER DESIGN

Realization of basic compensators - cascade compensation in time domain and frequency domain - feedback compensation - Design of lag, lead, lag-lead series compensator (using Bode plot)- Introduction to P, PI, PID controllers.

UNIT V **8 Hours**

STATE SPACE ANALYSIS

State equation - Solutions, Realization, Controllability, Observability - State space to transfer function conversion.

FOR FURTHER READING

Tachometer - Synchro - Need for time & frequency domain analysis and its applications - Impacts of stability and its important methods - Application of compensation

Total: 60 Hours

Reference(s)

1. Norman S. Nise, Control System Engineering, Wiley India Edition New Delhi, 2018
2. J. Nagrath and M. Gopal, Control System Engineering, New Age International Publisher, New Delhi, 2008
3. Rao V Dukkippatti, Control Systems, Narosa Publications, New Delhi, 2005
4. M. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, New Delhi, 2003
5. K. Ogata, Modern Control Engineering, Pearson Edition 5th Edition, London, 2010
6. <https://nptel.ac.in/courses/108106098/>

18MC502 ROBOTICS**3 0 0 3****Course Objectives**

- To acquire knowledge on the fundamentals of robotic systems

Programme Outcomes (POs)

- 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.
- 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.
- m. Analyze, design and develop electro mechanical system using contemporary tools
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

- Interpret fundamental terminology used in robotics
- Classify major types of end effectors and controls used in robot
- Apply fundamental transformation matrix for kinematic solution and sensors used in robotics
- Determine major robot work cell design and robot applications for manufacturing and assembly sectors
- Compare micro and nano robots and its application

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION TO ROBOTICS**

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robots-Simple problems- Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems- Hydraulic, Pneumatic and Electric system

UNIT II**10 Hours****END EFFECTORS AND ROBOT CONTROLS**

Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control

UNIT III

8 Hours

ROBOT KINEMATICS

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Denavit- Hartenberg convention, Forward and inverse kinematics solution for SCARA configured robot

UNIT IV

9 Hours

ROBOT CELL DESIGN AND APPLICATIONS

Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using software. Introductions-Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and underwater robot

UNIT V

9 Hours

SERVICE AND FIELD ROBOTICS

History of service robotics - Present status and future trends - Need for service robots - applications-examples and Specifications of service and field Robots.Non conventional industrial robots

FOR FURTHER READING

Medical robot, Nuclear material handling robot, Robots for thermal and chemical plants, Autonomous Vehicles, Application of collaborative robots

Total: 45 Hours

Reference(s)

1. S.R. Deb, Robotics Technology and flexible automation, 2nd Edition, Tata McGraw-Hill Education, 2017
2. Mikell P Groover & Nicholas G Odrey, Mitchell Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, 2nd Edition, Tata McGraw- Hill Education, 2017.
3. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, PHI Learning, 2009.
4. Francis N. Nagy, Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1986
5. Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press, 2008
6. NPTEL - <https://nptel.ac.in/courses/112105249/>

**18MC503 MICROPROCESSORS AND
MICROCONTROLLER****3 0 0 3****Course Objectives**

- To give an emphasis on the hardware features of Microprocessor and Microcontroller with their functions
- To provide essential knowledge on various operating modes of I/O ports Timers/Counters, control registers and various types of interrupts
- To design and verify the various interfacing techniques for various applications

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Analyze the internal hardware architecture and instruction of 8085 microprocessor
2. Analyse the hardware architecture and instruction of 8086 microprocessor
3. Develop an interfacing circuit using various interfacing device with Microprocessor 8085
4. Analyse the hardware architecture and instruction of microcontroller 8051, ATMEGA and arduino
5. Apply the microprocessor and microcontroller used for various industrial application

Articulation Matrix

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

UNIT I**9 Hours****INTEL 8085 MICROPROCESSOR**

Introduction - Organization of 8085: Architecture, Internal Register Organization and Pin Configuration
 - Instruction Set of 8085 - addressing modes - instruction and machine cycles with states and timing diagram

UNIT II **9 Hours**

8085 INTERFACING DEVICES

Programmable peripheral Interface (8255) - Programmable interval timer (8253) - Programmable communication interface (USART) - Programmable interrupt controller - Programmable DMA Controller (8257).

UNIT III **9 Hours**

8051 ARCHITECTURE

Microcontroller Hardware - I/O Pins, Ports - External memory - Counters and Timers - Serial data I/O - Interrupts - 8051 Assembly Language Programming: Instruction set of 8051, Addressing modes, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions

UNIT IV **9 Hours**

MSP430 MICROCONTROLLER

Introduction to MSP Microcontroller, MSP430 Architecture - Functions, Interrupts and Low- Digital Inputs and Outputs - analog inputs and outputs - Timer - Communications.

UNIT V **9 Hours**

APPLICATIONS OF MICROCONTROLLER

Interfacing of Keyboards(4x4 & 8) - Interfacing of Display Devices(LED, LCD, 7 Segment LED) - DC Motor control - Stepper motor control - Servo Motor control - Traffic light control - Closed loop process control.

FOR FURTHER READING

Designing real time clock, detecting power failure, detecting presence of objects using 8253. Microcontroller System Design - Testing the Design, Look up Tables.

Total: 45 Hours

Reference(s)

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085 6/e, Penram International Publishing (India) Pvt. Ltd., 2013
2. Douglas V Hall., Microprocessor and Interfacing: Programming and Hardware, McGraw Hill Inc., New Delhi, Second Edition 2002.
3. Davies, John H. MSP430 microcontroller basics. Elsevier, 2008.
4. Muhammad Ali Mazidi and Janice Gillipie mazidi, The 8051 Microcontroller and Embedded System, Pearson Education Asia, 2011.
5. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, Thomson Delmar New Delhi, 2014
6. Krishna Kant, Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096, PHI, 2007

**18MC504 THERMODYNAMICS AND HEAT
TRANSFER****3 1 0 4****Course Objectives**

- To enlighten the knowledge of students about the fundamentals of thermodynamics and heat transfer

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

- Apply fundamental thermodynamic properties and laws for engineering problems
- Analyze various thermodynamic process and solve steady flow energy equation for engineering system
- Apply the concept of entropy and evaluate efficiency for major thermodynamic gas power cycles
- Apply fundamentals of heat transfer and evaluate overall heat transfer coefficient of a system
- Evaluate the convection and radiation heat transfer coefficient for an engineering system

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION TO THERMODYNAMICS**

Thermodynamic systems. Temperature and the zeroth law of thermodynamics. Thermodynamic scales. Ideal gas. Simple, compressible pure substances: gases and steam .Numerical problems

UNIT II**9 Hours****FIRST LAW OF THERMODYNAMICS**

Expansion work. Friction work. Internal energy. Heat. Enthalpy. Specific heats of gasses. Adiabatic, isothermal, isochoric and isobaric processes. Polytropic processes. First law of thermodynamics. Open and closed systems, steady flow energy equation- Numerical problems

UNIT III

9 Hours

SECOND LAW OF THERMODYNAMICS

Entropy and irreversibilities. Second law of thermodynamics. Thermal engine. Carnot's efficiency. Isentropic processes and isentropic efficiencies for thermal engines. Gas turbine: Brayton cycle. Steam turbine: Rankine cycle. Steam compression refrigeration systems. Numerical problems.

UNIT IV

9 Hours

CONDUCTION

General differential equation for conduction heat transfer. Conduction in a flat wall. Conduction in a cylindrical wall. Thermal resistance. Overall heat transfer coefficient. Numerical problems

UNIT V

9 Hours

CONVECTION AND RADIATION

Free and forced convection mechanism. Interior and exterior convection. Convection over flat surfaces. Convection over cylinders. Electromagnetic spectrum and radiation physics. Kirchoff's law. Black-body radiation. Numerical problems

FOR FURTHER READING

Reversibility- S.I and C.I engines- Conduction through Plane Wall, Cylinders and Spherical system, Grey body radiation -Shape Factor Algebra - Electrical Analogy- Convective Mass Transfer Correlations

Total: 60 Hours

Reference(s)

1. P. K. Nag, Engineering Thermodynamics, Edition 5, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2013
2. Yunus A. Cengel and Michael A. Boles, Thermodynamics - An Engineering Approach in SI Units, Tata McGraw Hill Publishing Company, New Delhi, 2017
3. C. P. Kothandaraman and S. Subramanya, Fundamentals of Heat and Mass Transfer, New Age International Publishers, New Delhi, 2012
4. T. D. Eastop and McConkey, Applied Thermodynamics for Engineering Technologists, Pearson, New Delhi, 2004
5. C. P. Kothandaraman, S. Domkundwar and A. V. Domkundwar, A course in Thermal Engineering, Dhanpatrai and Co. Pvt. Ltd., New Delhi, 2016
6. NPTEL - <https://nptel.ac.in/courses/112105123/1>

18MC507 ROBOTICS LABORATORY**0 0 4 2****Course Objectives**

- To model forward and inverse kinematics for major robotic configuration
- To simulate pick and place operation using an industrial robot

Programme Outcomes (POs)

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.

k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

m. Analyze, design and develop electro mechanical system using contemporary tools

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Carry out forward and inverse kinematics using simulation software
2. Demonstrate pick and place operation using six axis industrial robot
3. Generate program for forward and inverse kinematics solutions

Articulation Matrix

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

1 **6 Hours**

EXPERIMENT 1

Visualization of Denavit- Hartenberg parameters

2 **6 Hours**

EXPERIMENT 2

Simulation of forward kinematics of 3R robot

3 **6 Hours**

EXPERIMENT 3

Simulation of forward kinematics of 3P robot

4 **6 Hours**

EXPERIMENT 4

Simulation of Forward kinematics of PRP configured robot

5 **6 Hours**

EXPERIMENT 5

Simulation of Forward and inverse kinematics of SCARA robot.

6 **6 Hours**

EXPERIMENT 6

Generate a program in CpROG environment for pick and place operation

7 **6 Hours**

EXPERIMENT 7

Generate a program for forward kinematics numerical solution for 3 degrees of freedom robot manipulator

8 **6 Hours**

EXPERIMENT 8

Generate a program for forward kinematics numerical solution for 5 degrees of freedom robot manipulator

9 **6 Hours**

EXPERIMENT 9

Develop a continuous motion program using 6 axis industrial robot for spray painting

10 **6 Hours**

EXPERIMENT 10

Develop a point to point motion program using 6 axis industrial robot for pick and place operation

Total: 60 Hours

Reference(s)

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, Industrial Robotics Technology, Programming and Applications, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017
2. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics Control, Sensing, Vision, and Intelligence, Tata McGraw-Hill Publishing Company Limited, India, 2017

**18MC508 MICROPROCESSORS AND
MICROCONTROLLER LABORATORY****0 0 2 1****Course Objectives**

- To focus the implementation of arithmetic operations using microprocessors and microcontroller
- To simulate embedded C programs
- To implement various on-chip and off-chip interfacing and algorithms

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Implement the arithmetic and logical operations using microcontrollers and microprocessors
2. Carry out the digital and analog hardware interface for microcontroller-based systems
3. Generate an embedded C program to control stepper and DC motor

Articulation Matrix

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

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

Perform the basic arithmetic operations using Embedded C in Microprocessor 8085 and 8086

2**3 Hours****EXPERIMENT 2**

Perform the search operation for finding the number (largest, smallest) in the array using Embedded C in Microprocessor 8085 and 8086.

3**3 Hours****EXPERIMENT 3**

Execute code conversions like HEX to ASCII and Vice versa using Embedded C in Microprocessor 8085 and 8086

4 **3 Hours**

EXPERIMENT 4

Perform the basic arithmetic operations using Embedded C in Microcontroller 8051.

5 **3 Hours**

EXPERIMENT 5

Implement the search operation for finding the number (largest, smallest) in the array using Embedded C in Microcontroller 8051.

6 **3 Hours**

EXPERIMENT 6

Execute code conversions like HEX to ASCII and Vice versa using Embedded C in Microcontroller 8051.

7 **3 Hours**

EXPERIMENT 7

Perform the different mode of operation using Embedded C by interfacing the Programmable Peripheral Interface with the Microprocessor 8085 and Microcontroller 8051.

8 **3 Hours**

EXPERIMENT 8

Perform the controlling operation to the stepper motor using Embedded C by interfacing the stepper motor with the Microprocessor 8085 and Microcontroller 8051.

9 **3 Hours**

EXPERIMENT 9

Perform the controlling operation of DC motor using Embedded C by interfacing the DC motor controller with the Microprocessor 8085 and Microcontroller 8051.

10 **3 Hours**

EXPERIMENT 10

Conversion of Analog to digital and vice versa using embedded C with Microprocessor 8085 and Microcontroller 8051.

Total: 30 Hours

Reference(s)

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085 6/e, Penram International Publishing (India) Pvt. Ltd., 2013.
2. Douglas V Hall., Microprocessor and Interfacing: Programming and Hardware, McGraw Hill Inc., New Delhi, Second Edition 2002.
3. Muhammad Ali Mazidi and Janice Gillipie mazidi, The 8051 Microcontroller and Embedded System, Pearson Education Asia, 2011
4. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, Thomson Delmar New Delhi, 2014
5. Krishna Kant, Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096, PHI, 2007.

0 0 2 0

18GE501 SOFT SKILLS - APTITUDE I

- 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.

Programme Outcomes (POs)

- Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

Course Outcomes (COs)

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

1 **2 Hours**

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.

2 **2 Hours**

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.

3 **2 Hours**

AVERAGES AND AGES

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

4 **2 Hours**

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.

5 **2 Hours**

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.

6 **2 Hours**

TIME AND WORK

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

7 **2 Hours**

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.

8 **2 Hours**

CODING AND DECODING

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

9 **4 Hours**

SEQUENCE AND SERIES

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

10 **4 Hours**

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.

11 **4 Hours**

DIRECTION

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

12 **2 Hours**

CRITICAL REASONING

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

Total: 30 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

18HS002 PROFESSIONAL ETHICS IN ENGINEERING

2 0 0 2

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.

Programme Outcomes (POs)

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

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.

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
1								3			2			
2								2			2			
3											3			
4								2			2			
5								2			2			

UNIT I

6 Hours

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

6 Hours

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

6 Hours

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

UNIT IV

6 Hours

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

6 Hours

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.

Total: 30 Hours

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>

18MC602 CNC TECHNOLOGY**3 0 0 3****Course Objectives**

- To understand the construction and principle of CNC machines
- To generate simple programs for CNC turning and machining centres

Programme Outcomes (POs)

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

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.

m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Interpret the evolution and working principle of CNC machine tools with its relevant applications
2. Illustrate the basic structure, construction, working and control of CNC machines over conventional units.
3. Generate real time program for producing desired products using CNC machines.
4. Explain the different tooling and work holding device of CNC
5. Explain the maintenance and troubleshooting techniques

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION TO CNC MACHINE TOOLS**

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators Computer Aided Inspection

UNIT II**9 Hours****STRUCTURE OF CNC MACHINE TOOL**

CNC Machine building, structural details, configuration and design, guide ways Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements gears, timing belts, flexible couplings, Bearings

UNIT III

9 Hours

CNC PROGRAMMING

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, parametric programming, machining cycles, programming for machining, generation of CNC codes from CAM packages, CNC controllers

UNIT IV

9 Hours

TOOLING AND WORK HOLDING DEVICES

Introduction to cutting tool materials Carbides, Ceramics- Cubic Boron Nitride, Polycrystalline Cubic Diamond- insert selection codes - PMK, NSH, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC

UNIT V

9 Hours

CNC MAINTENANCE AND TROUBLE SHOOTING

Warnings-Check operation, Replacement, Parameters, Daily Maintenances - Caution, Note, Alarms, Maintenance Parts, Parameters. Trouble shooting-Causes and Remedies for failures - Machine position, Reference Position, Manual operation, Automatic operation, Jog Operation, Feed rate, Spindle Speed, LCD Display, Abnormal Servo System

FOR FURTHER READING

CNC Program generation from CAD models, geometric modeling for NC machining & machining of free-form surfaces, CNC controller & motion control in CNC system. Application of CNC and recent advances in CNC machines, maintenance of CNC machine tools, CNC trainer

Total: 45 Hours

Reference(s)

1. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017
2. Warren S.Seamers, Computer Numeric Control, Fourth Edition Thomson Delmar, 2002
3. P. N. Rao and N. K. Tiwari, Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill Publishing company, New Delhi 2012
4. Tilak Raj, CNC technology & programming, Dhanpat Rai publishing company(p) ltd., N Delhi,2014
5. P. Radhakrishnan, Computer Numerical Control Machine & Computer Aided Manufacturing, New Academic Science Limited,England 2014
6. M. Adithan & B. S. Pabla, CNC Machines, New Age International Publishers , Delhi, 2018

18MC603 MACHINE DESIGN

3 1 0 4

Course Objectives

- To learn the different standards used in machine design
- To design the various machine elements subjected to simple and variable loads

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Compute the stresses for various loads and apply the theories of failure to design the machine components
2. Design shaft, keys and couplings based on power transmission capability
3. Analyse the forces acting on bolts in eccentric loading, welded joints and design the elements
4. Design a flywheel for an IC engine and calculate stresses in springs for different end conditions
5. Compute static, dynamic load carrying capacity for a bearings and select the suitable bearings.

Articulation Matrix

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

UNIT I

9 Hours

STEADY STRESSES AND VARIABLE STRESSES IN MACHINE ELEMENTS

Machine Design: Design process - procedure & requirements of machine elements - Standards in design - Factor of safety. Design against static load: Application of Principal stresses and theories of failure in designing machine elements. Design against Fluctuating Load: Endurance limit - S-N Curve - Design for finite and Infinite life (Reversed load only) - Stress concentration: Factors - Reduction of stress concentration

UNIT II

9 Hours

DESIGN OF SHAFT, KEYS AND COUPLINGS

Design of shaft: Shaft materials - Selection of preferred sizes - Solid shaft design based on strength, torsional rigidity and A.S.M.E code. Key: types - stresses developed - Design of Square and Flat key. Couplings: Types - applications - Design of Muff coupling, clamp coupling, rigid flange coupling and bushed-pin flexible coupling

UNIT III

9 Hours

DESIGN OF THREADED JOINTS AND WELDED JOINTS

Threaded Joints: Types - bolt of uniform strength - terminology of screw threads - ISO Metric screw thread - materials - Design of eccentrically loaded bolted joints in shear and eccentric load perpendicular to axis of bolt. Welded Joints: welding symbols - standards - types - stress relieving of welded joints - Conditions for maximum shear in parallel and transverse fillet weld. Design of butt, parallel and transverse fillet welds against static load.

UNIT IV

9 Hours

DESIGN OF SPRINGS AND FLYWHEEL

Springs: types - terminology of helical spring - styles of end - spring materials- Wahl's stress factor - Design of helical springs for static and variable loads - Design of helical torsion springs - nipping in leaf springs - design of semi-elliptic leaf spring. Flywheel: Functions - materials - types - stresses in rimmed flywheel - design of rimmed flywheel based on constructing turning moment diagram

UNIT V

9 Hours

DESIGN OF BEARINGS

Bearings - classifications - Rolling contact bearings: Types - static and dynamic load carrying capacity - Stribeck's equation - equivalent bearing load - Selection of deep groove ball bearing from manufacturer's catalogue. Sliding contact bearings: lubricants - types - modes of lubrication - types - petroff's equation - McKee's analysis - Design of hydrostatic thrust and full hydrodynamic bearings based on different parameters

FOR FURTHER READING

Manufacturing considerations in design - Design of cotter joint - design of levers - Fatigue failure - Notch sensitivity - Soderberg and Goodman lines - Design for infinite life (Fluctuating load) - Impact stresses - Castigliano's theorem - Design of Belleville spring

Total: 60 Hours

Reference(s)

1. V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2017
2. J. E. Shigley and C. R. Mischke, Mechanical Engineering Design, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2017
3. R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, John Wiley and Sons, New Delhi, 2018.
4. R. L. Norton, Design of Machinery, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2007
5. Faculty of Mechanical Engineering, PSG College of Technology, Design Data, M/s.Kalaikathir Achchagam, Coimbatore, 2014
6. <https://nptel.ac.in/courses/112105125>

18MC604 EMBEDDED SYSTEM DESIGN**3 0 2 4****Course Objectives**

- To impart knowledge on the Building Blocks of Embedded System, Various Embedded Development Strategies, Bus Communication in processors, Input/output interfacing and processor scheduling algorithms
- To understand Real time operating system

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

- Analyse the internal hardware parts of embedded systems architecture
- Implement an embedded system for a given Networking application
- Execute the various Embedded Development Strategies
- Analyse various processor scheduling algorithms
- Analyse the basics of Real time operating system application

Articulation Matrix

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

UNIT I**8 Hours****INTRODUCTION TO EMBEDDED SYSTEMS**

Embedded Systems - Overview - Structural units, selection of processor - memory devices - Memory management methods - Timer and Counting devices, Watchdog Timer, Real Time Clock

UNIT II**10 Hours****EMBEDDED NETWORKING**

Introduction - I/O Ports - Communication protocols : RS232, RS422, RS 485, CAN Bus - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C).

UNIT III**9 Hours****EMBEDDED FIRMWARE DEVELOPMENT**

Embedded Product Development Life Cycle- Objectives, Different Phases Of EDLC, Modelling of EDLC; Data Flow Graph, State Machine Model, Sequential Program Model, V Model

UNIT IV **9 Hours**

EMBEDDED SYSTEM DESIGN

Introduction to basic concepts of RTOS-Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing

UNIT V **9 Hours**

EMBEDDED SYSTEM APPLICATION

Line Follower robot, Linear conveyor control system, Temperature monitoring and control system

FOR FURTHER READING

Real Time Application, Device control using Mobile, Security Alert system, Automatic Car Control system, Mobile operating Land Rover

1 **2 Hours**

EXPERIMENT 1

Study of ARM evaluation system

2 **3 Hours**

EXPERIMENT 2

Interfacing ADC and DAC

3 **3 Hours**

EXPERIMENT 3

Interfacing LED and PWM

4 **4 Hours**

EXPERIMENT 4

Interfacing real time clock and serial port

5 **3 Hours**

EXPERIMENT 5

Interfacing keyboard and LCD through communication protocols

6 **2 Hours**

EXPERIMENT 6

Interfacing EPROM and interrupt

7 **3 Hours**

EXPERIMENT 7

Interrupt performance characteristics of ARM and FPGA

8 **3 Hours**

EXPERIMENT 8

Flashing of LEDS

9

4 Hours

EXPERIMENT 9

Interfacing stepper motor and temperature sensor

10

3 Hours

EXPERIMENT 10

Implementing zigbee protocol with ARM.

Total: 75 Hours

Reference(s)

1. Peckol, Embedded system Design, John Wiley & Sons, 2010
2. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson, 2013
3. Shibu. K.V, Introduction to Embedded Systems, Tata McGraw Hill, 2017
4. Raj Kamal, Embedded System-Architecture, Programming, Design, Tata McGraw Hill, 2013
5. C.R.Sarma, Embedded Systems Engineering, University Press (India) Pvt. Ltd, 2013
6. Han-Way Huang, Embedded system Design Using C8051, Cengage Learning, 2009.

18MC607 COMPUTER AIDED MANUFACTURING LABORATORY

0 0 2 1

Course Objectives

- To provide knowledge on modelling and creating toolpath of machine components using computer aided manufacturing softwares
- To impart part programming knowledge on CNC lathe.
- To expose part programming knowledge on CNC milling machine
- To study the working of wire cut EDM for cutting various shapes.
- To impart knowledge on developing the prototype by additive manufacturing process

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Formulate the tool path for circular and prismatic parts using machining programs
2. Create the part program for the machining component using CNC lathe.
3. Create the part program for the machining component using CNC milling
4. Demonstrate the the wire cut EDM for producing intricate shapes
5. Demonstrate the component using additive manufacturing process

Articulation Matrix

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

1

4 Hours

EXPERIMENT 1

To make a protected type flange coupling to transmit the power from dia 20mm shaft.

2

4 Hours

EXPERIMENT 2

To manufacture the Vee block component as per the dimensions shown below.

3

4 Hours

EXPERIMENT 3

To fabricate a frame support as shown in figure.

4 **4 Hours**

EXPERIMENT 4

To machine a logo of Bannari amman Institute of Technology

5 **4 Hours**

EXPERIMENT 5

To make a profile of shaft support as per the dimensions given in the figure

6 **4 Hours**

EXPERIMENT 6

To make an injection molding die for Ball point pen case using CNC milling

7 **4 Hours**

EXPERIMENT 7

Reverse engineering of pump components like impeller, Shaft, Casing, Centre line support using 3D scanner and printer

8 **2 Hours**

EXPERIMENT 8

Redesign and make an extruder assembly of a 3D printer to hold three filaments using design for additive manufacturing principles

Total: 30 Hours

Reference(s)

1. Koren Y, Computer Control of Manufacturing systems, McGraw Hill, 2006
2. S.K.Sinha, CNC Programming, McGraw Hill, 2007
3. Wego Wang, Reverse Engineering Technology, CRC Press, 2004

18MC608 OBJECT ORIENTED PROGRAMMING LABORATORY

0042

Course Objectives

- To understand the concepts of Object Oriented Programming
- To study the concepts of objects and classes
- To familiarize the concepts of functions and constructors, use them to create real-time applications

Programme Outcomes (POs)

- 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.
- 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.
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Understand the characteristics and data types of C++ language
2. Understand the Objects and Classes of C++ language
3. Develop efficient programs using operator overloading
4. Demonstrate the concepts of polymorphism to large scale software
5. Apply the concepts of files streams to real-world problems

Articulation Matrix

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

1**5 Hours**

EXPERIMENT 1

Introduction to OOPS concepts, datatypes

2**5 Hours**

EXPERIMENT 2

Program to implement Matrix addition, subtraction. Multiplication and division

3 **5 Hours**

EXPERIMENT 3

Implement the concept of type conversion, the precedence of operators

4 **5 Hours**

EXPERIMENT 4

Simple C Programs to check whether the entered number is positive or negative using if-else statement and realize a calculator operation Switch statement

5 **5 Hours**

EXPERIMENT 5

Simple C Programs to print the first 50 odd/even numbers and pyramid pattern printing using

- a) for loop
- b) while loop
- c) do-while loop

6 **5 Hours**

EXPERIMENT 6

Write a C program for constructor and destructor concept

7 **5 Hours**

EXPERIMENT 7

Program to implement the concepts of function overloading and operator overloading and method overriding.

8 **5 Hours**

EXPERIMENT 8

Write a C program to Multiple, Multilevel, Hybrid, Hierarchical Inheritance

9 **5 Hours**

EXPERIMENT 9

Implement the concept of class using static data member and static member functions.

10 **5 Hours**

EXPERIMENT 10

Write a C program to file handling (file reader, file writer) random access file using Write, Read, Rename, and Remove commands

11 **5 Hours**

EXPERIMENT 11

Write a C program to store the information (name, roll, and marks) of 50 students using class and display the number of students who got A grade (100-85), B grade (85-70), C grade (70-66), D grade (55-45) and failed in the periodical exam.

12 **5 Hours**

EXPERIMENT 12

Write a C program to design Log-In screen, check username and password and to display the corresponding message on successful login/failed login.

Reference(s)

1. D.S.Malik, C++ Programming, Thomson, USA, 2011.
2. Robert Lafore, Object Oriented Programming in-C++,4th Edition, Galgotia Publication, Pearson India, New Delhi, 2008
3. K.R. Venugopal, Raj Kumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006
4. <https://nptel.ac.in/courses/106105151/>

18GE601 SOFT SKILLS-APTITUDE II**0 0 2 0****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.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

Course Outcomes (COs)

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

1**2 Hours****PERMUTATION AND COMBINATION**

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

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.

3**2 Hours****SYLLOGISM AND VENN DIAGRAM**

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

4**2 Hours****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.

5**2 Hours**

MIXTURES AND ALLIGATION

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

6

2 Hours

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.

7

2 Hours

DATA INTERPRETATION

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

8

2 Hours

PROGRESSION AND LOGICAL REASONING

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

9

4 Hours

PROBLEM ON AGES

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

10

4 Hours

ANALYTICAL REASONING

Introduction-Basic concept-Non-verbal Analytical Reasoning -Arrangements.

11

2 Hours

BLOOD RELATION

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations

12

2 Hours

VISUAL REASONING

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

13

2 Hours

SIMPLIFICATIONS

Introduction-Basic concepts-Arithmetic operations-Equation solving methods-Puzzles.

Total: 30 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.

Programme Outcomes (POs)

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

k. 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.

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
1							2		2		3			
2							2		2		3			
3							2		2		3			
4							2		2		3			
5							2		2		3			

UNIT I

6 Hours

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 Environment Current Trends and issues in Management.

UNIT II

6 Hours

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.

UNIT III

6 Hours

ORGANISING

Nature and purpose Formal and informal organization Organization chart Organization Structure Type - 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

6 Hours

DIRECTING

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

UNIT V

6 Hours

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.

Total: 30 Hours

Reference(s)

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
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

**18MC702 MICRO ELECTRO MECHANICAL
SYSTEM****3 0 0 3****Course Objectives**

- To comprehend the physical effects on miniaturisation through scaling laws
- To gain knowledge on principles of micro fabrication and micro manufacturing
- To be able to design and analyse MEMS-based sensors and actuators

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

- Retrieve the scaling laws used in conceptual design of microsystems
- Summarize the working principles of micro sensors and actuators
- Use photolithography and its allied processes to fabricate MEMS devices
- Select a suitable micro manufacturing technique for the fabrication of a specific MEMS device
- Outline the principles of microsystem packaging and design

Articulation Matrix

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

UNIT I**9 Hours****MICROSYSTEMS AND MINIATURIZATION**

Introduction to Microsystems and microelectronics - Applications of micro system in automotive , bio medical,aerospace - telecommunication industries. Trimmer's scaling vector and scaling laws - scaling in geometry- scaling in rigid body dynamics- scaling in electrostatic forces-scaling in electricity

UNIT II

9 Hours

MICRO SENSORS AND ACTUATORS

Microsensors- Types of micro sensors - Micro accelerometer, Pressure sensors and thermal sensors. Micro actuation techniques - piezoelectric crystals -Shape memory alloys - bimetallics - conductive polymers. Micro motors - micro grippers - Microfluidic devices - Micro pumps - micro valves - valve less micro pumps

UNIT III

9 Hours

MICRO FABRICATION

Clean room technology, Micro Fabrication processes: Photolithography - X Ray and UV, Ion implantation, Diffusion - Oxidation - Chemical Vapor Deposition - Physical Vapor Deposition - D.C. Sputtering

UNIT IV

9 Hours

MICROMACHINING

Processes for bulk micromachining - Wet vs dry etching - Chemical etching of Silicon - etchant systems and etching process - Reactive ion etching (RIE) and Deep reactive ion etching (DRIE) - mask layout design. Processes for Surface micromachining -Limitations of Bulk and surface micromachining - LIGA

UNIT V

9 Hours

MICROSYSTEMS DESIGN AND PACKAGING

Design Considerations- design challenges, selection of materials, manufacturing, signal transduction, electromechanical system, packaging, Mechanical design thermo mechanical loading, thermomechanical stress analysis, dynamic analysis and interfacial fracture analysis Micro system packaging: Materials die level, device level - system level - packaging techniques - die preparation - surface bonding - wire bonding - sealing

FOR FURTHER READING

Optical MEMS: Micro mirrors, optical switches, RF-MEMS: RF resonators for filters, frequency sources, Power MEMS: micro power sources, batteries and solar cells vs. MEMS based devices, energy harvesting, NEMS -sensors.

Total: 45 Hours

Reference(s)

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2017
2. Mohamed Gad-el-Hak, The MEMS Handbook, CRC Press Publishers, India, 2002
3. Chang Liu, Foundations of MEMS, Pearson Education, New Delhi, 2011
4. James J. Allen, Micro Electro Mechanical System Design, CRC Press Publishers, India, 2005.
5. Marc J Madou Fundamentals of microfabrication, Third Edition, CRC Press Publishers, 2011
6. MEMS and Microsystems (NPTEL Course) <https://nptel.ac.in/courses/117105082/>

18MC703 AUTOMOTIVE ELECTRONICS**3 0 0 3****Course Objectives**

- The purpose of this course is to study the basics of electronics, emission controls and its importance in automobiles
- To study the various sensors and actuators used in automobiles for improving fuel economy and emission control
- To study the various blocks of control units used for control of fuel, ignition and exhaust systems

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Represent the importance of emission standards in automobiles and understand the need for starting and charging system in automobiles
2. Summarize the electronic fuel injection/ignition components and their function
3. Choose a sensors/ transducer for measuring mechanical quantities, temperature and appropriate actuators
4. Determine the electronic engine control systems problems with appropriate diagnostic tools
5. Interpret the need for vehicle chassis and safety system

Articulation Matrix

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

UNIT I**8 Hours****VEHICLE NORMS, CHARGING AND STARTING SYSTEM**

Evolution of electronics in automobiles - emission laws - introduction to Euro I, Euro II, Euro III, Euro IV, Euro V, Euro VI standards - Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram - Alternators - Requirements of starting system - Starter motors and starter circuits

UNIT II **9 Hours**

IGNITION AND INJECTION SYSTEM

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition - Distribution less ignition - Direct ignition - Spark Plugs. Electronic fuel Control: Basics of combustion - Engine fueling and exhaust emissions - Types of exhaust: hot end and cold end.- Electronic control of carburetion - Petrol fuel injection - Diesel fuel injection

UNIT III **8 Hours**

SENSORS AND ACTUATORS

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall Effect, Throttle angle, temperature, exhaust gas oxygen sensors - study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator and vacuum operated actuator.

UNIT IV **10 Hours**

ENGINE CONTROL SYSTEM

Control modes for fuel control - Engine control subsystems - Ignition control methodologies - Different ECU's used in the engine management - block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard - Diagnostics systems in modern automobiles

UNIT V **10 Hours**

CHASSIS AND SAFETY SYSTEM

Traction control system - Cruise control system - Electronic control of automatic transmission
Antilock-braking system - Electronic suspension system - Working of airbag and role of MEMS in airbag systems - Centralized door locking system - Climate control of cars - Introduction to driverless car

FOR FURTHER READING

Power Train Control, Safety System Control (Brake System (ASR, ESP) and Airbag-Seat Belt Tensioners), Steering System Control, Bharat IV & V Emission Standard, Security System (Centralized Remote Door Locking, Immobilizer).

Total: 45 Hours

Reference(s)

1. Tom Denton, Automobile Electrical and Electronics Systems, Routledge Publishers, United Kingdom, 2017
2. William Ribbens, Understanding Automotive Electronics, Newnes Publishers, India, 2013.
3. BOSCH Automotive Handbook, Bentley Publishers, USA, 2005
4. Barry Hollembeak, Automotive Electricity, Electronics and Computer Controls, Delmar Publishers, USA, 2001
5. Ronald. K. Jurgon, Automotive Electronics Handbook, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 1999

18MC704 INDUSTRIAL AUTOMATION**3 0 0 3****Course Objectives**

- To understand the need of automation in various industrial sectors
- To learn about the various technology developments such as PLC, SCADA and DCS in industrial automation
- To understand the basics of communication with its protocol.

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Outline the need of automation in industries
2. Illustrate different instructions available in PLC for various applications
3. Implement supervisory control and data acquisition systems for particular applications
4. Integrate the distributed control system and to differentiate the DCS over other automation systems
5. Select the proper communication buses and its protocol for industrial applications

Articulation Matrix

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

UNIT I**9 Hours****BASICS OF AUTOMATION**

Automation in Production System-Principles and Strategies of Automation-Basic Elements of an Automated System-Advanced Automation Functions-Levels of Automation-Flow lines, Transfer Mechanisms-Fundamentals and Analysis of Transfer Lines, Fundamentals of IoT

UNIT II**9 Hours****PROGRAMMABLE LOGIC CONTROLLER**

PLC Architecture - Processor Memory Organization: Program Files, Data Files- Programming Languages- Wiring Diagrams and Ladder Logic Programs- Instructions: Simple Instructions, Timer, Counter, Program Control, Data Manipulation, Math Instructions - Selection of PLC

UNIT III

9 Hours

SUPERVISORY CONTROL AND DATA ACQUISITION

Elements of SCADA-Functionalities of SCADA-Architecture: Hardware, Software: Development, Runtime mode functions-Tools: Tag database-Recipe database- Alarm Logging-Trends: Real Time, Historical Trends-Security and User Access Management-Management Information System-Report Function.

UNIT IV

9 Hours

DISTRIBUTED CONTROL SYSTEM

Evolution of DCS - Types of Architecture - Local Control Unit - Communication Facilities - Operator and Engineering Interfaces - Operator Displays - Process Interfacing issues.

UNIT V

9 Hours

COMMUNICATION PROTOCOLS

Introduction - Communication Hierarchy, Communication System Requirements - Network Topologies - Communication Modes HART Networks and OSI models- Communication buses - Fieldbus, Modbus, Profibus - Device net - CAN network - System Operation and Troubleshooting.

FOR FURTHER READING

24 Hour Clock Design, Automatic Control of Warehouse Door, Automatic Lubrication of Supplier Conveyor Belt, Automatic Stacking Process.

Total: 45 Hours

Reference(s)

1. M. P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Fourth Edition, Pearson Education, UK, 2016
2. Webb J.W, Programmable Controller Principles and applications, Fifth Edition, Morrill Publishing Co, USA, 2002
3. Petruzella, FD, Programmable Logic Controllers, Fifth Edition, McGraw-Hill, New York, 2016.
4. Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, Fourth Edition, ISA Publication, Europe, 2009
5. Lucas M.P, Distributed control systems, Van Nostrand Reinhold Company, Newyork, 1986

18MC707 INDUSTRIAL AUTOMATION LABORATORY

0 0 2 1

Course Objectives

- To provide a clear view on Programmable Logic Controllers (PLC) and Supervisory Control and Data Acquisition (SCADA).
- To learn the various methods involved in automatic control and monitoring

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- m. Analyze, design and develop electro mechanical system using contemporary tools
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Understand the use of RS Logix software in PLC
2. Develop the PLC program for the implementation of logic gates
3. Develop the PLC program for various applications like traffic light control, bottle filling, cylinder actuation and elevator control
4. Understand the use of wonderware intouch SCADA software to develop a SCADA screen to display the process parameters such as temperature, pressure, humidity and level.
5. Develop a SCADA screen for receipe database, alarm logging and security access management

Articulation Matrix

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

1

3 Hours

EXPERIMENT 1

Implementation of logic gates using RS Logix software

2

3 Hours

EXPERIMENT 2

Two way and four way traffic light control system using PLC

3	3 Hours
EXPERIMENT 3 Bottle filling process using PLC	
4	3 Hours
EXPERIMENT 4 Automate the cylinder sequencing process using PLC	
5	3 Hours
EXPERIMENT 5 Select the suitable I/O module for control of elevator using PLC	
6	3 Hours
EXPERIMENT 6 Design a SCADA screen to display the plant information such as temperature, pressure and humidity using historical trends	
7	3 Hours
EXPERIMENT 7 Design a SCADA screen for automatic level monitoring system	
8	3 Hours
EXPERIMENT 8 Design a SCADA screen for recipe database	
9	3 Hours
EXPERIMENT 9 Design a SCADA screen for alarm logging	
10	3 Hours
EXPERIMENT 10 Design a SCADA screen for security access management	

Total: 30 Hours

Reference(s)

1. Petruzella Frank D., Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2010
2. Webb, John W. Programmable Logic Controllers: Principles and Application, Fifth edition, Prentice Hall of India, New Delhi, 2004.
3. Bolton , Programmable Logic Controllers, Sixth Edition Newnes, ,2015

**18MC708 MICRO ELECTRO MECHANICAL
SYSTEM LABORATORY****0 0 2 1****Course Objectives**

- To study the micro level model, simulate and analyse the same
- To perform the static and thermo mechanical analysis
- To virtually fabricate a micro device using etching and additive manufacturing process

Programme Outcomes (POs)

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.

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.

m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Create a mask layout of MEMS devices
2. Analyze the electro mechanical performance of created MEMS devices
3. Generate an appropriate procedure, to fabricate the MEMS devices

Articulation Matrix

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

1 **3 Hours**

EXPERIMENT 1

Development of a mask to form circular hole in a flat structure using direct and indirect methods.

2 **3 Hours**

EXPERIMENT 2

Virtual fabrication of comb drive used in micro accelerometer

3 **3 Hours**

EXPERIMENT 3

Transient analysis for a bimorph cantilever in a periodically changing magnetic field

4 **3 Hours**

EXPERIMENT 4

Virtual fabrication of die through an anisotropic etching process.

5	3 Hours
EXPERIMENT 5 Static analysis of piezoelectric beam.	
6	3 Hours
EXPERIMENT 6 Thermo ElectroMechanical Analysis of Piezoelectric pump.	
7	3 Hours
EXPERIMENT 7 Sub harmonic analysis of a cantilever beam	
8	3 Hours
EXPERIMENT 8 Design of micro accelerometer and perform g-displacement analysis.	
9	3 Hours
EXPERIMENT 9 Design of microbolometer and perform temperature-voltage analysis.	
10	3 Hours
EXPERIMENT 10 Design of pressure sensor and perform pressure analysis.	
Total: 30 Hours	

Reference(s)

1. Chang Liu, Foundations of MEMS, Pearson Education, New Delhi, 2011.
2. James J. Allen, Micro Electro Mechanical System Design, CRC Press Publishers, India, 2005
3. Intellisuite Tutorial <http://www.intellisense.com/upload/201212170207485975.pdf>

18MC707 PROJECT WORK I

0 0 6 3

Course Objectives

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

Programme Outcomes (POs)

- a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
- b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c. 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. 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. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f. 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. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- j. 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. 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.
- l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change
- m. Analyze, design and develop electro mechanical system using contemporary tools
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation

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 report and present oral demonstrations

Articulation Matrix

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

Total: 45 Hours

18MC804 PROJECT WORK II

0 0 18 9

Course Objectives

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

Programme Outcomes (POs)

- Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
- Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 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.
- 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.
- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 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.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 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.
- 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.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
- Analyze, design and develop electro mechanical system using contemporary tools
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation

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 report and present oral demonstrations

Articulation Matrix

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

18HS201 COMMUNICATIVE ENGLISH II

1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

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

UNIT I

9 Hours

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II

9 Hours

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III

9 Hours

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV

9 Hours

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V

9 Hours

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri
5.The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18HSH01 HINDI**1 0 2 2****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 teach them how to converse in Hindi on simple day- to -day situations

Programme Outcomes (POs)

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.

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 Dakshina Bharat Hindi Prachar Sabha

Articulation Matrix

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

UNIT I**9 Hours**

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

UNIT II**9 Hours**

Nouns: Genders (Masculine & Feminine Nouns)- Masculine & Feminine - Reading Exercises.

UNIT III**9 Hours**

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**9 Hours**

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

UNIT V**9 Hours**

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

Total: 45 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

18HSG01 GERMAN

1 0 2 2

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)

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.

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

Articulation Matrix

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

UNIT I

9 Hours

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

UNIT II

9 Hours

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

UNIT III

9 Hours

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

UNIT IV

9 Hours

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

UNIT V

9 Hours

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

Total: 45 Hours

Reference(s)

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

18HSJ01 JAPANESE**1 0 2 2****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

Programme Outcomes (POs)**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
1										2				
2										3				
3										2				
4										2				
5										2				

UNIT I**9 Hours**

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**

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 (Vehicle) 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**9 Hours**

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

9 Hours

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 hougga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V

9 Hours

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 form 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

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

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

18HSC01 CHINESE**1 0 2 2****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

Programme Outcomes (POs)

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.

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
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I**9 Hours**

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**1 0 2 2****Course Objectives**

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

Programme Outcomes (POs)

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.

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
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I**9 Hours****ENTRER EN CONTACT**

La langue française, alphabets, les numeros, les jours, les mois. Grammaire
 Les verbes s'appeler,etre, avoir, les articles definis, indefinis Communication - Saluer,
 s'informer sur quelqu'un, demander de se presenter Lexique - Les alphabets, les nationalites,
 l'age, les pays, les couleurs, les jours de la semaine, les mois de l'annee, les professions

UNIT II**9 Hours****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 logement Lexique
 - L'habitat, les pieces, l'equipement, la description physique

UNIT III

9 Hours

VIVRE AU QUOTIDIEN

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

UNIT IV

9 Hours

COMPRENDRE SON ENVIRONNEMENT - OUVRIR - À LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs démonstratifs, le passé composé, l'imparfait |
Communication - Proposer quelque chose, raconter une sortie au passé, parler d'un film |
Lexique - Les sorties, la famille, art, les vêtements et les accessoires

UNIT V

9 Hours

GOUTER À LA CAMPAGNE

Grammaire La forme négative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantité |
Communication Accepter et refuser une 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, Méthode de français
2. Hachette FLE

18GE0P1 NANOMATERIALS SCIENCE**3 0 0 3****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
1	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

UNIT I**9 Hours****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**9 Hours****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**9 Hours****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.

UNIT IV

9 Hours

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

9 Hours

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.

Total: 45 Hours

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.

18GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES**3 0 0 3****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

Programme Outcomes (POs)**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

Articulation Matrix

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

UNIT I**9 Hours****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**9 Hours****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**9 Hours****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

UNIT IV

9 Hours

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

9 Hours

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

Total: 45 Hours

Reference(s)

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

18GE0P3 APPLIED LASER SCIENCE**3 0 0 3****Course Objectives**

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)**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
1	1	1												
2	1	2												
3	2	1												
4	1	1												
5	1	2												

UNIT I**9 Hours****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**9 Hours****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**9 Hours****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 (LIDAR) - velocity measurement – holography

UNIT IV

9 Hours

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

9 Hours

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.

Total: 45 Hours

Reference(s)

1. K. Thiagarajan 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.

**18GE0C1 CORROSION SCIENCE AND
ENGINEERING****3 0 0 3****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

Programme Outcomes (POs)

- 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.
- 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

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 ($> 100\text{ }^{\circ}\text{C}$)
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

Articulation Matrix

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

UNIT I**9 Hours****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 diagrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II**7 Hours****TYPES OF CORROSION**

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion. Catastrophic oxidation corrosion

UNIT III **9 Hours**

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 **10 Hours**

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 **10 Hours**

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

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace 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>

18GE0C2 ENERGY STORING DEVICES**3 0 0 3****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

Programme Outcomes (POs)

- 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.

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

Articulation Matrix

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

UNIT I**6 Hours****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**10 Hours****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

UNIT III

10 Hours

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

10 Hours

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

9 Hours

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

Total: 45 Hours

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

18GE0C3 POLYMER SCIENCE

3 0 0 3

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

Programme Outcomes (POs)

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

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
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I

10 Hours

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

8 Hours

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

UNIT III

8 Hours

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

9 Hours

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

10 Hours

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

Total: 45 Hours

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

18MC001 ENGINEERING MATERIALS AND METALLURGY**3 0 0 3****Course Objectives**

- To provide knowledge on classification, microstructure, heat treatment and testing methods for metals
- To understand the types and properties of non metallic materials

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply phase rule to binary alloy systems and infer their microstructures through metallography
2. Classify ferrous and non-ferrous materials by composition and investigate their microstructures, properties and applications
3. Design a temperature profile of heat treatment process that improves mechanical properties such as hardness and toughness of materials
4. Predict the failure mechanisms in metals, ceramics and polymers.
5. Determine mechanical behavior of materials through standard testing methods

Articulation Matrix

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

UNIT I**9 Hours****PHASE DIAGRAMS AND METALLOGRAPHY**

Alloys, Solid solutions Phase diagram, phase rule, lever rule, Binary phase diagram (Isomorphous, eutectic, peritectic, eutectoid reactions) - Iron-Carbon phase diagram: Metallography, microstructure

UNIT II

9 Hours

ENGINEERING METALS AND ALLOYS

Classification of Engineering materials: Ferrous metals, Plain carbon steel (low carbon, medium carbon and high carbon steels), microstructure/composition, properties, applications Alloy steels, effect of alloying additions on steels, stainless steels, HSLA, maraging, tool steels - Cast iron (grey, white, malleable, spheroidal cast iron), microstructure, properties, applications. Non-ferrous metals (Ni, Cu, Ti, Al, Mg, Zn alloys), microstructure/composition, properties, and applications, Bearing materials

UNIT III

9 Hours

HEAT TREATMENT PROCESSES

Purpose of heat treatment Annealing (stress relief, recrystallization, spheroidizing) and Normalizing Hardening and Tempering, Isothermal transformation diagrams (T-T-T diagrams), Cooling curves superimposed on TTT diagrams (martensite and bainite phase formation) Hardenability, Jominy end quench test, Case hardening processes, carburizing, nitriding, carbonitriding, cyaniding, flame hardening, induction hardening.

UNIT IV

9 Hours

FAILURE

Fracture - Ductile, Brittle, Mechanisms of ductile and brittle fracture, fracture toughness, Impact, Ductile to Brittle transition. Fracture in ceramics and polymers, Crack Initiation and Propagation, Griffith Theory

UNIT V

9 Hours

MECHANICAL PROPERTIES AND TESTING

Elastic and plastic deformation, slip and twinning Tensile test, stress-strain behavior of ductile and brittle materials - Stress-strain behavior of elastomers. Viscoelasticity - Compression test - Hardness and testing methods - Impact test - Fatigue test, S-N curve, endurance limit, factors affecting fatigue - Creep test, creep curves

FOR FURTHER READING

Introduction to Super alloys, Shape memory alloys, Composites, Importance of surface properties of materials (corrosion and wear).

Total: 45 Hours

Reference(s)

1. Sydney H. Avner, Introduction to Physical Metallurgy, Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi, 2nd Edition, 2017
2. William D.Callister, Material Science and Engineering, John Wiley and Sons, Singapore, 9th Edition, 2013
3. Kenneth G.Budinski and Michael K.Budinski, Engineering Materials,Prentice Hall of India Learning. Ltd.,New Delhi, 2010.
4. V. Raghavan, Materials Science and Engineering, Prentice Hall of India Learning. Ltd., New Delhi, 2009
5. O.P.Khanna, Material Science and Metallurgy, Dhanpat Rai Publications (P) Ltd, New Delhi, 2013
6. https://onlinecourses.nptel.ac.in/noc19_mm01/preview

18MC002 INDUSTRIAL ENGINEERING**3 0 0 3****Course Objectives**

- To understand the use of forecasting, control of inventory, process of routing and scheduling for improving productivity
- To build and solve linear programming problem
- To analyse deterministic and probabilistic models of problems related to networks and queuing

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Explain the ways of improving productivity by job design, work study, ergonomics, forecasting techniques and following safety.
2. Explain inventory control techniques and the need for material requirement planning.
3. Solve sequencing of jobs with two and more machines and also compute the characteristics of single server queuing models
4. Formulate linear programming problems and find the optimum solution.
5. Construct the network model and identify the critical path of deterministic and probabilistic models

Articulation Matrix

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

UNIT I**9 Hours****PRODUCTION PLANNING AND CONTROL**

Productivity - Productivity index -Productivity measurement - Job design - Job standard - Work study - Method study - Operation process chart - Motion study - Motion economy - SIMO chart - Work measurement - PMTS - Ergonomics - Industrial safety: losses due to accidents, causes, preventive measures - Forecasting - Types - Accuracy of forecast -Sales forecasting techniques - Time series method: simple moving average, weighted moving average, exponential smoothing

UNIT II **9 Hours**

INVENTORY CONTROL

Inventory control - Purpose - Inventory costs - EOQ - Deterministic models - Shortage model - Classification: ABC analysis, FSN analysis - Material Requirement Planning (MRP)

UNIT III **9 Hours**

SCHEDULING AND QUEUING

Introduction - Rules - Factors affecting - Master schedule - Gantt chart - Sequencing problem: Models with n jobs with 2 machines Models with n jobs with 3 machines - Queuing models - Queuing systems and structures - Notation - Parameter - Poisson input - Exponential service - Constant rate service - Infinite population - Single server models

UNIT IV **9 Hours**

LINEAR PROGRAMMING

Introduction - Formulation - Graphical method, Simplex method Artificial Variable techniques: Big M method - Transportation Problems: North West corner method, Least cost method, Vogel's approximation method - MODI method - Assignment problems with Hungarian algorithm

UNIT V **9 Hours**

NETWORK MODELS

Network models - Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT networks - Critical path scheduling

FOR FURTHER READING

Simulation Process - Stochastic Simulation - Monte Carlo Sampling Process, Random Process Generation - Simulation of Queuing System

Total: 45 Hours

Reference(s)

1. T. R. Banga, N. K. Agarwal and S. C. Sharma, Industrial Engineering and Management Science, Khanna Publishers, Delhi, 1996
2. Prem Kumar Gupta and D. S. Hira, Operations Research, S. Chand and Co., New Delhi, 2014.
3. S. B. Srivastava, Industrial Management, I. K. International Publishing House Pvt. Ltd., New Delhi, 2012
4. Hamdy A. Taha, Operation Research: An introduction, Pearson Publications., New Delhi, 2010
5. Frederick S. Hiller and Gerald J. Liberman, Operations Research: Concepts and cases, Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi, 2010.

18MC003 FINITE ELEMENT ANALYSIS**3 0 0 3****Course Objectives**

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

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

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. Identify 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 isoperimetric problems.

Articulation Matrix

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

UNIT I**10 Hours****INTRODUCTION**

Relevance and scope of finite element methods -Basic concepts of Finite Element Analysis- 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**10 Hours****ONE-DIMENSIONAL 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.

UNIT III

8 Hours

TWO-DIMENSIONAL ELEMENTS

Two node truss element- problems in 2D truss -Introduction to beam element- Shape function for linear triangular element-Finite element formulation- Constant Strain Triangular (CST) element -plane stress, plane strain - axisymmetric elements - problems

UNIT IV

9 Hours

HEAT TRANSFER APPLICATIONS

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

UNIT V

8 Hours

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 natural coordinate system - problems. Gaussian quadrature method-problems.

FOR FURTHER READING

Steps for structural and thermal analysis of machine elements using FEM packages. Nodal Analysis in FEM packages

Total: 45 Hours

Reference(s)

1. Daryl L Logan, A First Course in the Finite Element Method, Cengage Learning, 2010
2. S. S. Rao, Finite Element Method in Engineering, Elsevier India, 2005.
3. David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2005.
4. Robert D. Cook, s. David , Malkucs Michael E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New Delhi, 2007
5. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements Engineering, Pearson Education, New Delhi, 2002.
6. <https://nptel.ac.in/courses/112104116/>

18MC004 DESIGN OF JIGS AND FIXTURES**3 0 0 3****Course Objectives**

- To understand 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 and fixtures for producing the part

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Assess the design aspects of jigs and fixtures and relate with an application.
2. Identify the suitable locators and clamps for jigs, fixtures.
3. Design a suitable jig for producing a part for the given component
4. Design a suitable fixture for the given component producing a part.
5. Generate a suitable die design for given simple components using different operations

Articulation Matrix

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

UNIT I**8 Hours****INTRODUCTION**

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 Tolerance- Scope of Jigs and Fixtures

UNIT II**8 Hours****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

10 Hours

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.

UNIT IV

10 Hours

FIXTURES

General Design Principles of Fixture. Types of Boring, Lathe, Milling and broaching fixtures - Setting Block. Grinding, Planning and Shaping fixtures. Inspection - Gauging, Measuring and Supplement fixtures. Welding, Assembly and Modular fixtures. Design of fixtures for given component

UNIT V

9 Hours

DESIGN AND DEVELOPMENT OF DIES

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies. Development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies. Blank development for axisymmetric, rectangular and elliptic parts - Single and double action dies

FOR FURTHER READING

Design of Press tools - Press working terminologies and elements of dies and strip layout.

Total: 45 Hours

Reference(s)

1. Edward G. Hoffman, Jig and Fixture Design, Cengage Learning, New Delhi, 2014
2. C. Elanchezhian, Design of Jigs, Fixtures and Press Tools, Eswar Press, Chennai, 2010
3. P. H. Joshi, Jigs & Fixtures, Tata McGraw Hill publishing Co. Ltd. New Delhi 2012
4. Hiram E Grant, Jigs and Fixtures, Tata McGraw Hill publishing Co. Ltd., New Delhi, 2011
5. C. Donaldson, G. H. Lecain and V. C. Goold, Tool Design, Tata McGraw Hill publishing Co. Ltd., New Delhi, 2011
6. <https://nptel.ac.in/courses/112105126/35>

**18MC005 DESIGN OF MATERIAL HANDLING
SYSTEMS****3 0 0 3****Course Objectives**

- To incorporate competency in system visualization and design
- To enable students to design a machine tool gearbox and material handling systems

Programme Outcomes (POs)

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

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.

m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Choose the right material handling systems with safety and efficiency
2. Utilize the correct methods to design hoists.
3. Compare the different types of drives for material handling
4. Select the correct type of transportation methods for material handling
5. Analyze appropriate lifting mechanisms to improve material handling

Articulation Matrix

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

UNIT I**9 Hours****MATERIALS HANDLING EQUIPMENT**

Importance and principles of material handling. Types of intraplant transport facility and applications. Choice of material handling equipment - Surface and overhead equipment - general characteristics of surface and overhead equipment - AGV- AS/RS

UNIT II**9 Hours****DESIGN OF HOISTS**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks - crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types

UNIT III**9 Hours****DRIVES OF HOISTING GEAR**

Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

UNIT IV

9 Hours

CONVEYORS

Types - description - design and applications of belt conveyors, apron conveyors and escalators
pneumatic conveyors, screw conveyors and vibratory conveyors.

UNIT V

9 Hours

ELEVATORS

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides,
counter weights, hoisting machine, safety devices - Design of fork lift trucks

FOR FURTHER READING

Occupational safety, Energy efficient machines and systems, Storage methods.

Total: 45 Hours

Reference(s)

1. Alexandrov, M., Materials Handling Equipment, MIR Publishers, Moscow, 1982
2. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.
3. Lingaiah. K. and Narayana Iyengar, Machine Design Data Hand Book, Vol. 1 & 2, Suma Publishers, Bangalore, 1983
4. P.S.G. Tech., Design Data Book, Kalaikathir Achchagam, Coimbatore, 2012
5. Rudenko, N., Materials handling equipment, Elnvee Publishers, New Delhi, 1970.
6. Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985

18MC006 DESIGN OF MECHATRONICS SYSTEM**3 0 0 3****Course Objectives**

- To study about mechatronics design process
- To study the data acquisition and control case studies
- To Understand about the application of mechatronics system

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Demonstrate the mechatronics design process, data acquisition and control through case studies
2. Analyze the various System modelling parameters available in mechatronics system.
3. Explain the aspects of real time interfacing in mechatronics system design
4. Implement the different design technology for various applications
5. Select the concept of micro mechatronics system and implementing in real time systems.

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION TO MECHATRONICS SYSTEM**

Key elements - Mechatronics Design process -Design Parameters - Traditional and Mechatronics designs - Advanced approaches in Mechatronics - Industrial design and ergonomics, safety

UNIT II**9 Hours****SYSTEM MODELLING**

Introduction-model categories-fields of application-model development-model verification-model validation-model simulation-design of mixed systems-electro mechanics design-model transformation-domain-independent description forms-simulator coupling.

UNIT III

9 Hours

REAL TIME INTERFACING

Introduction-selection of interfacing standards Elements of Data Acquisition & control Systems- Over view of I/O process, General purpose I/O card and its installation, Data conversion process, Application Software- Labview Environment and its applications, Vim-Sim Environment & its applications -Man machine interface

UNIT IV

9 Hours

CASE STUDIES ON MECHATRONIC SYSTEM

Introduction -Fuzzy based Washing machine - pH control system - Autofocus Camera, exposure control - Motion control using D.C.Motor & Solenoids - CNC related -Engine management systems - Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot - Part identification and tracking using RFID - Online surface measurement using image processing

UNIT V

9 Hours

MICRO MECHATRONIC SYSTEM

Introduction- System principle - Component design - System design - Scaling laws - Micro actuation - Micro robot - Micro pump - Applications of micro mechatronic components

FOR FURTHER READING

Mechatronics system design for Industrial robots for welding, painting and assembly, Industrial automation, Typical example of automated industries, application of visual inspection.

Total: 45 Hours

Reference(s)

1. Bishop, Robert H, Mechatronics Hand book, CRC Press, 2002.
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, CRC Press 1991 , First Indian print 2010.
3. De Silva, Mechatronics: A Foundation Course, Taylor & Francis, Indian Reprint, 2013.
4. Devdas shetty, Richard A. Kolk, Mechatronics System Design, 2nd Edition ,Cengage Learning 2011.
5. Georg pelz, Mechatronic Systems: Modeling and simulation with HDL's, John wiley and sons Ltd, 2003

18MC007 NON-CONVENTIONAL MACHINING**3 0 0 3****Course Objectives**

- To gather knowledge on the non-conventional machining processes
- To comprehend the use of unconventional machining, testing and inspection in manufacturing industries

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Apply non-conventional machining processes in the field of manufacturing industries
2. Analyze the source for defects in USM and AFF processes
3. Solve the issues related to material cutting and finishing by adopting appropriate process
4. Apply advanced machining processes in the field of production and testing
5. Apply high energy beam machining using laser and electron source in the field of fabrication and analysis

Articulation Matrix

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

UNIT I**9 Hours****MECHANICAL ADVANCED MACHINING PROCESSES**

Abrasive Jet Machining (AJM) - Introduction - Abrasive Jet Machining Setup - Gas Propulsion System - Abrasive Feeder - Machining Chamber - AJM Nozzle - Abrasives; Parametric Analysis - Stand-off-Distance - Abrasive Flow Rate - Nozzle Pressure - Mixing Ratio; Process Capabilities – Applications

UNIT II**9 Hours****ULTRASONIC MACHINING (USM)**

Introduction - Ultrasonic Machining System - Mechanics of Cutting - Parametric Analysis - Process Capabilities - Applications; Abrasive Flow Finishing - Working Principle, Abrasive Flow Machining System - Machine - Tooling - Media; Process Variables; Process Performance; Analysis and Modeling of Abrasive Flow Machined Surfaces - Number of Active Grains - Wear of Abrasive Grains; Applications - Aerospace - Dies And Molds

UNIT III

8 Hours

MAGNETIC ABRASIVE FINISHING (MAF)

Introduction - Working Principle of MAF - Material Removal (or Stock Removal) and Surface Finish - Bonded and Unbonded Magnetic Abrasives - Machining Fluid - Magnetic Flux Density; Analysis; Water Jet Cutting (WJC) - Introduction - WJM Machine - Process Characteristics, Process Performance, Applications

UNIT IV

9 Hours

ABRASIVE WATER JET MACHINING (AWJM)

Working Principle - Pumping System - Abrasive Feed System - Abrasive Jet Nozzle - Catcher. Process Characteristics : Water Jet Pressure During Slotting - Water Flow Rate. Abrasive Flow Rate - Abrasive Particle Size - Abrasive Material. Cutting Parameters - Traverse Speed - Number of Passes - Stand-off-Distance - Visual Examination - Process Capabilities; EDM - R-C Pulse Generator, EDM Machine - Power Supply - Dielectric System - Electrodes - Servo system - Electrode Refeeding - Power Delivered to the Discharging Circuit.

UNIT V

10 Hours

HIGH-ENERGY-BEAM MACHINING

Laser Beam Machining - Production of Lasers - Working Principle of Laser Beam Machining - Types of Lasers - Solid Lasers - Gas Lasers. Process Characteristics, Applications - Drilling - Cutting - Marking - Miscellaneous Applications; Electron Beam Machining - Working Principle - Electron Beam Machining System - Electron Beam Gun - Power Supply - Vacuum System And Machining Chamber - Process Parameters - Characteristics of the Process - Applications

FOR FURTHER READING

Electro chemical machining (ECM):Principle, applications, and process parameters and modelling

Total: 45 Hours

Reference(s)

1. P. N. Rao, Manufacturing Technology - Vol I and II, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2013.
2. T. R. Mishra, Non-Conventional Machining, Narosha Publishing House, New Delhi, 2012
3. D. K. Singh, Fundamentals of Manufacturing Engineering, ANE Books, New Delhi, 2008
4. J Paulo Davim, Traditional Machining Processes: Research Advances (Materials Forming, Machining and Tribology), Springer India, 2015
5. <https://nptel.ac.in/syllabus/112104028/>

**18MC008 COMPUTER INTEGRATED
MANUFACTURING****3 0 0 3****Course Objectives**

- To understand the application of computers in various aspects of manufacturing viz., design, proper planning, manufacturing cost, layout & material handling system.

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

- Explain the basics of automated system and CIM concepts
- Explain the production and computerised process planning
- Analyse the various techniques used in cellular manufacturing.
- Apply flexible manufacturing system and Automated Guided Vehicle System in the field of production.
- Recognize the Robot control systems and its applications in manufacturing

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION TO CIM**

Manufacturing Planning, Manufacturing Control- Introduction to CAD/CAM - Concurrent Engineering-CIM concepts - Computerised elements of cim system - Types of Production-Manufacturing Models and metrics - Mathematical models of Production performance - lean and just-in-time production, IoT and Cloud Manufacturing

UNIT II**9 Hours****PRODUCTION PLANNING CONTROL AND COMPUTERISED PROCESS PLANNING**

Process Planning - Aggregate Production Planning And The Master Production Schedule - Material Requirement Planning - Capacity Planning- Control Systems-Shop Floor Control-Inventory Control - Brief On Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III

10 Hours

CELLULAR MANUFACTURING

Group Technology(GT), Part Families - Parts Classification And Coding - Opitz Part Coding System - Production Flow Analysis - Cellular Manufacturing - Composite Part Concept - Machine Cell Design And Layout - Quantitative Analysis In Cellular Manufacturing - Rank Order Clustering Method - Arranging Machines In A GT Cell

UNIT IV

9 Hours

FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)

Types Of Flexibility - FMS - FMS Components - FMS Application & Benefits - FMS Planning And Control - Quantitative Analysis In FMS - Simple Problems. Automated Guided Vehicle System (AGVS) - AGVS Application - Vehicle Guidance Technology - Vehicle Management & Safety.

UNIT V

8 Hours

COMPUTER AIDED INSPECTION

Principles and interfacing, soft metrology -Application of lasers in precision measurements- laser interface, laser scanners, Coordinate measurement machine (CMM), Type of CMM & applications. Non contact CMM, Electro optical sensors for dimension, contact sensors for surface finish measurements. Image processing and its Metrology, Acoustical measurements

FOR FURTHER READING

Digital techniques in mechanical measurements

Total: 45 Hours

Reference(s)

1. Kant Vajpayee S, Principles Of Computer Integrated Manufacturing, Prentice Hall India, 2013
2. Rao. P, N Tewari &T.K. Kundra, Computer Aided Manufacturing, Tata McGraw Hill Publishing Company, 2000.
3. <https://nptel.ac.in/syllabus/112104028/>
4. https://www.me.iitb.ac.in/~ramesh/courses/ME338/non_trad.pdf

18MC009 ADVANCED MANUFACTURING**3 0 0 3****Course Objectives**

- To understand the purpose of advanced machining, metal forming, welding and foundry processes in manufacturing industries
- To comprehend the use of modern testing and inspection equipment in manufacturing industries

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Apply advanced machining processes in the field of manufacturing industries
2. Analyze the source for defects in casting processes
3. Solve the issues related to material joining by adopting advanced welding processes
4. Apply advanced forming processes in the field of production and testing
5. Apply mechanism of chip formation in the processing of polymers, ceramics, and composites

Articulation Matrix

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

UNIT I**10 Hours****MACHINING PROCESSES**

Introduction, Process principle, Material removal mechanism, Parametric analysis and applications of processes such as Abrasive water jet machining (AWJM), Electron beam machining (EBM), Wire Electrical Discharge Machining, Micromachining, Electro Chemical Discharge Machining (ECDM), Environmentally Friendly Machining

UNIT II**8 Hours****CASTING PROCESSES**

Special techniques: CO₂ moulding, shell molding, investment casting, pressure die casting, centrifugal casting, continuous casting

UNIT III**8 Hours****WELDING PROCESSES**

Metal joining, Details of electron beam welding (EBW), laser beam welding (LBW), ultrasonic welding (USW), advanced testing and inspection

UNIT IV

9 Hours

METAL FORMING PROCESSES

Details of high energy rate forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming - Special forming methods: hydro-forming, rubber pad forming

UNIT V

10 Hours

RAPID PROTOTYPING

Tooling and Manufacturing, Classification of Rapid Prototyping (RP), Tooling (RT) and Manufacturing (RM) processes; Materials for RP/RT/RM; Operating principles, characteristics and analysis of current and developing RP/RT/RM processes - Case studies.

FOR FURTHER READING

Selection of RP/RT/RM processes based on the product requirements

Total: 45 Hours

Reference(s)

1. J. P. Kaushish, Manufacturing Processes, Prentice Hall of India Learning Private Limited, New Delhi, 2014
2. Mikell P. Groover, Automation, Production System and Computer Integrated Manufacturing, Pearson Education, New Delhi, 2015.
3. A. Ghosh, and A.K. Mallik, Manufacturing Science, Affiliated East-West Press Pvt. Ltd. New Delhi, 2010
4. P. N. Rao, Manufacturing Technology - Vol I and II, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2013
5. Rafiq I. Noorani, Rapid Prototyping : Principles and Applications, Wiley & Sons, 2006.
6. https://nptel.ac.in/syllabus/syllabus_pdf/112107078.pdf

18MC010 NON-DESTRUCTIVE TESTING**3 0 0 3****Course Objectives**

- To understand the basic principles of various NDT methods
- To be aware of applications and limitations of the NDT techniques
- To know the different type of service and process defects.

Programme Outcomes (POs)

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

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.

m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply surface NDT techniques to carry out various inspection in accordance with the established procedures
2. Analyze eddy current testing procedures for non destructive testing
3. Apply principles of magnetism to investigate the service and processing defects
4. Choose right radiographic techniques and X-Rays for testing
5. Utilize ultrasonic testing as an NDT technique to investigate defects.

Articulation Matrix

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

UNIT I**9 Hours****VISUAL INSPECTION AND DYE PENETRANT TESTING**

Introduction to NDT, Scope and advantages of NDT, Comparison of NDT with DT, classifications of NDT. Equipment used for visual inspection -Magnifying Glass Magnifying Mirror, Microscope, Borescope , endoscopes. Liquid penetration testing- Introduction, Principle, Equipment, Procedures, Characteristics of penetrants- developers Evaluation hazards Precautions, advantages, limitations and applications.

UNIT II**9 Hours****EDDY CURRENT TESTING**

Eddy Current Testing- Principle, Advantages, Disadvantages, Factors Affecting Eddy Current Response-Material Conductivity Permeability - Frequency- Geometry-Proximity (Lift off)-Faraday's Law, Lenz's law, Typical Applications, limitations ,Types of Probes.

UNIT III

9 Hours

MAGNETIC PARTICLE TESTING

Principle of Magnetic Particle Testing-different methods to generate magnetic fields -Magnetic Particle Testing Equipment- Magnetic Particle Testing Procedures Method of De-Magnetization- Magnetic Particle Medium-Evaluation of Indications and Acceptance Standards- magnetic particle test-applications, advantages and limitations

UNIT IV

9 Hours

RADIOGRAPHIC TESTING

X-Ray properties and atomic scattering, X-ray radiography principle, equipment & methodology - Type of Industrial Radiation sources and Application-Radiographic exposure Factors and Technique - X-Ray Equipment- Radiographic Procedure - Radiograph Interpretation, Radiography Image Quality-Indicators-Radiographic Techniques- Film Processing-Methods of Viewing Radiographs- Radiographic Testing Procedures for welds. Precautions against radiation hazards.

UNIT V

9 Hours

ULTRASONIC TESTING

Introduction, Principle of operation Type of Ultrasonic Propagation- Ultrasonic probes. Types of Transducers -Ultrasonic Testing Techniques. Method for Evaluating Discontinuities-Ultrasonic Testing Procedures for different component- advantages and limitations,. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements.

FOR FURTHER READING

Leak Testing, Acoustic Emission Testing, Defects

Total: 45 Hours

Reference(s)

1. J Prasad, C G K Nair, Non-Destructive Testing and Evaluation of Materials, Tata McGraw Hill Education Private Limited, 2017
2. American Metals Society, Non-Destructive Examination and Quality Control, Metals Hand Book, Vol.17, 9th Ed, Metals Park, OH, 1989
3. Bray, Don.E and Stanley, Roderic.K, Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service. Revised, CRC Press New York, Edition, 1997
4. www.ndt-ed.org
5. <https://nptel.ac.in/courses/112105125/>

18MC011 DESIGN FOR MANUFACTURING AND ASSEMBLY**3 0 0 3****Course Objectives**

- To understand the basic concepts and design guidelines that suite for different manufacturing processes
- To study the problems in design modifications of the product made through various manufacturing techniques.
- To study the importance of global issues related in design for environment

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Select the suitable tolerance refer to Indian standards and ASME Y 14.5
2. Select the casting with consideration to materials and surface properties
3. Construct parts based on machining considerations in manufacturing.
4. Demonstrate the DFMA tools for minimizing the effort and cost in manufacturing and assembly
5. Implement the environmental considerations in parts design and assembly.

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION TO TOLERANCES**

Tolerances: Limits and Fits, tolerance Chains and identification of functionally important dimensions. Dimensional chain analysis-equivalent tolerances method, geometric tolerancing for manufacture as per Indian Standards and ASME Y 14.5 standard, surface finish.

UNIT II **9 Hours**

FORM DESIGN OF CASTINGS

Materials choice - Influences of materials - Space factor - Size - Weight - Surface properties and production method on form design. Redesign of castings based on parting line considerations, Minimizing core requirements, redesigning cast members using Weldments.

UNIT III **9 Hours**

COMPONENT DESIGN - MACHINING CONSIDERATIONS

Design features to facilitate machining - Drills - Milling cutters - Keyways - Doweling procedures, Countersunk screws - Reduction of machined area - Simplification by separation - Simplification by amalgamation - Design for machinability - Design for economy

UNIT IV **9 Hours**

DFMA TOOLS

Rules and methodologies used to design components for manual, automatic and flexible assembly, traditional design and manufacture Vs concurrent engineering, DFA index, Poke-yoke, lean principles, six sigma concepts, design for manual assembly; design for automatic assembly.

UNIT V **9 Hours**

DESIGN FOR THE ENVIRONMENT

Introduction Environmental objectives Global issues Regional and local issues Basic DFE methods Design guidelines Example application Life cycle assessment Techniques to reduce environmental impact Design to minimize material usage Design for disassembly Design for Recyclability.

FOR FURTHER READING

Form design aspects in Forging and sheet metal components - machining considerations, redesign for manufacture, examples - Design for energy efficiency Design to regulations and standards

Total: 45 Hours

Reference(s)

1. A.K. Chitale and R. C. Gupta, Product Design and Manufacturing, PHI 2007
2. G. Boothroyd, P. Dewhurst and W. Knight, Product Design for Manufacture and Assembly, Marcell Dekker, 2002
3. R. Bryan, Fischer, Mechanical Tolerance stackup and analysis, Marcell Dekker, 2004
4. M. F. Spotts, Dimensioning and Tolerance for Quantity Production, Prentice Hall Inc., 2002
5. J.G. Bralla, Handbook of Product Design for Manufacturing, McGraw Hill Publications, 2000.
6. <https://nptel.ac.in/courses/107103012/42>.

18MC012 PROCESS PLANNING AND COST ESTIMATION**3 0 0 3****Course Objectives**

- To understand the necessity of process plan & cost estimation in production activities
- To learn about the various process planning techniques and production cost estimation
- To gain knowledge on principles and analytical methods for solving cost components

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Explain the methods of process planning and the various steps involved in process selection.
2. Examine the various steps involved in process planning activities.
3. Estimate the factory administrative expenses
4. Apply the cost estimation procedure for solving problems in fabrication shops
5. Calculate machining time for basic production activities

Articulation Matrix

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

UNIT I**10 Hours****INTRODUCTION**

Introduction- methods of process planning-Drawing interpretation-Material evaluation- Importance of costing and estimation -methods of costing-elements of cost estimation-Aims of cost Estimation - Types of estimates - Estimating procedure

UNIT II**10 Hours****PROCESS PLANNING ACTIVITIES**

Process parameters calculation for various production processes-Selection jigs and fixtures selection of quality assurance methods - Set of documents for process planning-Economics of process planning-steps in process selection-Production equipment and tooling selection-CAPP-Variant -Generative

UNIT III

9 Hours

PRODUCTION COST ESTIMATION

Types of estimates - Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Depreciation - Calculation of depreciation cost - Analysis of depreciation - Computing Material cost, Direct labour cost, overhead cost, Factory and Administrative Expenses

UNIT IV

8 Hours

ESTIMATION OF COST IN FABRICATION SHOPS

Estimation of Forging Shop- Estimation of Welding Shop- Estimation of Foundry Shop-Estimation in sheet metal shop-Shearing and forming-Illustrative examples.

UNIT V

8 Hours

MACHINING TIME

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

FOR FURTHER READING

Processing planning in PCB manufacturing industry-Advanced softwares used for process planning and cost Estimation

Total: 45 Hours

Reference(s)

1. B. P. Sinha, Mechanical Estimating and Costing, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2012
2. Phillip F. Ostwalal and Jairo Munez, Manufacturing Processes and Systems, John Wiley and Sons Publishing Company, New York, 2016.
3. R. S. Russell and B. W. Tailor, Operations Management, Prentice Hall of India, New Delhi, 2012
4. V. Chitale and R. C. Gupta, Product Design and Manufacturing, Prentice Hall of India, New Delhi, 2012

18MC013 VIRTUAL INSTRUMENTATION**3 0 0 3****Course Objectives**

- To understand the fundamentals of virtual instrumentation, and basic concept of Graphical programming with their functions in LabVIEW.
- To know the various types Interfaces and Protocol used in VI
- To describe the components of typical DAQ and various tools in VI with their application

Programme Outcomes (POs)

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.

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.

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Recall the fundamentals of virtual Instrumentation and compare conventional with traditional methods
2. Recognize the concept of graphical programming and LabVIEW with their functions
3. Identify the types of interfacing devices and protocol used in VI
4. Describe the functions and the interface requirements in Data acquisition system
5. Exemplify the types of VI tools with its application

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION TO VI**

Virtual Instrumentation: Block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow.

UNIT II**9 Hours****GRAPHICAL PROGRAMMING**

Concepts of graphical programming - LabVIEW software - Concept of VIs and sub VI - Error Handling Techniques - Display types - Digital - Analog - Chart and Graphs. Timers and dialog controls - Loops - structures - Arrays - Clusters. Local and global variables - String and file I/O. State Machine Architecture - Design pattern : Producer/ Consumer pattern & Master/Slave pattern

UNIT III

9 Hours

INSTRUMENT INTERFACES AND PROTOCOLS

RS232, RS422, RS485 and USB standards - IEEE 488 standard - Introduction to bus protocols of MOD bus and CAN bus. Electronic standards for signals - noise and EMI effects. Signal conditioning chassis and extension modules. Image acquisition cards and Motion Controllers

UNIT IV

9 Hours

DATA ACQUISITION SYSTEM

Introduction to data acquisition on PC, Sampling fundamentals, ADCs, DACs, Calibration, Resolution, - analog inputs and outputs - Single-ended and differential inputs - Digital I/O, counters and timers, DMA, Data acquisition interface requirements - Parameters involved in selection of Data acquisition cards - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT V

9 Hours

VI TOOLS

Mathematical tools for statistical calculation - Signal processing tools- Fourier transforms, power spectrum - Windowing and filtering tools -Control system tools - PID controller Applications: CRO - function generator -Illustration and case study-Temperature controller.

FOR FURTHER READING

Introduction to LabVIEW NXG - LabVIEW NXG WebVI Projects - Simulation of a simple second order system - Controlling motion of servo and stepper motors- Controlling an ice cream-making process- Generation of HTML page.

Total: 45 Hours

Reference(s)

1. Jeffrey Travis, Jim Kring, LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition), Prentice Hall, 2012.
2. Sanjeev Gupta, Virtual Instrumentation using LabVIEW, TMH, 2013
3. Gary W. Johnson, Richard Jennings, Lab-view Graphical Programming, McGraw Hill Professional Publishing, 2011
4. Robert H. Bishop, Learning with Lab-view, Prentice Hall, 2013
5. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newness, 2010
6. <https://nptel.ac.in/courses/108105062/10>

18MC014 MEDICAL MECHATRONICS**3 0 0 3****Course Objectives**

- To recall the human physiological system associated with biological signal acquisition using ECG, EEG, EMG and EOG machines
- To represent the principle function and working of different sensor, transducers, and electronics interfaces such as signal conditioning, recording system related to biomedical field
- To illustrate the functional blocks and operation of some advanced patient monitoring and diagnostic instruments

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Interpret the biological behavior of human cell and to relate the resting and action potential associated with the principle of ECG, EEG, EMG and EOG Machines
2. Summarize the principle, working and application of different types of biomedical sensors and transducers
3. Represent the various signal conditioning, recording and display systems associated with the biomedical devices.
4. Elaborate the construction and working of different biomedical patient measurement and monitoring systems
5. Determine the need for various diagnostic instruments used in biomedical instrumentation

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION**

Cell structure - electrode - electrolyte interface, electrode potential, resting and action potential - electrodes for their measurement, ECG, EEG, EMG and EOG - machine description - methods of measurement, failures and troubleshooting, Stem cells

UNIT II

9 Hours

BIO MEDICAL SENSORS AND TRANSDUCERS

Basic transducer principles Types - resistive, inductive, capacitive, fiber-optic, photoelectric, chemical, active and passive transducers and their description and feature applicable for biomedical instrumentation. Bio, Nano sensors and application

UNIT III

9 Hours

SIGNAL CONDITIONING, RECORDING AND DISPLAY

Input isolation, DC amplifier, instrumentation, charge amplifier, power amplifier, and differential amplifier - feedback, op-Amp-electrometer amplifier, carrier Amplifier - instrument power supply, basis of signal conversion and digital filtering, data reduction technique - time and frequency domain technique.

UNIT IV

9 Hours

MEDICAL MEASUREMENT AND MONITORING SYSTEMS

Blood pressure measurement: by ultrasonic method - plethysonography - blood flow measurement by electromagnetic flow meter, cardiac output measurement by dilution method - phonocardiography - vector cardiography. Heart lung machine - artificial ventilator - Anesthetic machine - Basic ideas of CT scanner - MRI and ultrasonic scanner - cardiac pacemaker -defibrillator patient safety - electrical shock hazards - Centralized patient monitoring system

UNIT V

9 Hours

RECORDERS AND ADVANCED SYSTEMS

Oscillographic - galvanometric - thermal array recorder, photographic recorder, storage oscilloscopes, electron microscope. Biotelemetry, Diathermy, Audiometers, Dialyzers, Lithotripsy.

FOR FURTHER READING

Equipment failures and troubleshooting - ECG Analysis - Centralized patient monitoring system - Biotelemetry - Bio, Nano sensors and application.

Total: 45 Hours

Reference(s)

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2011.
2. Cromwell, Weibell and Pfeiffer, Biomedical Instrumentation and Measurements, Prentice Hall of India Learning. Ltd., New Delhi, 2011
3. L. A. Geddes and Baker, L.E., Principles of Applied Bio-medical Instrumentation, John Wiley and Sons Publishing Company, New York, 1995
4. W. J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India Learning. Ltd., New Delhi, 2000.

18MC015 MODELLING OF INDUSTRIAL ROBOTS**3 0 0 3****Course Objectives**

- To impart knowledge on components of robot and types of endeffectors
- To understand kinematics, dynamics and programming of robot mechanisms
- To apply trajectory generation, motion analysis of robotic movements and robot vision.

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Select the components and recognize the specifications of an Industrial Robot.
2. Apply forward and inverse kinematics and DH convention for predicting the position and orientation of serial manipulator.
3. Analyse the velocity kinematics and static force of serial manipulator robot.
4. Analyse the dynamics and plan the trajectory for industrial robot.
5. Create an algorithm for mobile robot control by applying suitable controlling techniques.

Articulation Matrix

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

UNIT I**9 Hours****ROBOTS AND END EFFECTORS**

Robotics: A brief history, laws of Robotics, Differentiate serial and parallel manipulator - concept of workcell - selection of robot specification - classification of Industrial robot manipulator based on configuration - end-effector mechanism and types.

UNIT II **9 Hours**

KINEMATICS OF ROBOT MANIPULATOR

Representing position and rotation - Dot and Cross product - coordinate frames - rotation in plane - rotation in three dimension - Rotational transformation - Translational transformation - Euler angle, Roll, Pitch, Yaw angles Axis/angle representation - rigid motion - Homogeneous transformation - Denavit-Hartenberg convention - inverse and forward kinematics and problems

UNIT III **9 Hours**

VELOCITY ANALYSIS AND STATIC FORCE ANALYSIS

Representation of Linear and Angular Velocity of Manipulator Links Skew Symmetric matrix representation Velocity Forward Propagation Velocity / Manipulator Jacobian. Static Force Analysis: Force transformation of robotic manipulators - Force Jacobian - Singularity Analysis, Workspace Singularities.

UNIT IV **9 Hours**

ROBOT DYNAMICS AND TRAJECTORY PLANNING

Introduction, Lagrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar articulated robot - Trajectory planning, point to point, Continuous path motion

UNIT V **9 Hours**

MOBILE ROBOTICS

Introduction - types of mobile robot - kinematics of wheeled mobile robot - predictive modeling and system identification - kalman filters - bayesian estimation - Localization and mapping - ROS and programming.

FOR FURTHER READING

Industrial robots for welding, painting and assembly, Industrial automation, Typical example of automated industries, application of visual inspection.

Total: 45 Hours

Reference(s)

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, Industrial Robotics: Technology, Programming and Applications, McGraw Hill Book Company, 2012
2. Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2008
3. J.J. Craig, Introduction to Robotics: Mechanics and Control, Prentice Hall Inc. / Pearson Education, 2008.
4. Kelly, Alonzo. Mobile robotics: mathematics, models, and methods. Cambridge University Press, 2013
5. R.N. Jazer, Theory of Applied Robotics. Springer, 2010
6. Mark W Spong, Seth Hutchinson, M. Vidyasagar Robot Modeling and Control, Wiley India Edition, New Delhi., Nov, 2006.

**18MC016 FUZZY LOGIC AND ARTIFICIAL
NEURAL NETWORK****3 0 0 3****Course Objectives**

- To understand fuzzy logic and neural network concepts
- To equip with the latest application of soft computing

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Explain the concept of fuzzy set theory and its architectures.
2. Apply the knowledge based rules and its controller types for the given application
3. Carry out the design for fuzzy knowledge representation and multi objective decision making controllers
4. Implement machine learning through neural networks
5. Interpret the concept of artificial neural networks and their control applications.

Articulation Matrix

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

UNIT I**9 Hours****FUZZY LOGIC SYSTEMS**

Classical sets-fuzzy sets- fuzzy operation -fuzzy relations - fuzzification - defuzzification - if-then rules- Fuzzy Functions.

UNIT II**9 Hours****FUZZY SYSTEMS**

Membership function-knowledge base - data base - rule base -decision-making logic -fuzzy logic controller: Mamdani and Sugeno-Takagi architecture

UNIT III**9 Hours****FUZZY RULES AND LOGIC**

Representation of fuzzy knowledge - fuzzy inference systems - Fuzzy decision making - Multi Objective Decision Making-Fuzzy logic controller for inverted pendulum

UNIT IV

9 Hours

ARTIFICIAL NEURAL NETWORK

Introduction -biological neuron and their artificial models - neuron modeling- learning rules - types of neural networks - single layer - multi layer feed forward network - back propagation - learning factors.

UNIT V

9 Hours

NEURAL NETWORKS IN CONTROL APPLICATIONS

Feedback networks - Hopfield networks - Applications of neural networks - Process identification - Artificial neuro controller for inverted pendulum

FOR FURTHER READING

ANN in mobile robots navigation and control, Neuro fuzzy approach in machine vision system for parts identification

Total: 45 Hours

Reference(s)

1. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, New Delhi,2012.
2. John Yen, Reza Langari, Fuzzy logic Intelligence, control and Information, Pearson Education,1999.
3. C T Jang, J S R Sun and E Mizutani , Neuro Fuzzy and Soft computing, Pearson Education,2006.
4. Laurene Fauseett: Fundamentals of Neural Networks, PHI,2004
5. Timothy J.Ross: Fuzzy Logic Engineering Applications, McGrawHill, 2004
6. B. Yagnanarayanan, Artificial Neural Networks, Prentice Hall of India Ltd .,New Delhi.2012.

18MC017 ARTIFICIAL INTELLIGENCE**3 0 0 3****Course Objectives**

- To understand the various characteristics of intelligent agents
- To understand the different search strategies in AI
- To represent knowledge in solving AI problems and understand the different ways of designing software agents
- To know about the various applications of AI

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Represent a problem using first order and predicate logic
2. Select appropriate search algorithms for any AI problem
3. Choose the apt agent strategy to solve a given problem
4. Design software agents to solve a problem
5. Design applications for Natural Learning Process that uses Artificial Intelligence.

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION**

Introduction -Definition - Future of Artificial Intelligence - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to Typical AI problems

UNIT II**9 Hours****PROBLEM SOLVING METHODS**

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems - Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games - Alpha - Beta Pruning - Stochastic Games

UNIT III **9 Hours**

KNOWLEDGE REPRESENTATION

First Order Predicate Logic - Prolog Programming - Unification - Forward Chaining-Backward Chaining - Resolution - Knowledge Representation - Ontological Engineering-Categories and Objects - Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information

UNIT IV **9 Hours**

SOFTWARE AGENT

Architecture for Intelligent Agents - Agent communication - Negotiation and Bargaining - Argumentation among Agents - Trust and Reputation in Multi-agent systems

UNIT V **9 Hours**

APPLICATIONS

AI applications - Language Models - Information Retrieval- Information Extraction - Natural Language Processing - Machine Translation - Robot - Hardware - Perception - Planning - Moving

FOR FURTHER READING

Speech Recognition Application

Total: 45 Hours

Reference(s)

1. Gerhard Weiss, Multi Agent Systems, Second Edition, MIT Press, 2013.
2. Bratko, Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010
4. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009
5. M. Tim Jones, Artificial Intelligence: A Systems Approach(Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008
6. <https://nptel.ac.in/courses/106105079>

18MC018 OPTIMIZATION TECHNIQUES**3 0 0 3****Course Objectives**

- To formulate design optimization problems for engineering applications
- To provide knowledge on single variable unconstrained problems
- To learn multi-objective unconstrained optimization problems
- To introduce concepts of constrained non-linear and non- traditional optimization problems

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- 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.
- Analyze, design and develop electro mechanical system using contemporary tools
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Formulate design optimization problem from real world applications.
2. Compute the solution for single variable unconstrained optimization problems
3. Identify the solution for multivariable unconstrained optimization problems
4. Compute the solution for the constrained non-linear optimization problems
5. Apply non-traditional optimization techniques to solve engineering problems

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION TO DESIGN OPTIMIZATION**

Optimization - design process, Conventional Vs Optimum design - Statement of an optimization problem- Classifications of optimization problems. Optimum design problem formulation - process steps - Problem formulation for engineering applications - Two-bar bracket, Design of coil springs

UNIT II

9 Hours

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

9 Hours

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.

UNIT IV

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.

UNIT V

9 Hours

NON TRADITIONAL 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

FOR FURTHER READING

Unconstrained algorithms - Variable metric method (Davidson-Fletcher-Powell method). Constrained algorithms - Geometric programming- Primal-Dual relationship. Powell's quadratic function.

Total: 45 Hours

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. <http://www.nptelvideos.in/2012/12/design-and-optimization-of-energy.html>
6. <http://nptel.ac.in/courses/112106064/>

18MC019 MACHINE LEARNING

3 0 0 3

Course Objectives

- To Understand the fundamentals of various machine learning algorithms
- To gain knowledge on important methods in ANN, Fuzzy and Genetic algorithm
- To study the machine learning algorithms for various heuristic and non heuristic algorithms.

Programme Outcomes (POs)

- a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Differentiate the basics of supervised and semi supervised learning methods.
2. Retrieve the unsupervised and reinforcement learning methods involved in artificial learning
3. Interpret the concept of artificial neural networks and their control applications
4. Implement the fuzzy knowledge representation and multi objective decision making controllers
5. Compute the knowledge about various heuristic and non heuristic algorithms.

Articulation Matrix

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

UNIT I

9 Hours

SUPERVISED AND SEMI SUPERVISED LEARNING METHODS

Introduction to learning & classifiers- LDA - ANN - Naive Bayes classifier- decision tree Regression- Ordinary Least Squares - linear and Logistic Regression- Gaussian process -Stepwise Regression - Multivariate Adaptive Regression Splines (MARS) - Locally Estimated Scatterplot Smoothing (LOESS) - overview of nearest neighbour - Support vector machines- Temporal difference learning - Q-learning

UNIT II

9 Hours

UNSUPERVISED

Expectation -maximization (EM) - Vector quantization, Clustering Fuzzy K & C means algorithm - Density-based spatial clustering of applications with noise (DBSCAN) - Conceptual clustering- Association rule learning - Apriori algorithm- SVD

UNIT III **9 Hours**

NEURAL NETWORK

Perceptron - Probabilistic Neural Network (PNN) - Back-Propagation (BPN) - Hopfield Network - Self-Organizing Map (SOM) - Learning Vector Quantization (LVQ) - Adaptive Resonance Theories 1 & 2 - Case studies on GA based algorithm development

UNIT IV **9 Hours**

FUZZY CLASSIFICATION

Basic concepts in Fuzzy Set theory-Fuzzy logic controllers - Principles - Various industrial Applications of Fuzzy logic control - Adaptive Fuzzy systems - Fuzzy Decision making - Fuzzy classification - Fuzzy pattern Recognition - Image Processing applications - Fuzzy optimization - Case studies on fuzzy based algorithm development

UNIT V **9 Hours**

HEURISTIC AND NON HEURISTIC ALGORITHMS

Introduction to genetic algorithm -initialization, selection, mutation and termination Swarm intelligence - PSO-ACO - Tabu search - Reactive search optimization (RSO)- cross-entropy (CE) methods. Case studies on GA based algorithm development

FOR FURTHER READING

Self-driving cars, Face recognition, Web search, Industrial robots, Missile guidance

Total: 45 Hours

Reference(s)

1. Ethem Alpaydin, Introduction to Machine Learning, The MIT Press, Cambridge, London.2014.
2. Klir, G.J. Yuan Bo, Fuzzy sets and Fuzzy Logic: Theory and Applications, Prentice Hall of India Pvt. Ltd.New jersey. 2005
3. Randy L. Haupt, Sue Ellen Haupt Practical Genetic Algorithms, Wiley interscience 2004
4. S. Rajasekaran, GA Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, Prentice Hall of India Private Limited, 2003
5. Simon Haykin, Neural Networks – A comprehensive foundation, Prentice Hall, 3rd Edition, 2004
6. https://onlinecourses.nptel.ac.in/noc18_cs26/course.

18MC020 LINEAR INTEGRATED CIRCUITS**3 0 0 3****Course Objectives**

- To study the IC fabrication procedure.
- To study the characteristics, realize circuits, design for signal analysis using Op-amp ICs.
- To familiarize students with applications of various IC's
- To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator circuits, ADCs

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 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.
- 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.
- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Classify the ICs and examine the processes involved in IC fabrication
2. Analyse the DC & AC Characteristic of OPAMP and specify the application of OPAMP
3. Design the circuits using OP-AMP for various linear and nonlinear applications
4. Analyse the characteristics and applications of special ICs like Timers, PLL circuits, and regulator circuits.
5. Analyse the function of different of voltage regulators and infer the need for Optocoupler.

Articulation Matrix

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

UNIT I**9 Hours****IC FABRICATION**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking, diffusion of impurities, Realization of monolithic ICs and packaging.

UNIT II**9 Hours****CHARACTERISTICS OF OP-AMP**

Basic information of Operational Amplifier -Ideal Operational amplifier- Block diagram-Differential amplifier-DC characteristics- AC characteristics-Frequency response-stability-CMRR-Slew rate

UNIT III

9 Hours

APPLICATIONS OF OP-AMP

Inverting and non inverting amplifiers-summing amplifier-voltage follower-Instrumentation amplifier, V/I and I/V converters, comparators-Zero crossing detector- D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.

UNIT IV

9 Hours

SPECIAL ICS

555 Timer circuit Functional diagram-monostable operations-Astable operations-schmitt trigger-Voltage regulator-series op-amp regulator-IC voltage regulator-723 General purpose regulator-Switching regulator-Voltage controlled oscillator(VCO)

UNIT V

9 Hours

APPLICATION ICS

IC Voltage regulators-LM78XX,79XX, LM317-adjustable voltage regulators-Phase-locked loop-565-block diagram-applications-LM380 power audio amplifier-Switch mode power supply(SMPS)

FOR FURTHER READING

Etching, summer, differentiator and integrator, peak detector, Analog multiplier ICs, opto electronic ICs.

Total: 45 Hours

Reference(s)

1. Ramakant A. Gayakward, Op-amps and Linear Integrated Circuits, Pearson Education, New Delhi, 2009.
2. D. Roy Choudhury and Sheil B. Jani, Linear Integrated Circuits, New Age International, New Delhi, 2010
3. Jacob Millman and Christos C.Halkias, Integrated Electronics - Analog and Digital Circuits System, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003
4. Robert F. Coughlin and Fredrick F. Driscoll, Op-amp and Linear ICs, Pearson Education, New Delhi, 2008
5. David A. Bell, Op-amp and Linear ICs, Prentice Hall of India Learning. Ltd., New Delhi, 2007

**18MC021 CONTROL SYSTEM AND DRIVES FOR
ELECTRIC VEHICLES****3 0 0 4****Course Objectives**

- To impart knowledge in c electric vehicles.
- To understand the control system of electric vehicles

Programme Outcomes (POs)

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.

Program Specific Objectives(PSO)

m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Understand working of Electric Vehicles and recent trends
2. Understand the properties of batteries and its types
3. Develop the electric drives unitits control for application of electric vehicles.
4. Outline the control of electric vehicle design system.
5. Analyse different power converter topology used for electric vehicle application

Articulation Matrix

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

UNIT I**9 Hours****ELECTRIC VEHICLES**

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Electric Drive Trains, Architecture of Electric Drive Trains.

UNIT II**9 Hours****ENERGY STORAGE FOR EV**

Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, proton exchange membrane fuel cell (PEMFC) and its operation, Modelling of PEMFC, Super Capacitors.

UNIT III

9 Hours

ELECTRIC DRIVES

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

UNIT IV

9 Hours

DESIGN OF ELECTRIC VEHICLES

Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of battery, design of electric motor drive capacity, transmission design, energy storage design.

UNIT V

9 Hours

POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING

Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Zconverter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology

Total: 45 Hours

Reference(s)

1. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2015
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2017
3. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2018.
4. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2016.
5. Chris Mi, M. AbulMasrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Wiley Publication, 2018

18MC022 PROCESS CONTROL**3 0 0 3****Course Objectives**

- To obtain the mathematical models for first order and higher order real-time systems and also understand the concept of self-regulation
- To get adequate knowledge about the characteristics of various controller modes and controller tuning methods
- To understand how to apply the control schemes for various applications

Programme Outcomes (POs)

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.

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.

Program Specific Objectives (PSO)

m. Analyze, design and develop electro mechanical system using contemporary tools

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Solve the mathematical models for first order real time systems.
2. Understand the characteristics of various control modes and the concept of various control schemes.
3. Understand the various controller tuning methods to tune the controller.
4. Know the construction, characteristics and applications of different type of actuators.
5. Apply the process control knowledge on Industrial environment.

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION**

Need for process control continuous and batch process mathematical model of first order level, pressure and thermal processes interacting and non-interacting systems servo and regulator operation self-regulation

UNIT II **9 Hours**

CONTROLLER CHARACTERISTICS

Basic control actions characteristics of On-Off, proportional, integral and derivative control modes composite control modes: P+I, P+D and P+I+D control modes selection of control mode for different processes typical control schemes for level, flow, pressure and temperature processes.

UNIT III **9 Hours**

TUNING OF CONTROLLERS AND MULTI-LOOP CONTROL

Optimum controller settings Evaluation criteria-IAE, ISE and ITAE decay ratio Tuning of controllers by process reaction curve method damped oscillation method Ziegler-Nichol's tuning Feed forward control - ratio control cascaded control averaging control inferential and split range control.

UNIT IV **9 Hours**

FINAL CONTROL ELEMENT

Pneumatic and electric actuators valve positioner control valve characteristics of control valves type of valves: globe, butterfly, diaphragm, ball valves control valve sizing cavitation and flashing in control valves. Response of control valves, electric and electro pneumatic valves Selection of control valves

UNIT V **9 Hours**

SELECTED UNIT OPERATIONS

Distillation column control of top and bottom product compositions reflux ratio. Case study: control of CSTR, control of heat exchanger, Steam boiler: drum level control and combustion control.

FOR FURTHER READING

Interacting and non interacting system-Cascade control for level process-temperature process station.

Total: 45 Hours

Reference(s)

1. George Stephanopoulos, Chemical Process Control, Prentice Hall of India learning Pvt. Ltd., New Delhi, 2012
2. B. Wayne Bequette, Process Control: modeling, design, and simulation, Prentice Hall of India Learning Pvt.Ltd., New Delhi, 2008
3. Donald P. Eckman, Automatic Process Control, Wiley-India Pvt. Ltd., New Delhi, 2009
4. Dale E. Seborg, D. A. Mellichamp and Thomas F Edgar, Process Dynamics and Control, Wiley-India, 2010.
5. Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008
6. S B Thakore and B I Bhatt, Introduction to Process Engineering and Design, Tata McGraw-Hill PublishingCo. Ltd., New Delhi, 2008

18MC023 AD-HOC AND SENSOR NETWORK**3 0 0 3****Course Objectives**

- To understand the wireless adhoc and sensor networks enable them to recognize the wide range of applicability of these networks.
- To understand the major design issues such as protocol mechanisms and resource constraints.

Programme Outcomes (POs)

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.

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.

Program Specific Objectives (PSO)

m. Analyze, design and develop electro mechanical system using contemporary tools

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. To comprehend the fundamental Concepts and applications of ad hoc and wireless sensor networks.
2. To solve the MAC protocol issues of ad hoc networks.
3. To label routing protocols for ad hoc wireless networks with respect to TCP design issues.
4. To elucidate the concepts of network architecture and MAC layer protocol for WSN.
5. To discuss the WSN routing issues by considering QoS measurements.

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION**

Fundamentals of Wireless Communication Technology -The Electromagnetic Spectrum - Radio propagation Mechanisms - Characteristics of the Wireless channel mobile ad hoc networks (MANETs) - Wireless Sensor Networks (WSNs): concepts and architectures - Applications of Ad Hoc and Sensor Networks - Design Challenges in Ad hoc and Sensor Networks.

UNIT II

9 Hours

MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS

Issues in designing a MAC Protocol - Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks - Design Goals of a MAC Protocol for Ad Hoc Wireless Networks - Classification of MAC Protocols -Contention based protocols - Contention based protocols with Reservation Mechanisms - Contention based protocols with Scheduling Mechanisms - Multi channel MAC - IEEE 802.11.

UNIT III

9 Hours

ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS

Routing Protocol: Issues in designing a routing protocol for Ad hoc networks - Classification- proactive routing - reactive routing (on-demand) - hybrid routing - Transport Layer protocol for Ad hoc networks - Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks -Classification of Transport Layer solutions-TCP over Ad hoc wireless - Network Security - Security in Ad Hoc Wireless Networks - Network Security Requirements.

UNIT IV

9 Hours

WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS

Single node architecture: hardware and software components of a sensor node -WSN Network architecture: typical network architectures -data relaying and aggregation strategies - MAC layer protocols: self-organizing - Hybrid TDMA/FDMA and CSMA based MAC - IEEE 802.15.4

UNIT V

9 Hours

WSN ROUTING, LOCALIZATION & QOS

Issues in WSN routing –OLSR - Localization –Indoor and Sensor Network Localization - absolute and relative localization - triangulation - QOS in WSN - Energy Efficient Design – Synchronization.

Total: 45 Hours

Reference(s)

1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Pearson Education, 2008.
2. Labiod. H, "Wireless Adhoc and Sensor Networks", Wiley, 2008.
3. Li, X, "Wireless ad -hoc and sensor Networks: theory and applications", Cambridge University Press, 2008.
4. Carlos De Moraes Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2nd edition, 2011.
5. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication

18MC024 INDUSTRIAL IOT**3 0 0 3****OBJECTIVES**

- To understand the IoT concepts and standards
- To use various components of IoT system
- To analyze the challenges in IoT implementation
- To relate and apply IoT for the applications

PROGRAM OUTCOMES (POs)

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 analyze 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 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.

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.

Program Specific Objectives (PSO)

m. Analyze, design and develop electromechanical system using contemporary tools

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation

COURSE OUTCOMES (COs)

1. Implement the IoT concepts and its standards.
2. Develop components of IoT system
3. Configure IoT platform for the security and privacy.
4. Apply IoT system for transportation, health care and agriculture.
5. Analyze the challenges in IoT implementation.

Articulation Matrix

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

UNIT I **9 Hours**
IOT CONCEPTS

IoT - Technologies that led to evolution of IoT - IoT and SCADA - IoT and M2M - IoT and Big Data - International standard - Operating platforms - Communication protocols – Modbus – Profibus – RS485 – RTU - Ethercat.

UNIT II **9 Hours**
COMPONENTS OF IOT SYSTEM

Design of IoT systems - Device configuration and addressing - Interfacing IoT sensors and actuators - IoT cloud building blocks - Platform specific dashboard - MQTT Server - Time series database - Data monitoring, visualization and IoT analytics.

UNIT III **9 Hours**
SECURITY IN IOT

MQTT vs HTTP performance - Security considerations - Firmware updates - Cryptography basics - Cryptography in IoT - Privacy considerations and design guidelines - Individual privacy.

UNIT IV **9 Hours**
IOT CASE STUDY

Lighting as a service - Intelligent traffic systems - Smart parking - smart water management - smart cities - IoT for health services – IoT for OEE evaluation – IoT for Smart Factory and Smart Home Automation.

UNIT V **9 Hours**
CHALLENGES IN IOT IMPLEMENTATION

Big data management - Connectivity challenges - Dashboard development challenges - privacy implementation - Mission critical applications.

For Further Reading

Implementation on two platforms - Amazon IoT cloud - Microsoft Azure basics - Open source IoT platform on local machine.

Total: 45 Hours

References

1. Michael Miller, The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World, QUE , 26 March 2015
2. Arsheep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Orient Blackswan Private Limited - New Delhi; First edition, 2015.
3. Srinivasa K. G., Siddesh G. M., Hanumantha Raju R., Internet of Things, Cengage Learning India Pvt. Ltd., 2018.
4. Adrian McEwen, Hakin Cassimally, Designing The Internet of Things, Wiley, 2015

18MC025 INDUSTRIAL DRIVES AND CONTROL**2023****Course Objectives**

- To understand the working principle and performance characteristics of 3-Phase Induction motor
- To determine the operation, characteristics and performance parameters of converters
- To describe feedback control and basic components of control drive system

Programme Outcomes (POs)

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

Program Specific Objectives (PSO)

- Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

- Understand the various types of drive system with gear arrangement
- Understand the construction and working principle of asynchronous and asynchronous machine
- Interpret the operation and characteristics of invertors and its related techniques
- Acquire the knowledge on various types of frequency pattern and control modes
- Write the integrate positioning programming for various types of application

Articulation Matrix

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

UNIT I 6 Hours

BASICS OF DRIVE SYSTEM AND GEARS

Drive system introduction Comparison of drives Characteristic curves Gears introduction
Gears sizes and Gear ratio Various types

UNIT II 6 Hours

BASICS OF ASYNCHRONOUS

Design and theory of operation Motor poles Construction - Enclosure Torque Vs Speed
characteristics curve Brakes & Brake rectifiers Encoder theory of operation Various types

UNIT III 6 Hours

BASICS OF FREQUENCY INVERTERS

Block diagram Components of inverter Brake chopper & 4 quadrant operation accessories of
invertors Energy recovery EMC effects Various communication types.

UNIT IV 6 Hours

FREQUENCY PATTERNS

Introduction to the V/f characteristic curve- 50Hz pattern 70Hz pattern 87Hz pattern Open
loop control modes (V/F & VFC) closed loop control modes (VFCN & CFC)

UNIT V 6 Hours

IPOS PROGRAMMING, PARAMETER SET

Basics of IPOS programming commands Sample programs Touch probe Compiler specific
information Various parameter sets Various fault codes & its description.

FURTHER READING

Application modules- Extended Positioning via bus-Modulo Positioning- Drive sync via S-
Bus

List of Experiments

1. Working with Motion studio operating software
2. Startup with Keypad and Motion Studio software for open loop drive
3. Parameterization and operating mode- open loop system.
4. Startup with Keypad and Motion Studio software for closed loop drive
5. Parameterization and operating mode- Closed loop system
6. Frequency pattern and fault code diagnosis
7. IPOS program - Write a program to change the travel speed during movement.
8. IPOS program - Write a program for table positioning.
9. Application Module - Extended positioning via bus
10. Application Module - Module Positioning.

Total: 30+30=60 Hours

Reference(s)

1. Muhammad H. Rashid, Power Electronics - Circuits, Devices and Applications, Prentice Hall of India Learning. Ltd., New Delhi, 2004
2. G. K. Dubey, Fundamentals of Electrical Drives, Wiley Eastern Ltd., New Delhi, 2007
3. D.P.Kothari and J.J.Nagrath, Electric Machines, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2010
4. J. Nagrath and M. Gopal, Control System Engineering, New Age International Publisher, New Delhi, 2011
5. SEW Study materials, practical workbooks

18MC0YA INDUSTRIAL ROBOTICS**3 0 0 3****Course Objectives**

- To analyze robot manipulators in terms of their kinematics, control
- Enable to program and control an industrial robot system that performs a specific task
- To discuss various applications of industrial robot systems

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Identify the configuration of a robot
2. Analyze the kinematics and control of robots
3. Understand different robot sensors and vision system
4. Perform simple programming of robot
5. Identify a suitable robot for a given application

Articulation Matrix

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

UNIT I**8 Hours****INTRODUCTION**

Definition of a robot - scope of industrial robots, Robot anatomy - robotics and automation, law of robots, specification of robots, resolution, repeatability and accuracy of manipulator. Classification of robots and justifying the use of robots. Drive mechanisms - hydraulic, electrical, pneumatic drives

UNIT II

10 Hours

ROBOT CONTROL AND KINEMATICS

Power transmission systems and control - mechanical transmissions method- Rotary to rotary, rotary to linear conversions - rotary problem- remote centered compliance devices. End effectors - vacuum, magnetic and air operated grippers. Robot Kinematics- 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) -DH matrices

UNIT III

9 Hours

ROBOT SENSORS AND 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, robot cell, design and control layouts

UNIT IV

9 Hours

ROBOT PROGRAMMING AND ARTIFICIAL INTELLIGENCE

Robotics programming: Teach Pendant Programming, Lead through programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effector commands, and Simple programs. Basics - Goals of Artificial Intelligence

UNIT V

9 Hours

INDUSTRIAL APPLICATIONS

Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading- CIM-hostile and remote environments. Inspection and future application-safety, training, maintenance and quality. Economic analysis of robotics. SCARA robots, wheeled robots, Bipedal robots (humanoid robots), hexapod robots

FOR FURTHER READING

Economic and social issues - Micro motor and micro gripper - Performance characteristics of a robot - Simple programs for drilling operations using VAL - Robot cell

Total: 45 Hours

Reference(s)

1. M. P. Groover, Industrial Robotics - Technology, Programming and Applications, Tata McGraw-Hill Publishing Company. Ltd., New Delhi, 2011
2. 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
3. D. Richard, Klafter A. Thomas, Chmielewski and Michael Negin, Robotics Engineering – An Integrated Approach, Prentice Hall of India, New Delhi, 2009
4. Ramesh Jain, Machine Vision, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 1995
5. Yoram Koren, Robotics for Engineers, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2004
6. James G. Keramas, Robot Technology Fundamentals, Cengage Learning India Pvt. Ltd., New Delhi, 2011

18MC0YB BASICS OF MECHATRONICS**3 0 0 3****Course Objectives**

- To provide a basic background to mechatronics and link to more specialized skills
- To develop the mix of skills in mechanical engineering, electronics and computing
- To familiarize about sensors and control system used in mechatronics
- To develop confidence and competence in designing mechatronics systems

Programme Outcomes (POs)

- 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.
- 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.
- k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Identify the Mechatronics system based on sensor and transducer; analyze the sensors for Particular applications.
2. Characterize the components and design the Hydraulic and Pneumatic circuit for Industrial applications.
3. Analyze the characteristics of actuators and select the suitable actuator for applications.
4. Develop the simple programmable logic controller and differentiate relay logic with ladder logic.
5. Develop the mechatronics system design and implement the Process parameters for given application.

Articulation Matrix

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

UNIT I **9 Hours**
MECHATRONICS

Introduction to Mechatronics Systems - Measurement Monitoring Systems Automation - Control Systems -Microprocessor based Controllers. Sensors and Transducers - Performance Terminology - Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors - Selection of Sensors

UNIT II **8 Hours**
ACTUATION SYSTEMS

Pneumatic and Hydraulic Systems - Directional Control Valves - Rotary Actuators. Mechanical Actuation Systems - Cams - Gear Trains - Ratchet and pawl - Belt and Chain Drives - Bearings. Electrical Actuation Systems - Mechanical Switches - Solid State Switches - Solenoids - D.C Motors - A.C Motors - Stepper Motors -Servomotors.

UNIT III **10 Hours**
SYSTEM MODELS AND CONTROLLERS

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational - Translational Systems, Electromechanical Systems - Hydraulic - Mechanical Systems. Continuous and discrete process Controllers - Control Mode - Two - Step mode - Proportional Mode - Derivative Mode - Integral Mode - PID Controllers - Digital Controllers - Velocity Control - Adaptive Control - Digital Logic Control - Micro Processors Control

UNIT IV **9 Hours**
PROGRAMMABLE LOGIC CONTROLLERS

Programmable Logic Controllers - Basic Structure - Input / Output Processing -Programming - Mnemonics - Timers, Internal relays and counters - Shift Registers - Master and Jump Controls - Data Handling - Analogue Input / Output - Selection of PLC

UNIT V **9 Hours**
DESIGN OF MECHATRONICS SYSTEM

Stages in designing Mechatronics Systems - Traditional and Mechatronic Design - Possible Design Solutions Case Studies of Mechatronics Systems, Automatic washing Machine - Automatic Camera - Pick and place robot - Automatic Car Park Systems - Engine Management Systems

FOR FURTHER READING

Smart sensors - Hybrid motor - Advanced Controllers - PLC in Mechatronics - Fault finding

Total: 45 Hours

Reference(s)

1. W. Bolton, Mechatronics: Electronic control systems in Mechanical and Electrical Engineering, Pearson Education, New Delhi,2013
2. David G. Alciature and Michael B. Histan, Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2007
3. Nitaigour Premchand Mahalik, Mechatronics : Principles, Concepts and Applications, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2008
4. M. D. Singh, and J. G. Joshi, Mechatronics, Prentice Hall of India, New Delhi,2009
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. Newton C. Braga, Mechatronic Source Book, Delmar Cengage Learning, 2009

**18MC0YC MICRO ELECTRO MECHANICAL
SYSTEMS****3 0 0 3****Course Objectives**

- To acquire a knowledge about fabrication process in MEMS
- To know about various etching techniques in micromachining
- To have a knowledge about applications in micromachining techniques

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Know the scaling laws that are used extensively in the conceptual design of micro-devices and able to use materials for common micro-components and devices
2. Select a fabrication process suitable for production of a MEMS device
3. Choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process
4. Understand the working principles of micro-sensors, actuators, valves, pumps, and fluidics used in Microsystems
5. Acquire knowledge on micro system packaging and design

Articulation Matrix

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

UNIT I**9 Hours****INTRODUCTION**

Introduction to MEMS: Introduction to Microsystems and micro electronics - Market scenario for MEMS. Working principle: Trimmers scaling vector and scaling laws - scaling in geometry - scaling in rigid body dynamics- scaling in electrostatic forces - scaling in electricity - scaling in fluid mechanics - scaling in heat transfer. Materials for MEMS: Silicon as a MEMS material - Crystal structure of silicon - Miller indices - silicon compounds - SiO₂, SiC, Si₃N₄ and polycrystalline silicon - silicon piezo-resistors - Gallium arsenide - polymers for MEMS -quartz.

UNIT II

9 Hours

FABRICATION OF MEMS

Clean room technology - Substrates and wafer - single crystal silicon wafer formation - ideal substrates - mechanical properties - Processes for bulk micromachining - Wet Vs dry etching - Chemical etching of Silicon - etchant systems and etching process - Reactive ion etching and DRIE - mask layout design. Processes for Surface micromachining - Deposition processes - ion implantation - Diffusion - oxidation - chemical vapor deposition - physical vapor deposition - deposition by epitaxy - photolithography and photoresists. Limitations of Bulk and surface micromachining - LIGA, SLIGA and other micromolding processes such as HeXIL

UNIT III

9 Hours

DESIGN CONSIDERATIONS BASED ON MICROMECHANICS

Micromechanics considerations - static bending of thin plates - circular plates with edge fixed - rectangular plate with all edges fixed - square plate with all edges fixed - mechanical vibration - resonant vibration - micro accelerometers - design theory and damping coefficients - thermo mechanics - thermal stresses - fracture mechanics - stress intensity factors - fracture toughness - and interfacial fracture mechanics

UNIT IV

9 Hours

MEMS DEVICES

Micro actuation techniques - piezoelectric crystals - Shape memory alloys - bimetallics - conductive polymers. Micro motors - micro grippers - Microfluidic devices - Micro pumps - mechanical and nonmechanical micropumps - micro valves - valveless micropumps - Lab on Chip. Types of micro sensors - Microaccelerometer - Micropressure sensors, MEMS switches/resonators, MEMS reliability.

UNIT V

9 Hours

MICROSYSTEM PACKAGING AND DESIGN

Micro system packaging - materials die level device level - system level - packaging techniques - die preparation - surface bonding - wire bonding - sealing - Case studies. Design considerations - process design - mechanical design - applications of micro system in automotive - bio medical - aerospace - telecommunication industries

FOR FURTHER READING

Use of gold and other metals in MEMS- MEMS devices for automotive application-MEMS device for the same purpose may be manufactured by different types of processes-Need for micromechanics considerations in MEMS design- Optical MEMS devices- Use of MEMS devices in cell phones, robots, automobiles, etc

Total: 45 Hours

Reference(s)

1. Mohamed Gad-el-Hak, The MEMS Handbook, CRC Press Publishers, India, 2002
2. Tai Ran Hsu, MEMS and Micro Systems Design and Manufacture, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008
3. Nadim Maluf, An Introduction to Micro Electro Mechanical System Design, Artech House Publishers, London, 2004
4. Chang Liu, Foundations of MEMS, Pearson Education, New Delhi, 2011. James J. Allen, Micro Electro Mechanical System Design, CRC Press Publishers, India, 2005
5. Julian w. Gardner, Vijay K. Varadan and Osama O. Awadelkarim, Micro sensors MEMS and smart Devices, John Wiley and Sons Ltd., England, 2002
6. E.H. Tay, Francis and W.O.Choong, Microfluids and Bio MEMS applications, Springer, 2002

**18MC0YD INDUSTRIAL DRIVES AND
AUTOMATION****3 0 0 3****Course Objectives**

- To study the industrial control methods of AC and DC drives
- To Understand the theory and applications of Industrial AC and DC drive systems
- To analyze the operation of Artificial-Intelligence Based drive

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Explain fundamental principles of various AC Machines and drives
2. Describe different types of Induction Motor Slip-Power Recovery Schemes..
3. Explain various AC drive control methods.
4. Apply control techniques for synchronous motor drives.
5. Apply Expert System and Fuzzy Logic principles for drives control

Articulation Matrix

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

UNIT I**9 Hours****AC MACHINES FOR DRIVES**

Induction Machines, Torque Production, Equivalent Circuit Analysis, Torque-Speed Curve, NEMA Classification of Machines, variable-Voltage, Constant frequency Operation, Variable-Frequency Operation, Constant Volts/Hz operation, Drive operating Regions, Variable Stator current operation, the effect of Harmonics.

Synchronous Machines: Wound Field Machine- Equivalent Circuit, Developed Torque, Salient Pole Machine Characteristics, Synchronous Reluctance Machine, Permanent Magnet Machine.

UNIT II **9 Hours**

INDUCTION MOTOR SLIP-POWER RECOVERY DRIVES

Introduction, Doubly-Fed Machine Speed Control by Rotor Rheostat, Static Kramer Drive, Static Scherbius Drive.

UNIT III **9 Hours**

CONTROL OF INDUCTION MOTOR DRIVES

Introduction, Vector of Field-Oriented Control, Indirect or Feed forward Vector Control, Vector Control of Line-Side PWM Rectifier, Stator Flux Oriented Vector Control, Vector Control of Current- Fed Inverter Drive, Vector Control of Cycloconverter Drive, Direct Torque and Flux Control (DTC).

UNIT IV **9 Hours**

CONTROL OF SYNCHRONOUS MOTOR DRIVES

Introduction, Sinusoidal SPM Machine Drives, Vector Control, Synchronous Reluctance Machine Drives, Wound-Field Synchronous Machine Drives.

UNIT V **9 Hours**

FUZZY LOGIC PRINCIPLES AND APPLICATIONS

Introduction, Fuzzy Sets, Fuzzy System, Defuzzification Methods, Fuzzy Control, General Design Methodology, Applications in Electrical Machines and Drives

FOR FURTHER READING

Neuro-fuzzy based control of DC drives, Design of AC drives using Brain Emotional Learning Based Intelligent Controller, Variable frequency control of multiple synchronous motor drives

Total: 45 Hours

Reference(s)

1. Bimal K Bose, "Power Electronics and Variable Frequency Drives - Technology and Application", IEEE Press, 1997.
2. Gopal K Dubey, Fundamentals of Electric Drives, Narosa Publishing House, New Delhi, 2005.
3. Peter Vas, "Vector Control of AC Machines", Oxford University Press, 1990.
4. Ned Mohan, Advanced Electric Drives: Analysis, Control and Modeling using Simulink, John Wiley and Sons Ltd, 2001
5. Peter Vas, Artificial-Intelligence-based Electrical Machines and Drives, Oxford University Press, 1999

18MC0XA COMMUNICATION PROTOCOLS

1 0 0 1

Course objectives

- To understand the importance of industrial communication protocols and acquire basic knowledge on various industrial communication standards used in automation industries

Data logging in Industrial automation with 485 MODBUS - Temperature monitoring using 485 MODBUS - Data transferring using RS232 for PLC and HMI - Ethernet And Can Interface For Industrial Automation - Speed control of motors using the RS485- Control of solenoid valves using the PROFINET - Management of servo devices using PROFIBUS - Flexible Manufacturing System with CC-link Network Decentralized - Scalable Motion control system using Ether-CAT based on shared variables - Automatic Packing Control using Ethernet I/P - Power monitor networked control based on DEVICENET field-bus.

Total: 15 hours

References

1. Communication Protocol Engineering by Miroslav Popovic, CRC Press, 2006
2. Industrial Communication Technology, 2nd edition by Richard Zurawski, CRC Press, December 2017

18MC0XB AC/DC DRIVES

1 0 0 1

Course Objectives

- To study the various power electronics devices and their characteristics
- To understand the real time application in AC/DC DRIVES
- To practically study the various AC/DC Drives for speed control application

Brief Basic Power Electronics (including Thyristors, Power-Transistors & IGBTs). DC Motor Basics (construction, principle of operation, T-N Characteristic etc). DC Drives Basics (Block diagram, 1Q-4Q principle of operation, T-N Curves etc) Selections, Calculations & applications of typical DC drives. Siemens DC Drives (6RA70) - Ratings, Specs, features, options & applications. AC Motor Basics (construction, principle of operation, T-N Characteristic etc). AC Drives Basics (Block diagram, 1Q-4Q principle of operation, T-N Curves etc) Selections, Calculations & applications of typical AC drives. AC Drives (Micromaster-MM4)-Ratings, Specs, features, options & applications. AC Drives (Master Drive-VC): Ratings, Specs, features, options & applications. AC Drives (Sinamics-G)-Ratings, Specs, features, options & applications in brief. MEDIUM VOLTAGE (MV Drives & Motors): MV Motor types & Fundamentals (including starting methods, options/features), MV Motor offers from Germany (separately for Induction & Synchronous Motor), MV Converter Basics & types (Voltage, Current Source & Cyclo- converters), Siemens MV Converters (Sinamics GM, Simovert-S and Perfect Harmony), Selection, configuration & Applications of MV Drive systems

Total: 15 Hours

Reference(s)

1. G. K. Dubey, Fundamentals of Electrical Drives, Wiley Eastern Ltd., New Delhi, 2007.
2. S. K. Pillai, A First Course on Electrical Drives, New Age International Pvt. Ltd., New Delhi, 2012.
3. Vedam Subrahmaniam, Electric Drives (concepts and applications), Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2007

**18MC0XC ADVANCED METROLOGY AND
QUALITY CONTROL**

1 0 0 1

Course Objectives

- Understand and explain the relevance of metrology in industries
- Recapitulate the need of various measuring instruments and the way it supports accuracy
- Examine and provide solution on measurements for a given industrial part/component

Advanced measuring machines, CNC systems, Laser vision, In-process gauging, 3D metrology, metrology softwares, Nano technology instrumentation, stage position metrology, testing and certification services, optical system design, lens design, coating design, precision lens assembly techniques, complex opto mechanical assemblies, contact bonding and other joining technologies. Statistical Methodologies: Graphical methods, Statistical control charts, Regression analysis, Analysis of variance, Sampling and acceptance. Quality and Calibration Techniques : Size and scale, Predictable accuracy, Trace-ability of measurement, Measurement uncertainty, surface texture, roundness. Metrology of machine tools: Alignment and practical tests. Case studies: Inspection and Validation practices adopted in various industries.

Total: 20 Hours

Reference(s)

1. Kalpakjian, S. and Steven R. Schmid, Manufacturing, Engineering & Technology, Pearson.
2. G. T. Smith, Industrial Metrology, Springer, ISBN: 9781852335076, 2012.
3. D. J. Whitehouse, Hand book of surface and nanometrology, 2nd Edition, CRC Press, ISBN: 9781420082012, 2012.
4. John W. Greve, Frank W. Wilson, Hand book of industrial metrology, PHI Publisher, New Delhi
5. Khare MK, Dimensional Metrology, OXFORD-IBH Publishers

18MC0XD INDUSTRIAL HYDRAULICS

1 0 0 1

Course Objectives

- To study the various standards and principles in hydraulics and pneumatics
- To understand the real time application in hydraulics and pneumatics
- To practically study the various hydraulics and pneumatics components and their manufactures

An Introduction to Hydraulics and its Principles - Hydraulic Fluids: Contamination control and fluid conductors - Cartridge Valves - Proportional and Servo Valves - Pressure switches and Pressure gauges - Measuring equipments: Flow , Temp , Oil level - Sound Dampening devices - Filters and other Tank Accessories - Oil coolers - Hydraulic Symbols - Calculations for designing a Hydraulic Systems - Analyzing the Hydraulic circuits - Basics to be considered while Assembling the Hydraulic systems - Standards for Hydraulics - Trouble shooting in Hydraulic Systems - Maintenance requirements in Hydraulic Systems - Application and usage of Hydraulics in Industries - Manufacturers of Hydraulic elements - Manufacturers of Hydraulic Machines - Scope and Future for Hydraulic Industry

Total: 15 Hours

Reference(s)

1. Henry M. Morris and James M. Wiggert., "Applied Hydraulics in Engineering", John Wiley & Sons Publications., New York, 1972.
2. John H. Pippenger, Tyler G. Hicks., "Industrial Hydraulics", Gregg Division McGraw-Hill., New York, 1979
3. Majumdar .S.R., "Oil Hydraulic Systems: Principles and Maintenance"., McGraw-Hill Education, New York 2003

**18MC0XE DESIGN AND ASSEMBLY OF
ELECTRONICS COMPONENTS IN PCB**

1 0 0 1

Course Objectives

- To study various standards and principles related with Electronics Manufacturing Service Industries.
- To understand the process methodologies and safety pre-cautions in EMS industries.
- To acquire practical knowledge about various electronic components, Printed Circuit Boards, assembly of Components, Inspection, Testing and Packing standards.

Introduction to EMS companies Operating Principles of machines in EMS - Electronics component SMT components - THT components other packages. Process methodologies - flowchart for solder paste and SMD glue with through hole component. THT electronics assembly floor: pre-forming cutting placing smaller and bigger components wave soldering fluxing pre heating lead bathing. SMD solder paste process kitting storage screen printing PCB with Solder paste SMD component stuffing or placement pre soldering inspection and correction reflow soldering post soldering inspection rework SMD glue with through hole components - kitting storage screen printing PCB with Solder paste SMD component stuffing or placement pre soldering inspection and correction glue curing glue curing inspection correction through hole stuffing through hole inspection correction wave soldering post soldering inspection and correction cleaning final inspection and correction SMD electronics assembly floor: Kitting stacking of PCBs in PCB loader printing using stencils role of stencils use of glue and solder paste selection criteria pick and place machine - automatic component health monitoring and rejection of defective components introduction to magazines and feeders role of colour in feeders (yellow, red and white) oven reflow ramp stage soak stage TAL stage cleaning materials used in cleaning. Inspection standards in ems need for such standards - IPC standards (Institute for Printed Circuits)

-MDA testing automated optical inspection X ray inspection Testing methods and process - functional testing cleanliness testing workmanship standards - IPC A 610 - Packing and shipping anti static packaging Code of conduct - Nature of job for electronics / Mechatronics engineers in EMS companies- skills set expected in EMS industries from fresh engineering graduates.

Total: 15 Hours

Reference(s)

1. Documents available at <http://www.ipc.org> - IPC - The global trade association serving the printed board and electronics assembly industries, their customers and suppliers.
2. Handbook - The Course of IPC-A-610 and IPC-J-STD-001 -Standard for Electronics Assemblies from IPC.
3. Handbook In-Plant Training at Electronic Manufacturing Service Industries by Sanjay Technologies, Coimbatore Private Circulation.

18MC0XF CNC SERVICING

1 0 0 1

Course Objectives

- Understand and explain the System Configuration of CNC Machine System
- Analyze the root cause for the machine failures.
- Evaluate and rectify the failures occurred in various Machine Functions
- Generate the safety instructions in handling CNC Machine

Manufacturing CNC Machine Structures, CNC State Display, Configuration Screens- Software, Module, ID Information, Alarm history, Maintenance Information screen, Color and Contrast Setting, Periodic Maintenance Screen,

Hardware Configuration, Connection diagrams, Mounting and De mounting -Connectors, Card and Power supply, DIMM module, PCBs Replacement procedure- Battery, LCD, Fuses.

Diagnostic display, Servo Parameter alarm, Machine position, Reference Position, position Deviation, Displacement Detection, Motor temperature.

Causes and Remedies for failures Machine position, Reference Position, Manual operation, Automatic operation, Jog Operation, Feed rate, Spindle Speed , LCD Display, Abnormal Servo System.

Warnings-Check operation, Replacement, Parameters, Daily Maintenances - Caution, Note, Alarms, Maintenance Parts, Parameters.

Total: 20 Hours

Reference(s)

1. Daniel D Nelson, The CNC Toolbox: Top Service for Machine Tools, Aero Publishing, 2nd Edition 1999
2. Fanuc Series oi-Model C, Maintenance Manual, Fanuc Series, 2016.
3. B S Pabla and M Adithan, CNC Machines, New age International Publishers, 2005

18GE0XA ETYMOLOGY

1 0 0 1

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 words enter 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

7 Hours

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

8 Hours

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

Reference(s)

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 PSYCOLOGY

1 0 0 1

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. Understand the basics of human behavior in the workplace and society at large
2. Understand the different fields of psychology and its uses
3. Deal people effectively in their personal and social life

15 Hours

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

Reference(s)

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 BEHAVIOURAL SCIENCE

1 0 0 1

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

15 Hours

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

Reference(s)

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
2. Horon C Philip. Sexology and Mind. Academic Press. 1993
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996

18GE0XD VISUAL MEDIA AND FILM MAKING

1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of film making as an art, and video production
- 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. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

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, Alternative Cinema 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

Reference(s)

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

1 0 0 1

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. Understand 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

15 Hours

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

Reference(s)

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

1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

15 Hours

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots-
Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

Reference(s)

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

1 0 0 1

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

5 Hours

FITNESS

Meaning & Definition, Need & importance of Physical fitness Types Physical fitness - Exercise, Training and Conditioning and it is important

5 Hours

YOGA AND MEDITATION

Meaning and definition; Principles of practicing; Basic Asana and it important, Pranayama and Meditation - Relaxation Techniques

5 Hours

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.

Total: 15 Hours

Reference(s)

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
APPLICATIONS OF VERICOMPOSTING**

1 0 0 1

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

15 Hours

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

Reference(s)

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

1 0 0 1

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 Outcome (COs):

Students will be able to:

- Understand the flow of language in natural manner.
- Understand the elements of a blog and be able to use them effectively.
- Find a niche for a long-term blog.
- Gain insight into the strategies, methods and writing of successful bloggers.
- Develop their creativity thinking.

Unit I

7 Hours

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

8 Hours

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

References:

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. \$29.95 paperback.
2. *Bloggng 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. Huffington Post Complete Guide to Blogging.

16GE0XJ INTERPERSONAL SKILLS

1 0 0 1

Course Objectives:

- To communicate and work effectively, both individually and in groups
- To be able to understand and manage one's own and other's emotions
- To define and solve problems by making decisions about the best course of action

Course Outcome (COs):

Students will be able to:

- Express themselves clearly and confidently
- Listen to others completely and with empathy
- Assert an opinion without diminishing other's opinion
- Be responsible and timely with a willingness to collaborate
- Develop innate personality traits to handle certain social situations

Unit I

7 Hours

Conversational Skills – Active Listening – Team working – Empathy – Emotional Intelligence

Unit II

8 Hours

Conflict Resolution and Mediation skills – Decision-making and Problem Solving – Negotiation and Persuasion skills

Total: 15 hours

References:

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

- - - 1

Course Objectives

- understand the basic concepts of National Service Scheme and its activity
- identify the needs and problems of the community and involve them in problem solving
- develop competence required for group living and acquire leadership qualities

Course Outcomes (COs)

- understand the community in which they work and render their service
- develop among themselves a sense of social and civic responsibility

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, DayCamps-Basisofadoption of village/slums- Methodology of conducting Survey -Financial pattern ofthescheme -Coordination withdifferent agencies- Maintenance oftheDiary. 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

Reference(s)

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
2. <http://nss.nic.in/intro.asp>
3. Delgado-Gaitán and Concha, The Power of Community: Mobilizing for Family and SchoolingNew York: Rowman& Littlefield Publishing, Inc. 2001
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World healthorganization, 2nd edition. 1980
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009

18GE0XL NATIONAL CADET CORPS

1 0 0 1

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)

- Recall the motto and aim of NCC.
- Implement synergy in disaster management.
- Execute an example patriotic leader to serve nation.

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 - NGO's role and Contribution - Social Security schemes.

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: 20 Hours

REFERENCES

1. Cadet's Hand book Common subject, DG NCC, New Delhi.
2. Cadet's 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

1 0 0 1

- 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

Programme Outcomes (POs)

- Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 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.
- 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.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

- Understanding entrepreneurship as an important career option
- Concept and methodology of idea translation to viable start-ups
- Events to occur in the building of a technology based venture for students or working professionals or women
- Overview of Indian trends in the start-up scene

Articulation Matrix

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

UNIT I

15 Hours

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 New Venture 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

Reference(s)

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, 3 edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2

18GE0XN DISRUPTIVE INNOVATION BASED START UP ACTIVITIES

1 0 0 1

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

- Understanding contemporary entrepreneurship as an important career option
- Concept and methodology of creative disruption to viable start-ups
- Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
- Overview of Indian trends with reference to disruptive innovation based start-ups

Unit I

15 Hours

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

References

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 PSYCHLOGY

1 0 0 1

Course Content

Introduction-Ice breaker, Time Line , Tasks and Challenges of the age(Erik Erikson),
Introduction to Reproductive Health, Student Questions
Reproductive Organs, Menstruation, Changes during Puberty, Difference between Sex and Gender
Introduction to the origins of Patriarchy, Gender
Images of Beauty and Body Image, Introduction to Media, Feedback Attraction,
Friendship , Differences and Similarities
Sexuality
Boundaries
Relationships, Marriage, Love, Emotional Health
Sexual Abuse and Safety
Role of Media
Abortions, Contraception,
Wrapping up the Course

Total: 20 Hours

**18GE0XP FM RADIO BROADCASTING
TECHNOLOGY**

1 0 0 1

Course Objectives

- The course focuses on community radio technology and various program productions techniques for FM Radio Broadcasting.

Course Outcomes (COs)

- Understand the hardware required for field recording and setting up a studio and carryout studio and field recording.
- Examine the available options for telephony interfaces for radio.
- Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

UNIT I

3 Hours

INTRODUCTION TO AM/ FM RADIO

History of Radio-Types of Radio and its Reach- Entertainment Radio- Community Radio- Internet Radio- Satellite Radio. Evolution of Community Radio (CR) in India- principles behind setting up of FM/CR- policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

UNIT II

3 Hours

STUDIO TECHNOLOGY

Use of Microphones-Console handling-OB Recordings & Live Shows-Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio.

UNIT III

3 Hours

AUDIO PRODUCTION

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production-telephony interfaces for radio- audio Post Production. Voice Culture Exercise- Radio Production Techniques & Tools.

UNIT IV

3 Hours

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

UNIT V

3 Hours

RADIO TRANSMISSION TECHNOLOGY

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable- propagation and coverage of RF signals-FM transmitter setup- Radio audience - measurements systems.

Total: 15 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, Other Voices: The Struggle for Community Radio in India, SAGE Publications India, 2007.
3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, Sean O Siochru, Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and Regulation, University of Michigan Press, 2008.
4. www.floridasound.com
5. www.mediacollege.com
6. www.mediacollege.com